

## ADVANCED MEDICAL SYSTEMS

## OPERATING PROCEDURE

TITLE:

COBALT SERVICE PROCEDURES MANUAL

Procedure No: ISP-25

Revision: C

Date Issued: 8/11/87

Prepared by

Approval

Revisions

*Howard R. Lurin*

See Revision Sheets

5



## INTRODUCTION

These procedures are to be followed by Advanced Medical Systems, Inc.'s service technicians when performing service on Advanced Medical Systems, Inc. and Picker Corporation Cobalt 60 Teletherapy and Industrial Radiography Systems.

If, during service, licensable work is to be performed but has been omitted from these procedures, the Radiation Safety Officer shall be notified before proceeding. The Radiation Safety Officer will then establish a procedure.

#### ADMINISTRATION OF LICENSED SERVICE

Advanced Medical Systems, Inc. has organized its service organization to operate under the guidance of the Radiation Safety Officer and Engineering Manager. The Radiation Safety Officer is responsible for RAD safety and the Engineering Manager is responsible for equipment operation.

The Radiation Safety Officer is responsible for employee and customer safety. He has the authority to:

1. Administer the Radiation Safety Program for service personnel and delegate responsibility as necessary.
2. Develop policy and oversee compliance with Radiation Safety Procedures.
3. Develop record forms, reports and notifications and to establish a record keeping system.
4. Require a documentation of surveys, dosimeter readings and instrumentation calibration.
5. Establish an Internal Audit System.
6. Direct the purchase of instrumentation.
7. Control emergency situations and remedial action.
8. Investigate incidents and institute preventive action.

## GENERAL

These instructions have been prepared for use as a check list and reference for persons trained in Shutter Service on Advanced Medical Systems, Inc. and Picker corporation Cobalt Therapy Units. It is to be used in conjunction with the service manual furnished with the unit.

Shutter service will be performed only by, or in the physical presence of, persons specifically certified by Advanced Medical Systems, Inc., Isotope Committee.

The person or persons licensed to perform shutter service may perform only those operations authorized in the instruction manuals which are incorporated, by reference. Service personnel are obligated to refuse to attempt any service operation should any condition or action present a situation wherein the service cannot be made within the spirit and the letter of the law.

Prior to the commencement of the operations outlined in this manual, the licensee for whom the service is being performed will relinquish control over the use of, and the keys for, the equipment and its controlled areas to the licensed person in charge until such time as it has been determined by the licensed person that the equipment is in safe operating condition. The licensed person will then return control of the equipment and controlled areas to the licensee.

Inasmuch as the licensed person performing the service is considered an agent of the source manufacturer, the equipment radiation leakage survey he performs does not constitute an acceptable survey of equipment as required by the customer's Radioactive Material License.

The calibration certificate furnished with each source by the manufacturer is for billing purposes only and does not constitute an acceptable source output calibration for therapy purposes as required by the customer's Radioactive Material License.

The wipe test certificate furnished with each source by the manufacturer DOES constitute an acceptable wipe test as required by the customer's Radioactive Material License, with regard to testing before initial use.

Officially acceptable survey and source leakage tests can be performed only by personnel outside Advanced Medical Systems, Inc.

### Radiation Protection Program

Exposure of personnel to ionizing radiation will be kept "as low as reasonable achievable" and within the current limits specified in 10 CFR 20. Records and reports will be specified in 10CFR 20.

All individuals, while performing licensable service work, must wear radiation monitoring equipment including film badges, personal dosimeters and audible detectors.

Film badges will be changed and processed at least monthly. Reports of film badges will be retained by the Radiation Safety Officer.

Dosimeters will be set to zero before the start of each work day, then read and recorded at the end of each work day. A report of these readings is to be sent to the Radiation Safety Officer at the end of each month for review and record keeping.

In the event that a personal dosimeter is found to be off scale during the course of a service operation, it is to be considered an emergency. Immediate notification shall be made to the Radiation Safety Officer at the telephone numbers listed below. He will record the incident and give instructions for the immediate processing of the film badge or TLD. A written memo explaining the circumstances resulting on the off scale reading shall be signed by the individual and submitted to the Radiation Safety Officer as soon as possible.

Radiation Safety Officer - Robert Meschter

Telephone: (216) 692-3270

Home: (216) 298-1462

Address: Advanced Medical Systems, Inc.  
1020 London Road  
Cleveland, OH 44110

Revised 01/95

MONTHLY DOSIMETER LOG

NAME \_\_\_\_\_

This form is to be completed for each day work is done on or around radiation producing equipment. Submit with Therapy Service Record form for Cobalt and Cesium unit service work.

	MON.	TUES.	WED.	THUR.	FRI.	SAT.	SUN.
FIRST WEEK							
SECOND WEEK							
THIRD WEEK							
FOURTH WEEK							
FIFTH WEEK							

This record is for film badge dated: \_\_\_\_\_  
Mail this report each time your film badge is changed to:

Radiation Safety Officer  
Advanced Medical Systems, Incorporated.  
1020 London Road  
Cleveland, Ohio 44110

TOTAL MONTHLY EXPOSURE \_\_\_\_\_

RADIATION SAFETY CHECKLIST

Film Badge-Dosimeter-Survey Meter-Control Key Shutter Locked.

Dosimeter Reading \_\_\_\_\_ mR

Survey Meter \_\_\_\_\_

Date Calibrated \_\_\_\_\_

Serial No. \_\_\_\_\_

Supervisor \_\_\_\_\_

RADIATION SURVEY

ROUTINE SERVICE AND LICENSED PROCEDURES

S/M Reading \_\_\_\_\_ mR/hr. at end of Maze and Shield Wall

S/M Reading \_\_\_\_\_ mR/hr. at Top of Head

Head Type \_\_\_\_\_ Serial No. \_\_\_\_\_

SERVICE PERFORMED \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

IF COLLIMATOR IS REMOVED - WIPE TEST RESULTS \_\_\_\_\_ cpm SURVEY METER \_\_\_\_\_

Wipe Sample Disposed At: \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

EMERGENCY SERVICE

S/M Reading \_\_\_\_\_ mR/hr. at End of Maze

S/M Reading after Head is Rotated or Repositioned \_\_\_\_\_ mR/hr.

BRIEFLY DESCRIBE PROBLEM: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ACTION TAKEN: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_

Final Dosimeter Reading: \_\_\_\_\_ mR Total Dose: \_\_\_\_\_ mR

Service Engineer: \_\_\_\_\_ Date: \_\_\_\_\_

Mail This Report To: ADVANCED MEDICAL SYSTEMS, INCORPORATED  
1020 LONDON ROAD  
CLEVELAND, OHIO 44104

ATTENTION: Radiation Safety Officer

In an Emergency, if assistance is required, contact the Radiation Safety Officer at  
216-692-3269.

## INTRODUCTION

These procedures are to be followed by Advanced Medical Systems, Inc.'s service technicians when performing service on Advanced Medical Systems, Inc. and Picker Corporation Cobalt 60 Teletherapy and Industrial Radiography Systems.

If, during service, licensable work is to be performed but has been omitted from these procedures, the Radiation Safety Officer shall be notified before proceeding. The Radiation Safety Officer will then establish a procedure.



#### ADMINISTRATION OF LICENSED SERVICE

Advanced Medical Systems, Inc. has organized its service organization to operate under the guidance of the Radiation Safety Officer and Engineering Manager. The Radiation Safety Officer is responsible for RAD safety and the Engineering Manager is responsible for equipment operation.

The Radiation Safety Officer is responsible for employee and customer safety. He has the authority to:

1. Administer the Radiation Safety Program for service personnel and delegate responsibility as necessary.
2. Develop policy and oversee compliance with Radiation Safety Procedures.
3. Develop record forms, reports and notifications and to establish a record keeping system.
4. Require a documentation of surveys, dosimeter readings and instrumentation calibration.
5. Establish an Internal Audit System.
6. Direct the purchase of instrumentation.
7. Control emergency situations and remedial action.
8. Investigate incidents and institute preventive action.

## GENERAL

These instructions have been prepared for use as a check list and reference for persons trained in Shutter Service on Advanced Medical Systems, Inc. and Picker corporation Cobalt Therapy Units. It is to be used in conjunction with the service manual furnished with the unit.

Shutter service will be performed only by, or in the physical presence of, persons specifically certified by Advanced Medical Systems, Inc., Isotope Committee.

The person or persons licensed to perform shutter service may perform only those operations authorized in the instruction manuals which are incorporated, by reference. Service personnel are obligated to refuse to attempt any service operation should any condition or action present a situation wherein the service cannot be made within the spirit and the letter of the law.

Prior to the commencement of the operations outlined in this manual, the licensee for whom the service is being performed will relinquish control over the use of, and the keys for, the equipment and its controlled areas to the licensed person in charge until such time as it has been determined by the licensed person that the equipment is in safe operating condition. The licensed person will then return control of the equipment and controlled areas to the licensee.

Inasmuch as the licensed person performing the service is considered an agent of the source manufacturer, the equipment radiation leakage survey he performs does not constitute an acceptable survey of equipment as required by the customer's Radioactive Material License.

The calibration certificate furnished with each source by the manufacturer is for billing purposes only and does not constitute an acceptable source output calibration for therapy purposes as required by the customer's Radioactive Material License.

The wipe test certificate furnished with each source by the manufacturer DOES constitute an acceptable wipe test as required by the customer's Radioactive Material License, with regard to testing before initial use.

Officially acceptable survey and source leakage tests can be performed only by personnel outside Advanced Medical Systems, Inc.

### Radiation Protection Program

Exposure of personnel to ionizing radiation will be kept "as low as reasonable achievable" and within the current limits specified in 10 CFR 20. Records and reports will be specified in 10CFR 20.

All individuals, while performing licensable service work, must wear radiation monitoring equipment including film badges, personal dosimeters and audible detectors.

Film badges will be changed and processed at least monthly. Reports of film badges will be retained by the Radiation Safety Officer.

Dosimeters will be set to zero before the start of each work day, then read and recorded at the end of each work day. A report of these readings is to be sent to the Radiation Safety Officer at the end of each month for review and record keeping.

In the event that a personal dosimeter is found to be off scale during the course of a service operation, it is to be considered an emergency. Immediate notification shall be made to the Radiation Safety Officer at the telephone numbers listed below. He will record the incident and give instructions for the immediate processing of the film badge or TLD. A written memo explaining the circumstances resulting on the off scale reading shall be signed by the individual and submitted to the Radiation Safety Officer as soon as possible.

Radiation Safety Officer - Robert Meschter

Telephone: (216) 692-3270

Home: (216) 298-1462

Address: Advanced Medical Systems, Inc.  
1020 London Road  
Cleveland, OH 44110

Revised 01/95

MONTHLY DOSIMETER LOG

NAME \_\_\_\_\_

This form is to be completed for each day work is done on or around radiation producing equipment. Submit with Therapy Service Record form for Cobalt and Cesium unit service work.

	MON.	TUES.	WED.	THUR.	FRI.	SAT.	SUN.
FIRST WEEK							
SECOND WEEK							
THIRD WEEK							
FOURTH WEEK							
FIFTH WEEK							

This record is for film badge dated: \_\_\_\_\_  
Mail this report each time your film badge is changed to:

Radiation Safety Officer  
Advanced Medical Systems, Incorporated.  
1020 London Road  
Cleveland, Ohio 44110

TOTAL MONTHLY EXPOSURE \_\_\_\_\_

RADIATION SAFETY CHECKLIST

Film Badge-Dosimeter-Survey Meter-Control Key Shutter Locked.

Dosimeter Reading \_\_\_\_\_ mR

Survey Meter \_\_\_\_\_

Date Calibrated \_\_\_\_\_

Serial No. \_\_\_\_\_

Supervisor \_\_\_\_\_

RADIATION SURVEY

ROUTINE SERVICE AND LICENSED PROCEDURES

S/M Reading \_\_\_\_\_ mR/hr. at end of Maze and Shield Wall

S/M Reading \_\_\_\_\_ mR/hr. at Top of Head

Head Type \_\_\_\_\_

Serial No. \_\_\_\_\_

SERVICE PERFORMED \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

IF COLLIMATOR IS REMOVED - WIPE TEST RESULTS \_\_\_\_\_ cpm SURVEY METER \_\_\_\_\_

Wipe Sample Disposed At: \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

EMERGENCY SERVICE

S/M Reading \_\_\_\_\_ mR/hr. at End of Maze

S/M Reading after Head is Rotated or Repositioned \_\_\_\_\_ mR/hr.

BRIEFLY DESCRIBE PROBLEM: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ACTION TAKEN: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

CUSTOMER: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_

Final Dosimeter Reading: \_\_\_\_\_ mR Total Dose: \_\_\_\_\_ mR

Service Engineer: \_\_\_\_\_ Date: \_\_\_\_\_

Mail This Report To: ADVANCED MEDICAL SYSTEMS, INCORPORATED  
1020 LONDON ROAD  
CLEVELAND, OHIO 44104

ATTENTION: Radiation Safety Officer

In an Emergency, if assistance is required, contact the Radiation Safety Officer at 216-692-3269.

## EMERGENCY NOTIFICATIONS AND PROCEDURES

If under any of the circumstances noted in this manual, a source cannot be returned to the off position, or it is believed the source is leaking, the following steps must be taken immediately in the order given:

1. Restrict the area from entry by locking or posting a guard. Post a signed, dated notice on the entry side of door to the room, that entry can be made only on authorization of the responsible person (physicist, chief radiologist, etc.) given on the customer's isotope license.
2. Call the Radiation Safety Officer (see page 4 ) for further instructions.
3. Take no further action except under the direction of the RSO or appropriate state or federal officials.



## PERSONNEL MONITORING

- A. Any person engaged in Licensable operations or directly assisting in these operations must have on his person at all times during these operations the film badge provided by the Advanced Medical Systems, Inc.
- B. In addition to the above mentioned film badge, a direct reading pocket dosimeter shall be worn. This dosimeter must have a range of 0-200 milliroentgens (mR), and must be read at intervals not exceeding 15 minutes during any periods when the operations being performed may permit radiation to be emitted in excess of 10 mR/hr at one meter from the source.
- C. The licensed person shall wear an audible gamma alarm during service operations. The alarm should be the Tattler, Rad-Tad or equivalent.
- D. In general, it is rare for service personnel to receive a total dose in excess of 15 milliroentgens during the performance of any Cobalt Service Procedure. If during the operations it appears that the dose being absorbed is at a rate which would exceed a total of 15mR, the personnel involved will retire to a low radiation back-ground area and review their procedures to determine what steps must be taken to reduce their exposure.

NOTE: 1. Dosimeters, which are cold when they are first put on, may show a reading of up to 10 mR when they reach body temperature. Make sure they are fully warmed up before taking the initial reading.

- 2. Wear the film badge on the trouser belt.



## SUMMARY OF LICENSABLE SERVICE OPERATIONS

This section of the manual includes those operations which may be performed only by an individual authorized under our NRC license.

They are as follows:

<u>PROCEDURE</u>	<u>PAGE</u>
1. Contamination Check	10
2. Waste Disposal	11
3. Emergency Closing of a Stuck Shutter	12
4. Head Leakage Surveys	15
5. Source Installation or Exchange	See ISP-18
6. Collimator Removal	18
Model #3313	18
Model #3347	20
Model #3706	22
7. #581 Head	
Inboard Bearing Lubrication - 581, 581A	23
Inboard Bearing Lubrication - 581B	28
Shutter Gear Replacement - 581, 581A	30
8. #583 Head Removal and Shutter Cleaning	33
9. #590 Head	
Inboard Bearing Lubrication - 590C, D and E	44
10. Loaded Head Installation or Removal	Refer to Manuals for Specific Unit
11. Unit Checkout After Completion of Service	16
12. Final Cleanup	17

## CONTAMINATION CHECKS

### A. General

A contamination or leak test must be performed prior to removal of a collimator. This test is for the protection of AMS personnel and does not constitute an official wipe test.

There are basically two reasons for contamination being present:

1. The source or equipment was not thoroughly clean when shipped or installed. This type of contamination generally would be of low level (less than 2000 cpm) and only in isolated spots which are easily cleaned to wipe less than 200 cpm.
2. The source is leaking. This type of contamination is usually of high level (about 50,000 cpm) and cannot be easily cleaned up. If this type is found, the emergency procedure outlined in this manual will be put into operation.

### B. Wet Smear Contamination Procedure

Coveralls and rubber gloves should be worn during this procedure.

1. Place the No. 491 (or equivalent) Victoreen survey meter in a low radiation background area, turn on and check against "check source" for proper operation. Set to most sensitive scale. Open the beta window or shield. Note background rate in cpm.
2. Moisten a small pad (2 or 3 square inches) of absorbant paper with water or alcohol. Wipe the area to be checked with the moist paper pad.
3. Hold the wipe within 1/4 inch of (but not touching) the Geiger tube.
  - a. If the meter indicates less than 200 cpm above background, the area wiped is considered to be clean.
  - b. If the meter indicates greater than 200 cpm above background, stop work. Notify the customer of a potential contamination problem. The customer is responsible for decontamination activities and waste disposal under his radiation safety program.

(Cont' Wet Smear Contamination Check)

- c. If the meter indicates greater than 20,000 cpm above background, the source should be considered to be leaking. Implement the emergency procedure outlined in this manual. Monitor exposed portions of body and clothing for contamination.

C. Waste Disposal

Seal any contaminated waste (wipes and/or clothing) in plastic bags. Label as "Radioactive Materials." Check with the customer to see if they have a Nuclear Medicine Department that will accept the contaminated waste. If not, properly package the waste and call the Radiation Safety Officer for instructions on shipping it back to Cleveland.

## EMERGENCY CLOSING OF A STUCK SHUTTER

If, in spite of all precautions, an emergency situation develops, the Emergency Procedures must be followed precisely. The procedures give the name and telephone number of the individual to be called in case of an emergency. To attempt to close a shutter without the proper knowledge, both of the principles of radiation and of the head involved, and without the proper equipment is not only foolhardy, but most likely will make a bad situation worse.

The emergency procedures are as follows:

1. If you are present when the emergency arises, remove all personnel from the treatment room and close the door. If possible, obtain the key and lock the door. If there is no door, make sure no one enters the room.
2. Calmly assess the situation and follow the procedures given below.

### EMERGENCY SHUTTER CLOSURE

In general, there are three reasons why a shutter will not return to the closed position:

1. The return spring is broken.
2. The shutter bearings are frozen.
3. The shutter is jammed because of foreign matter or particles in the gap between the shutter and head (this situation is highly unlikely).

In all these cases, the shutter can usually be returned to the closed position by depressing the EMERGENCY BAR. This energizes the shutter motor and drives the shutter back to the closed position.

Therefore, *do not* enter the room and attempt to manually close the shutter.

### POWERED SHUTTER CLOSURE

First; Make sure everyone is out of the treatment room. Close the door and make sure personnel do not enter.

Second; Find out what happened, whether there were unusual symptoms prior to the failure and whether hospital personnel tried to close the shutter.

Third; Read the section on shutter locks given in this manual. Locate the shutter lock or obtain one locally. Now, turn on the control and observe the shutter position lights. If the red light or red and green lights are on, there is a good chance that the spring has not returned the shutter to the off position.

1. Rotate the "C" arm or yoke until the collimator points at the floor.
2. Operate the key switch, timer and switch in an attempt to return the shutter to the off position. If unsuccessful,
3. Depress the EMERGENCY BAR and hold it in. Observe the shutter position

lights. The red light should go out and the green light should come on. Release the EMERGENCY BAR (prolonged application of power to the reverse winding on the shutter motor may over heat the winding). The green light should stay on, indicating that the shutter is closed. If the shutter won't close, try rocking the head. If the EMERGENCY BAR closed the shutter, the shutter lock must now be installed. If the BAR closed the shutter, but it opens upon release of the BAR, you will need an assistant to hold the BAR down while you are removing the front cover of the head and installing the shutter lock.

#### PREPARATIONS FOR ENTERING THE ROOM

1. Wear your film badge, pocket dosimeter and tattler. Switch the survey meter to the XI scale (0-10 mR/hr).
2. Open the treatment room door. Do not enter the room, but survey the area through the open door. If the shutter is closed, the survey meter will indicate about 1 mR/hr or less. If the shutter is open the reading will be in the 1-10 mR/hr range depending on the number of curies and the collimator setting. If the survey meter indicates the shutter is open, do not enter the room. REFER TO MANUAL SHUTTER CLOSURE BELOW.
3. If the shutter is closed, you will not need assistance at the EMERGENCY BAR, so you must have the control key in your pocket before entering the room.

#### ENTERING THE TREATMENT ROOM

Hold the survey meter out in front of you as you walk into the room. If readings are less than 10 mR/hr, you will have plenty of time to lock the shutter. Set the meter on the floor next to the barrier or about three feet away from a point below the head (to avoid kicking the instrument as you work). Remove the manual wheel.

#### LOCKING THE SHUTTER - C9 TYPE UNITS

Remove the 4 screws from the front cover of the head and remove the head cover. Install the shutter lock.

#### C10 TYPE UNITS

Remove the 2 screws and split cover. Install the shutter lock mechanism.

#### C3000 TYPE UNITS

Remove the arm of the optical distance indication and install the locking bolt.

#### MANUAL SHUTTER CLOSURE

If the EMERGENCY BAR will not close the shutter, the manual method must be used. This requires entering a high radiation area and relatively unknown radiation field. The levels will be 4 to 10 R/hr next to the head, depending on source strength and collimator opening.

The only factor which can be used to minimize the whole body dose is TIME, since personnel must approach the source at a close distance to manually close the shutter. Therefore, the procedure must be completed as rapidly as possible. In some cases, certain angles from the head afford lower radiation levels, but these would have to be determined by factory survey, not in the field.

Before entering the room, estimate the time required to close the shutter. Multiply the time by an estimate of the dose rate, ie., 5 R/hr. If it takes a full minute to turn the shutter wheel (worst case), the dose will be:

$$\frac{5 \text{ R}}{\text{hr}} \times \frac{1 \text{ hr}}{60} = \frac{1}{12} \text{ R} = 83 \text{ mR}$$

The survey meter will pin above 1000 mR/hr (1 R/hr) so it will be useless at 5 R/hr. However it must be used as before to indicate the levels of the area.

#### ENTERING THE ROOM

1. Only one person should enter the room while an assistant outside monitors the time. Wear dosimeter and film badge as before. Remove tattler, as it's screaming will be annoying.
2. Switch the survey meter to the X100 (0-1000 mR/hr) range and hold it out in front of you as you walk in. Set the meter on the floor when you have reached the 1000 mR/hr perimeter. (applies to vertical units only).
3. Rapidly approach the head. Grip the shutter wheel in both hands and turn the wheel in the CLOCKWISE direction until the shutter is closed.
4. If the manual wheel will not turn, and one minute has elapsed, pick up the survey meter and leave the room. Execute the EMERGENCY NOTIFICATION procedure on page 7.
5. If shutter closure was successful, remove the manual shutter wheel and lock the shutter as before.

After completing the procedure read your pocket dosimeter and record the accumulated dose.



## HEAD LEAKAGE RADIATION SURVEY

### A. Model 583 and 590 series heads

1. Using the Geiger type survey meter, beta window closed, check the radiation leakage at the mouth of the collimator when set with its smallest opening, with the meter probe touching the end of the collimator and the collimator pointing straight down. Normal leakage is 1.5 to 3.0 mR/hr per 1000 RHM of source strength. If readings fall within this range, proceed with service work. If radiation levels exceed the values given above, then a check of inverse square correlation must be made. The distance to the active portion of the source from the bottom of the collimator is 45 cm, while the distance to the dust cover is only 25 cm. For example, if all the radiation is from the source, then the reading 10 cm from the end of the collimator should be about 2/3 of the reading at the end of the collimator. Readings appreciably above 1.5 to 3.0 mR/hr per 1000 RHM may be caused by contamination on the dust cover. It must be remembered that these tests are only indicative, and only in the case of relatively high levels of activity on the dust cover will readings be meaningful. 100  $\mu$ ci of Cobalt 60 on the dust cover would only increase the radiation level about 2 mR/hr. If it is suspected that there is contamination on the dust cover, immediately put on a respirator or surgical mask and make the following check for contamination.

### B. Model 581 and 583 series heads

2. Turn the head so the collimator is pointing towards the ceiling. Take a cotton swab stick (available at all medical institutions) and moisten with water or alcohol. Carefully remove the plug from the shutter locking bolt hole and swab the portion of the shutter wheel that is exposed through this hole. Replace plug. Check swab with survey meter, beta window open.
3. If more than 2000 cpm is detected the source must be considered to be leaking and the emergency procedure outlined in this manual must be put into operation.
4. If less than 2000 cpm is detected, wash and/or check hands for contamination, and proceed with the service operation.



## UNIT CHECKOUT AFTER COMPLETION OF SERVICE

Warning: Make sure you have the control key in your possession each time you enter the room.

Evacuate personnel from the room and make the following operational tests of the completely reassembled unit: (Make corrections where necessary in accordance with applicable unit manuals.)

1. Check that the shutter opens and completely closes at  $0^{\circ}$ ,  $90^{\circ}$ ,  $180^{\circ}$ , and  $270^{\circ}$  or at maximum angles in both directions allowable for this particular installation.
2. Make sure, where applicable, that the shutter will not open beyond allowable angles for this particular installation.
3. Check that the timer switch properly closes the shutter.
4. Make sure the "shutter close" or "emergency" button properly closes the shutter.
5. Check that the shutter closes when main power is turned off and that it does not reopen when main power is restored.
6. Make sure the shutter closes when the room door is opened and that the shutter does not reopen when the door is reclosed.
7. Where applicable, verify that back pointer, collimator and localizer lights function properly and are calibrated properly.
8. Verify that control panel and room warning lights work properly.

### FINAL CLEAN UP

Monitor hands, feet and clothing of all persons involved. Clean if necessary. Seal any contaminated wipes or clothing in plastic bags. If the hospital Radiation Therapy Department will accept the waste material, dispose of it in their facility. If not, arrange for shipment of the contaminated material back to the Cleveland Isotope Facility. At this point, and upon satisfactory completion of the operational checks, jurisdiction of the unit and its key may be returned to the licensee.

## 1. Remove the collimator as follows:

On this type unit, the dust shield is part of the head rather than part of the collimator. The collimator can therefore be removed without fear of spreading contamination from a leaking source. Inasmuch as this dust shield is so close to the source and the collimator is so long, a leakage radiation survey at the mouth of the collimator would be of little value.

- a. Place a soft pad on the floor to the right side of the unit directly under the collimator on track mounted units or for fixed stand units, on a flat top "dolly" (can be rented locally if needed) capable of holding 1000 lbs.
  - b. Adjust head into a straight down position and lock. (See manual for unit).
  - c. Lower the collimator electrically to about one inch above the resting place described above.
  - d. Manually lower collimator (see instruction manual for unit being worked on) until it is resting on floor or "dolly" (with soft pad).
  - e. Turn off main power switch.
  - f. Remove chrome plated ring at top of collimator. Mark and disconnect all wires running from the head to the collimator. Temporarily jumper all collision switch wires. (See schematic). Tape bare ends of all wires. Turn on the main power switch.
  - g. Remove all the socket head cap screws holding the collimator to the head.
  - h. Manually raise head from collimator until wires can be pulled through hole in the top flange of the collimator.
  - i. Make a wet smear contamination check of the bottom of the head.
  - j. Put a plastic bag over the collimator to keep it clean and move it aside if on a "dolly" or move the unit to one side if on tracks.
- Caution: The head must not be moved from the vertical position after the collimator is removed since it is badly unbalanced and the tilting gears may be damaged or broken. Brake on tilt gear assembly must be locked tightly.
- k. Place a pad of soft material to the right of the unit on which to place the collimator and bearing ring. Open a plastic bag large enough to hold the collimator and bearing ring and place on pad.
  - l. Prepare a 3" square patch of masking tape and hang nearby.

- m. Lift the collimator and bearing ring (about 175 lbs.) by the four handles of the collimator service tool and place it on pad and bag provided. One man then brings the plastic bag up around collimator and tapes the bag closed while the other man covers the orifice in the head with the 3" square of masking tape.

Warning: Keep head and trunk as far away from bottom of head as possible as the radiation leakage on this surface may be several hundred milli-roentgens per hour.

2. Wet smear contamination checks will then be made in this order.

- a. The newly exposed bottom of the head.
- b. The area of the shutter wheel just under the 3" square of tape (lift momentarily and then replace).
- c. The newly exposed top of the collimator (can be tipped by one person and wiped by the other). Bag may be opened momentarily.
- d. Remove the 3" square of masking tape and check as a wet smear.
- e. Remove the tungsten or brass saddle (on 583 A, B, C and 590 series heads).

3347 COLLIMATOR REMOVAL  
Model 583 & 590, A,B,C,D, Heads

1. Remove the Collimator as follows:

- a. Rotate unit so that collimator is pointing straight up.
- b. Lock the head so that it can not turn (refer to unit manual for details). Open collimator to widest opening.
- c. Remove the two stainless steel cover plates that are fastened to the sections with the field size dials.
- d. Put a cable clamp on each cable just above the point where it comes over the pulley.
- e. Remove the other two stainless steel cover plates.
- f. Carefully release cables so that cable clamps are resting just below pulleys.
- g. Remove the four roll pins and two pulleys holding bottom frame assembly of collimator in place. Mark assembly and collimator with masking tape so it can be reassembled in same relative position. Lift off bottom frame assembly and set aside.
- h. Close collimator. Place collimator service tool (part C14332) on the collimator where bottom assembly was fastened. Fasten in frame with 1/4-20 x 1" machine screws and hex nuts.
- i. Make sure main power switch is "off". Remove the four screws that hold the head positioning handle to the collimator bearing ring (on 583 model heads). Remove the light switch and tape so that bare terminals cannot short to head (on 583 model heads). Unsolder collimator light wire from bearing ring terminal and tape bare wire end.
- j. Set rotational arm so position dial reads 180° and turn on main power switch so that magnetic brake will hold rotational arm at 180°. Check to make sure brake holds properly.
- k. Remove collimator light.
- l. Remove the eight screws holding the bearing ring and collimator to the head.
- m. Prepare a 3" square patch of masking tape and hang nearby.
- n. Place a pad of soft material to the right of the unit on which to place the collimator and bearing ring.
- o. Lift the collimator and bearing ring (about 175 lbs.) by the four handles of the collimator service tool and place it on pad. Cover the orifice in the head with the 3" square of masking tape.

Warning: Keep head and trunk as far away from bottom of head as possible as the radiation leakage on this surface

may be several hundred milli-roentgens per hour.

2. Wet smear contamination checks will then be made in this order.
  - a. The newly exposed bottom of the head.
  - b. The area of the shutter wheel just under the 3" square of tape (lift momentarily and then replace).
  - c. The newly exposed top of the collimator (can be tipped by one person and wiped by the other).
  - d. Remove the 3" square of masking tape and check as a wet smear.

### 3706 COLLIMATOR REMOVAL

Find a platform (dolly, table, box, etc.) within about one inch of the height of the lower end of the collimator which will safely hold the nearly two hundred pound load and position it under the collimator.

1. Lower the head until the collimator rests on the platform.
2. Remove the eight screws holding the collimator to the head.
3. Prepare a 3 inch square piece of masking tape and hang loosely on head.
4. Lift the head electrically to about 6 inches above the collimator.
5. Place the 3 inch square of masking tape over the port in the head and a plastic bag over the collimator.
6. Make wet smear contamination checks of the bottom of the head and the newly exposed surface of the collimator; remove the 3 inch square of masking tape and check as a wet smear.



## INBOARD BEARING LUBRICATION (581 & 581A) HEADS

Procedure to be Performed only by Licensed Personnel.

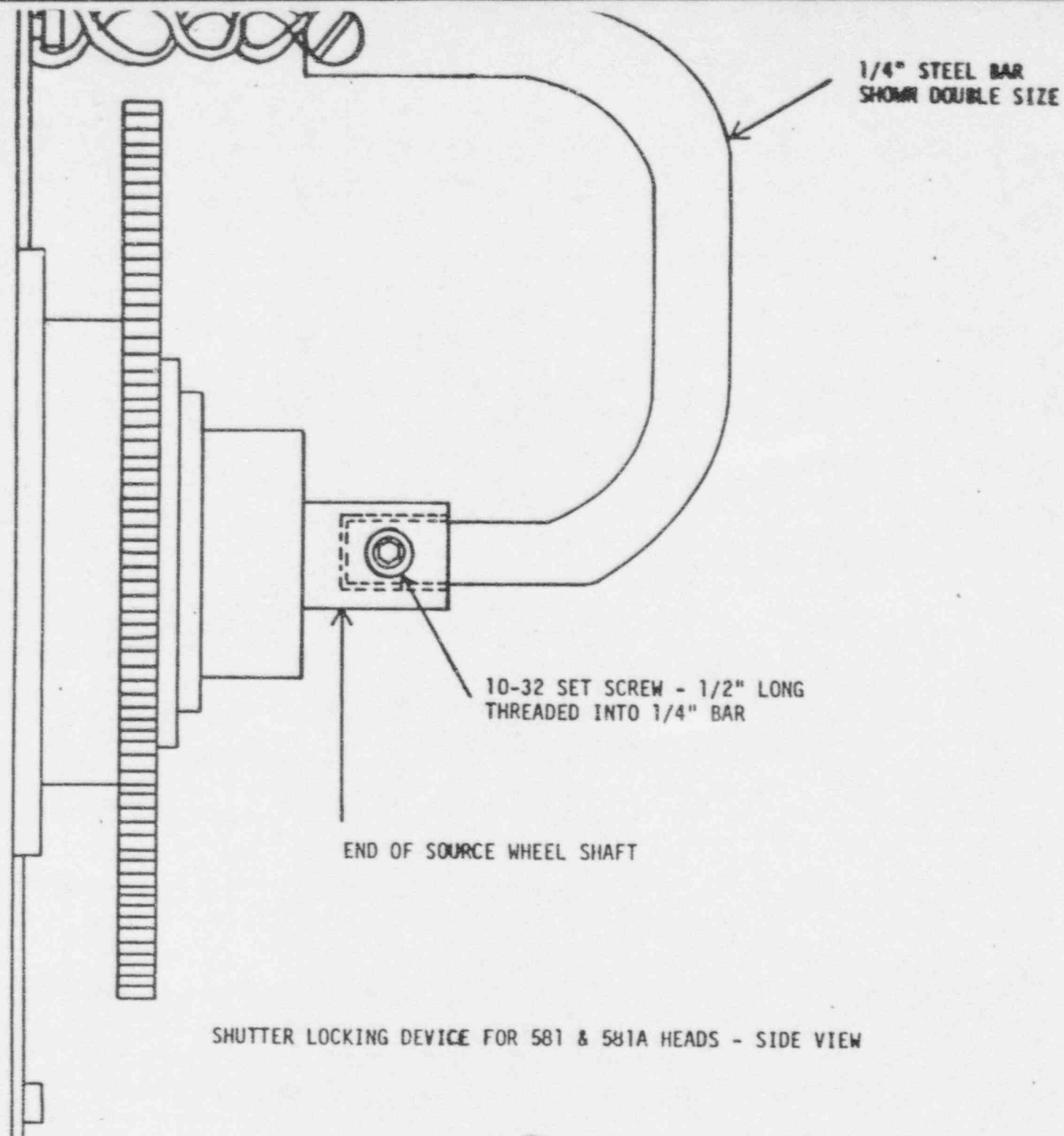
The collimator is not removed during this procedure. Close the collimator and securely fasten a 2" lead block over the end of the collimator. There is no locking bolt hole on the 581 head. There is a hole on the 581A and 581B. On the 581 head, a hole must be drilled into the head  $\frac{1}{2}$ " deep and tapped for a 1/4-20 bolt. This hole must line up with the locking bolt hole in the shutter stop arm.

Be sure to mark all the items in sequence and direction in the following procedure.

1. Remove the wires from the terminal board going to the motor.
2. Remove the three screws holding the gear train and motor assembly. Remove this unit carefully. Do not pull on the outer casting of the gear train or the train will fall apart.
3. The shutter plug and head must be scribed to assure proper alignment during reinstallation. The off microswitch and terminal board will be damaged if the plug is not reinstalled properly.
4. CAUTION: When the shutter stop arm is removed, later in this procedure, the source will be free to be turned on. The locking tools mentioned must be used to lock the source in its closed position. The first tool considered is a  $\frac{1}{2}$ " dia. rod, bent into a "U" shape (see attached drawings). The end of this tool without the chain will fit into a  $\frac{1}{2}$ " dia. hole in the end of the shutter shaft. If necessary, drill the shutter shaft out slightly, and fasten the tool to the shaft with a short set screw. Do not use a set screw longer than the dia. of the shutter shaft. Lock the chain to the closest outer bolt hole in the head.
5. Mark the shutter shaft with a reference mark. This mark is your indication of the source location. After all the hardware is removed and only the shutter shaft remains, be sure that the reference mark does not shift. If it shifts 180°, the source will be full on. The "U" tool is used to prevent this.
6. Remove all three allen screws holding the stop arm. Be careful of the spacers behind the screws. Remove the stop arm and let it hang in the "U" tool. Do not remove the chain from the "U" tool.
7. Drive the pin out of the gear and remove the gear. Back up the shaft when driving the pin so as not to bend the shaft.
8. Remove the spacer, the spring retainer, and the spring and let hang.
9. Insert the long locking rod with the chain into the hole in the shutter shaft that the gear pin was removed from. Lock the chain to the closest outer bolt hole in the head.

NOTE: From this point on, only one of the two locking tools can be removed at one time. Be certain that one tool is always connected.

10. Remove the chain from the "U" tool and remove the loose parts. Replace the chain. Lay out the parts in order and direction. All resistance to the shutter rotation except the shutter wheel bearing and of course your safety



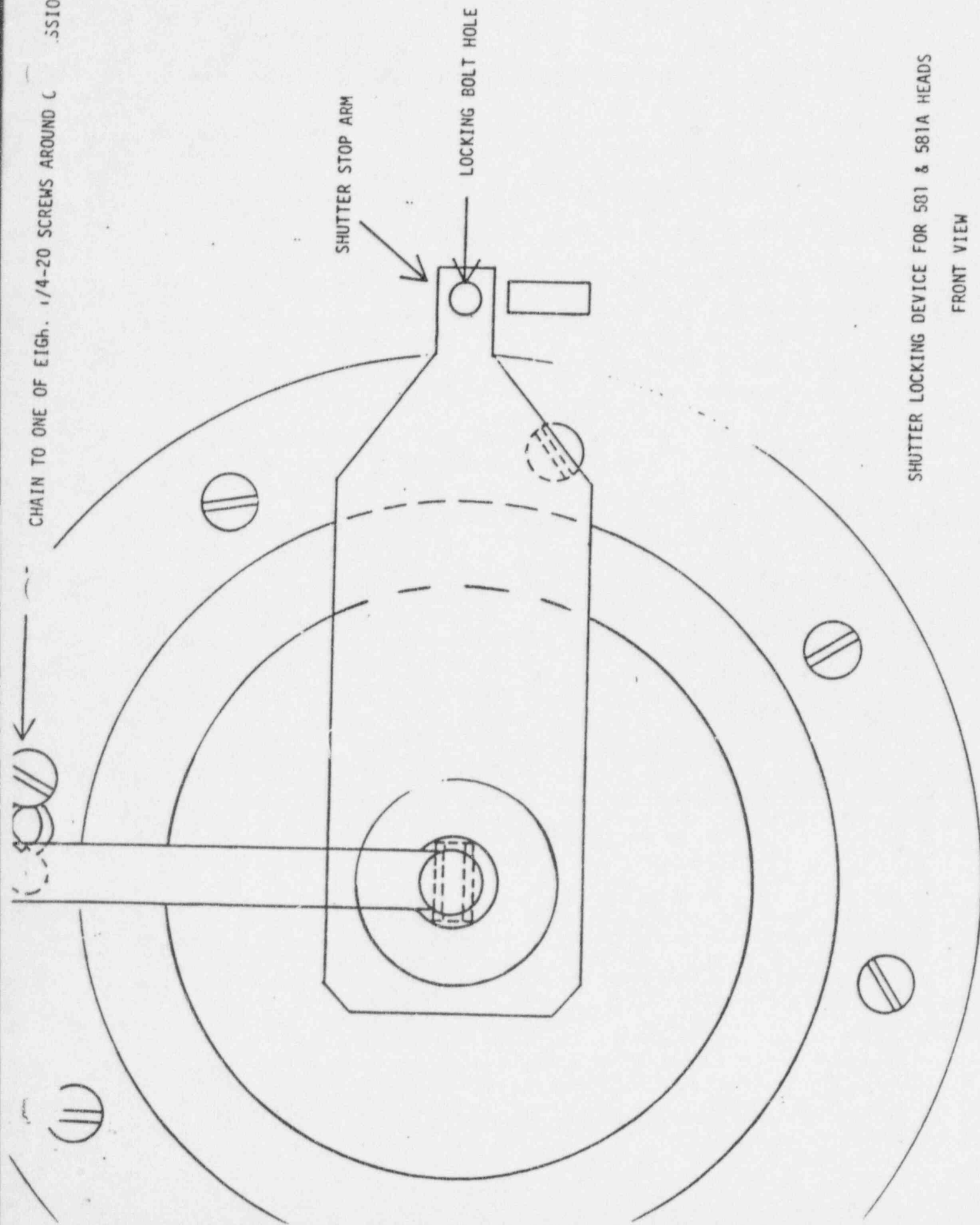
CHAIN TO ONE OF EIGH. 1/4-20 SCREWS AROUND C

SHUTTER STOP ARM

LOCKING BOLT HOLE

SHUTTER LOCKING DEVICE FOR 581 & 581A HEADS

FRONT VIEW



11. Reinstall the "U" tool safety chain. Leave a little slack in the chain. Rotate the shutter about  $10^{\circ}$  in either direction to check the bearing. Remove the brass spring hub, under the spring, and its taper pin and set screw.
  12. Remove the four counter-sunk allen screws on the brass plate behind the spring hub.
- NOTE: At all times keep one or both safety tools fastened to the unit.
13. Remove the snap ring from behind the spring hub.
  14. Install the straight safety tool and remove the "U" tool.
  15. Mount the bearing puller to the shutter shaft. The bearing puller on the three inch by three inch by  $1/4$ " plate with 7 holes in it.
  16. Disconnect the microswitch leads from the terminal board and remove the terminal board from the unit.
  17. The outboard bearing pressed into the shaft, seldom fails. The inboard bearing, close to the source and not visible, can cause binding. It is pressed into the shutter plug.
  18. Install, four each, 2" long bolts in the outer holes of the head. Put stop nuts about 1" back from the plug to prevent the plug from coming all the way out.
  19. Tighten in on the bearing puller and the shutter plug will begin to pull out.
  20. When the bearing drops off the small diameter of the shutter shaft, drive the plug back into the head with the 4 nuts on the safety bolts around the outer part of the head installed in step 18.
  21. Remove the bearing puller.
  22. Remove the outboard bearing. See the note after step 12.
  23. Replace the bearing puller and pull the shutter plug back out about 1" (be sure to have the 4 outer safety  $1/4 \times 20 \times 2$ " long bolts and stop nuts in place.
  24. Remove the bearing puller.
  25. The lubrication used in the foll wing procedure can only be "3 in 1" brand oil. No other household oil may be used. A fifty-fifty solution of "3 in 1" oil and lacquer thinner must be mixed. The lacquer thinner will loosen the hardened lubrication already in the bearing. Normally 1-1/2 to 2 cc of oil are needed. A maximum of 3 cc can be used. Any more oil than this can drip down into unwanted areas and harden.
  26. It was mentioned in step 17 that the inboard bearing is pressed into the shutter plug. This bearing is 8-1/2" in from the outer face of the plug. This is measured at the shutter shaft hole in the plug.
  27. Use a syringe and a 8-1/2" long thin catheter to insert the oil solution slowly around the bearing.

28. Readings of approximately 100mr/hr can be expected at the space between the shutter shaft and plug. Work off to one side and not directly in back of the head.
  29. Pull the shutter wheel back into its seat, that is up onto the back bearing, by pulling the shutter shaft towards the back of the head.
  30. Rotate the source wheel slightly to work in the lubricant.
  31. Check the alignment of the plug.
  32. Remove the two set screws from the plug and install 2 2" long bolts in these holes and pry the plug around until the alignment marks of step 2 match.
  33. If too much friction is encountered in step 32,
  34. Push in the shutter plug by tightening on the four 1/4 x 20 bolts in the outer ring.
  35. Replace the 4 2" long bolts with the original bolts and install the remaining four bolts.
  36. Install the bearing (see note after step 12). When the bearing is seated properly, there will be no in and out play of the shutter shaft.
  37. Replace the tru-arc.
  38. Clean all pieces before replacing.
  39. Replace set screws removed in step 32.
  40. Clean the burrs from the shutter shaft.
  41. At this time, a plus and minus 10° rotation of the source wheel should indicate any improvement due to oiling of the bearing.
  42. Replace the spring hub, the groove pin and set screw.
  43. Replace the 1/4" thick brass bearing retainer and its four flat head 1/4 x 20 allens.
  44. Lubricate and replace the spring.
  45. Replace the thin outboard spring retainer and spacer washer.
  46. Replace the gear, its pin and set screw.
- CAUTION: The hole in the gear or shaft can elongate and cause the gear to shift. Mark the gear and shaft and check for any shift. A shift will prevent proper alignment of the source in its open position.
47. Replace the stop arm, the outer stop arm retainer (large washer with three holes) and the three screws.

Lubrication Procedure  
Inboard Bearing

581-B Heads Loaded With a Source  
TO BE PERFORMED BY LICENSED PERSONNEL ONLY

1. Install the shutter locking bolt.
2. Close the collimator and securely fasten a 2" lead block over the center beam.
3. Remove the large brass drive gear.
4. Remove the snap ring, brass gear and "V" belt pulley.
5. Remove the hub for the large brass drive gear from the shutter rotor shaft.
6. Mark the position of and remove the micro switches for open and closed lights.
7. Remove the shutter drive casting assembly and set aside.
8. Remove the shutter power spring covers, power spring, brass anchor block and anchor pin.
9. Remove the cap screws from the shutter stop arm assembly.
10. Remove the taper pin from the shutter stop arm assembly.
11. Insert the special stop tool into the outermost taper pin hole and secure to  $\frac{1}{4}$ -20 hole for socket head cap screws used to secure the shutter plug retainer ring. Remove only 1 screw at this time and use a  $\frac{1}{4}$ -20 X 2 in. bolt for this.
12. Remove the shutter locking bolt and move the shutter stop arm assembly back to the special stop tool. Then take the bolts out of the outer bearing retainer plate and move it back also.
13. Insert a second special stop tool into the inner taper pin hole and anchor the same as the first one.
14. Remove the first special stop tool and take the stop arm and bearing retainer plate off the rotor shaft.
15. Insert the first special stop tool again and remove the second special stop tool.
16. Remove (3)  $\frac{1}{4}$ -20 cap screws at 90 degree increments from the bolt used to anchor the special stop tool and replace them with  $\frac{1}{4}$ -20 X 2" bolts.
17. Make alignment marks to accurately reposition the shutter plug in the head.



18. Remove the rest of the  $\frac{1}{4}$ -20 cap screws from the shutter plug retainer ring.
19. Install the special bearing puller onto the shutter rotor shaft using the holes for the outer bearing retractor plates. Use collar over the  $\frac{3}{8}$ " diameter part of the shutter shaft.
20. Press the shutter shaft with the bearing puller until the shutter plug moves back about one inch.
21. Remove the bearing puller and put the screws from the puller through the shutter plug retainer ring. Then press the shutter plug back into the head. This will remove the outer bearing from the shutter shaft.
22. Press the shutter shaft with the bearing puller until the shutter plug moves back about one inch.
23. Put a small amount (about 10 drops) 3 in 1 oil (USE NO SUBSTITUTES) down the shaft. Use liquid for biplane heads and drop straight down the shaft with the shaft pointed up. For fixed head and vertical units use aerosol can and catheter and spray in. The catheter may have to be flattened. If old grease has hardened, use about 0.5 cc of 50% lacquer thinner and "3 in 1" oil mixture.
24. Put the outer bearing on the shutter shaft and rotate slightly (about  $\pm 45$  degrees from full off) to work in the lubrication. For this the stop tool may be removed from the anchor bolt. NOTE: The position of the source must be carefully observed using a survey meter. Replace the anchor bolt.
25. Reassemble the unit making sure that the shutter plug is accurately lined up in the head.
26. Check out electrically from outside the room with the voltage to the motor set at 80VAC.  
NOTE:  
The shutter opening and closing times at the 0 degree position should be about equal and not exceeding 3 seconds. As the "C" arm is rotated the times will vary with the worst positions being from 135 degrees thru 225 degrees.
27. Check alignment, using Pinhole Camera.

---

## SHUTTER GEAR REPLACEMENT INSTRUCTIONS - CAT. 581 & 581-A HEADS

---

### To Be Performed by Licensed Personnel Only.

In order to orient the shutter lever in precisely the same position as it was originally, refer to D-13774 and B-13777 blueprints. The following instructions will assure this proper alignment of source "on" position.

#### CAUTION:

Be sure that you use a survey meter while making these repairs. During this repair, there will be times when the shutter wheel will not be held in any particular orientation. The instructions will be such that the chance of shutter wheel orientation getting mixed up will be very remote, but the possibility still exists. Do not attempt this repair single handed.

To replace the shutter gear, do the following:

- 1) Mark the end of the shutter shaft with a punch mark or a painted mark such that you will know that which side of the shaft the source is on.  
BE SURE YOU DO THIS.
- 2) Remove all of the soft parts on the shutter "off" position. This would include the shutter "off" switch, remains of the rubber grommet and so forth. The intent is that the shutter lever must be made to bottom on the shutter "off" adjusting screw to give you a positive "hard" position.
- 3) Remove the shutter drive.
- 4) Drill a  $\frac{1}{8}$ " hole axially into the shutter shaft until the drill breaks through the  $\frac{3}{16}$ ths cross drilled hole in the shaft. This hole may already be there.
- 5) Insert the special wheel alignment pointer into the cross drilled hole with a light press fit at the knurled section. Pointer must be tight in the hole. Tap in if necessary. This pointer will be a gauge which will orient this cross drilled hole to a particular carefully measured scribed mark on the shutter plug clamping ring. It will be very necessary that you mark down, how this pointer is inserted and that you carefully construct a perpendicular (by using a machinist's square) between the shutter plug clamping ring and this pointer. This pointer will be inserted later after the new gear is installed. This will repeat for you the exact location of that shaft when the shutter lever is pressing against the adjusting screw of the "off" position. This must, of course, be done very accurately.
- 6) Remove the special wheel alignment pointer and install the approved shutter locking fixture.
- 7) Remove the shutter lever clamping screws and washer.

- 8) Press the shutter lever away from the shutter gear. Note that the shutter wheel is now free to swing since it has lost its "off" stop. The approved shutter locking fixture will prevent the source from coming "on".
- 9) Tap out the existing roll pin or taper pin which holds the shutter gear onto the shaft. Be extremely careful not to bend the shaft. Units before January of 1957 had 3/16ths diameter by 1" long roll pins. Units after that date had #3 standard taper pins 1" long for installation and holding the shutter gear.
- 10) Finish tapping out the roll pin and pull off the gear. The gear will slide over the approved shutter locking fixture.
- 11) Remove the washer in front of the shutter spring and carefully pull the spring hook off the spring pin. Don't let it fly off. This will now allow the shutter to be free swinging and it should be easier to clamp it in that position with the approved shutter locking fixture. Be careful, however, not to lose your shutter wheel orientation. KEEP THE SOURCE IN THE CENTER OF THE HEAD.
- 12) Remove the old gear from the outer end of the locking fixture and push the replacement gear onto the shaft, line up the holes.
- 13) Drill 3/16ths hole through the far side of the gear. On units before 1957, a roll pin can be installed, and units built after 1957, the hole should be taper reamed being sure that the reaming is done from the same side as it was originally. DO NOT DRILL A NEW HOLE IN THE SHAFT.
- 14) Thread the spring washers and the gear onto the approved shutter locking fixture. Holding the shutter wheel in this manner, rehook the spring onto the spring pin. Be sure the original amount of spring turns is duplicated. This operation will be very hard to do and the approved shutter locking fixture must be anchored securely. The spring should be almost coiled tight when you make the hook up.
- 15) Push the gear onto the shaft in its proper orientation and install either the roll pin or the taper pin as required.
- 16) Check again the alignment marks which were previously made on the shaft. Clamp the shutter lever to the gear with the right screws and washer.
- 17) Reinstall in exactly the original manner the wheel alignment pointer and then exactly duplicate the original method of constructing a perpendicular and bringing the alignment pointer to the same scribed mark on the shutter plug clamping ring, as was done in step 5. Make sure that the shutter lever is pressing against the shutter "off" set screw. If everything is exactly as it was in step 5, the source is now in perfect agreement with the original alignment.
- 18) Drill and install the 3/32ths diameter groove pins which hold the shutter lever in alignment with the shutter gear.
- 19) Reinstall switch parts and install new rubber grommet on shutter "off" set screw. This should complete the repair.

If it is found that the shutter lever switch actuating spring has been broken, then it should be replaced. The spring is included with the parts which were sent. The rivets for installing the spring are also included. Some springs had to be notched. If original was notched, then duplicate.

SEND THE FOLLOWING:

1	T21-35	Rubber Grommet	
1	T77-67	Spur Gear	
1	T14-950	Taper Pin	
1	T5-226	Tension Spring	
2	T15A-11	Round Head Rivet	
1	T14A-62	3/16 X 1 roll pin	
3	T14A-10	3/32 X 1/2 groove pin	
1	_____	Wheel alignment pointer	} MUST BE RETURNED TO FACTORY
1	_____	Approved lock fixture	

### 583 HEAD REMOVAL AND SHUTTER CLEANING

1. Install shutter locking bolt.  
It is recommended that a case hardened bolt, long enough to bottom into the head, be used instead of the spring action assembly on some of the units.
2. Remove the stand covers from one side. The head will be at 5 o'clock or 7 o'clock during this operation. If at 5 o'clock, remove left-hand covers. If at 7 o'clock, remove the right-hand covers.
3. Check the stand to floor mounting bolts for tightness. If they are not tight, the unit could tip over during the procedure.
4. Remove shutter motor access cover from above and behind the head.
5. Remove the transformer and the cover and disconnect it from the terminal board.
6. Tilt the head in the C-arm to expose the terminal board and wiring.
7. Remove all wires coming up from the slip rings to the terminal board.
8. Remove the stainless trim covers from the back of the head and disconnect the wires from the mercury switches and distance localizer assembly.

NOTE: Eight pieces of 2"x2"x14" long are needed to build the cradle shown in figure 3. This cradle is placed on a dolly of 2,000 pound capacity.

9. Swing the head around to the 5 o'clock position and position the head in the cradle with the collimator pointing toward the ceiling (use padding to protect paint). Set the wheels of the dolly so that it can be pulled straight out away from the stand after the head is removed.
10. Place a 4,000 lb. come-along hook into the top of the C-arm access hole. The other hook of the come-along is fastened to the outside of the left toe. See figure 1A, B & C. If the 7 o'clock position of the head allows more room for this procedure, the come-along is fastened to the right toe. The unit is now in position shown in figure 4.
11. Take up on the come-along until the head rests firmly in the cradle. The come-along will prevent the barrier from swinging down once the head is removed.



12. Remove the allen head bolts to separate the head from the stand. Loosen the last two bolts mentioned above, and watch to see if the come-along tension is right. This is done by watching to see that the C-arm and barrier are rigid and that the head is snug in the cradle.
13. In addition to the bolts that hold the head to the C-arm, there are two 3/8 inch centering pins holding the head. Use two screw drivers to separate the head and C-arm.
14. The head is now pulled away from the C-arm. Pull from the dolly and not from the head or cradle. Pull the dolly straight out, or the motor assembly will be damaged. Mount to an area out of the swing of the C-arm and barrier.
15. Remove all the wires between the motor drive assembly and the head from the terminal board.
16. Remove the motor assembly by backing off equally on the three hex shafts approximately 1-1/4" long.
17. Separate all the wires and remove the flat cable clamp at about the center of the head. The wires will have to go through a small hole in the head. Unsolder the fuse holder cap.
18. Remove the magnetic lock brackets from both sides of the head, remove the shutter open and shutter close switches with the magnets. Mark the switches to insure that they will not be reversed during reassembly. The cable harness with the three switches and two magnets is draped back out of the way. A third switch at the top of the head for head centering must be removed. Remove switch and switch bracket.
19. At this time the spring, spring hub, and gear are left on the head. You will see one cable harness going through a hole in the head, these wires must be separated and will be pulled through the hole.
20. Remove the gear from the end the shaft in front of the spring. It is held to the shaft by a taper lock. The taper lock is screwed to the gear and press-fitted to the shaft. Remove the bolts holding the taper lock to the gear. A gear puller is handy for removing this gear. The gear is 2-5/8" in diameter. The taper lock will probably be damaged during removal. Have a new one on hand.
21. Remove the brass spring keeper and the spring. The pin holding the spring should not be straight. It is bent to align the spring. Inspect the rivet on the spring. On the left side of the head there is a block. The shutter closed switch actuator, a 10-32 screw, in front of this block, will have to be backed off to allow clearance. Remove the locking screw from this 10-32 and back the 10-32 off 6 turns counterclockwise so it will clear the block.
22. Remove the four countersunk allens from the brass bearing retainer.
23. Remove the brass spring hub by taking out the set screw from one side, and the groove pin on the other side. Have someone back up the shutter shaft when driving out the pin so you do not bend the shaft.
24. Remove the snap ring from behind the hub at the center of the shaft.



25. Remove the five bolts from the outboard bearing mounting plate. This plate is held on with two locating pins. A special tool will be helpful in removing this plate because it is tightly fitted to the bearing.

NOTE: CAUTION: The work from this point on should be done by standing off to one side of the head. There will be a slight amount of radiation leakage from the shaft. Make sure that the locking bolt is securely in place.

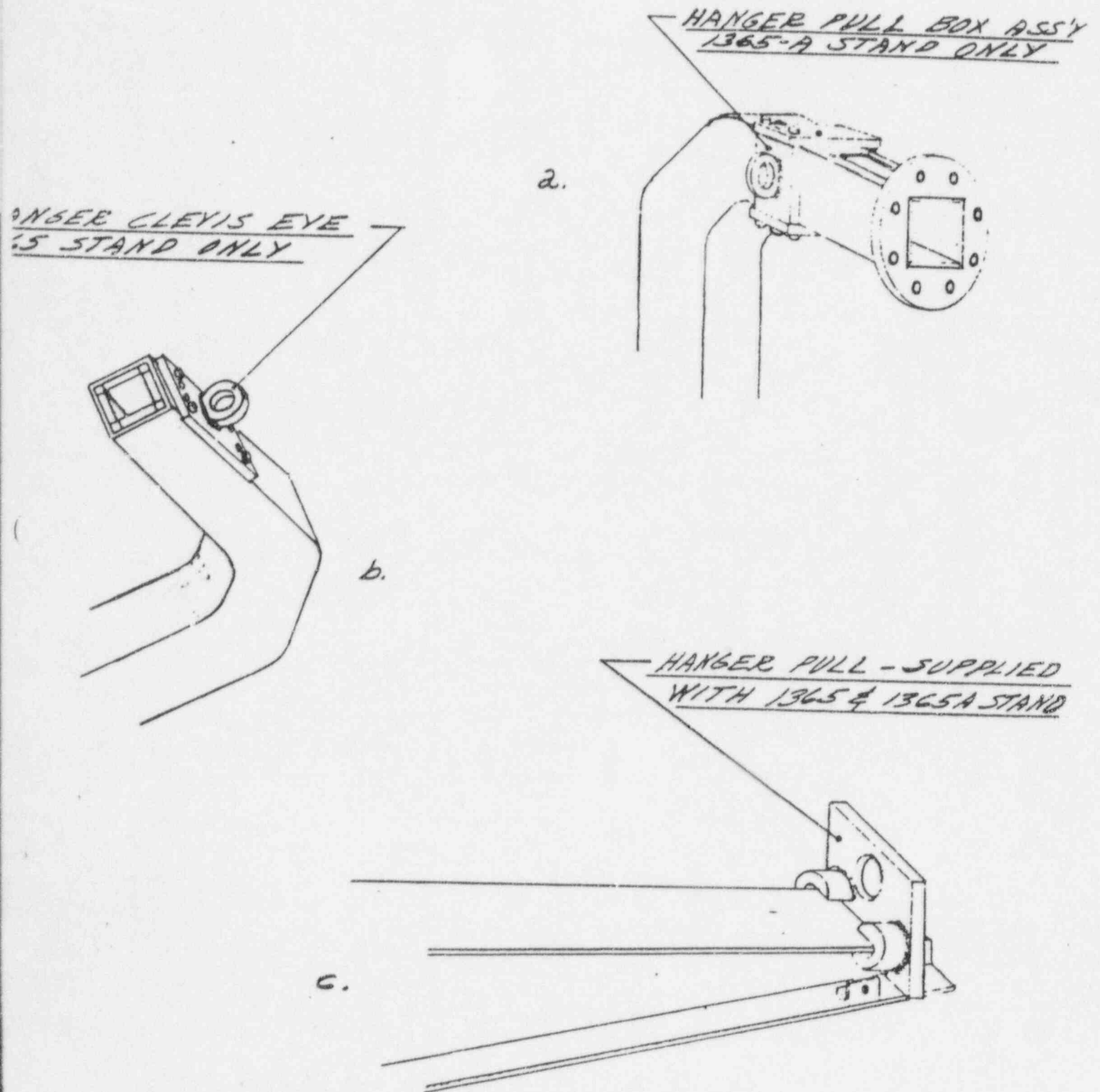
26. At this time the only thing that is holding the shutter plug into the head is the emergency locking bolt. The crack between the shutter plug and the head can be seen at this time. It is this crack that is cleaned to remove all foreign matter. At no time can the plug be removed from the unit because the source is embedded in this plug. A piece of x-ray film approximately 12" long and 1" wide with a small hook cut into the film is used to clean the foreign matter from the crack. It is necessary to clean around the shutter locking bolt for at no time can this bolt be removed. There is a slight clearance between the shutter plug and the head. It is necessary to lift up on the shutter plug to clean the crack at the bottom where the shutter plug is now resting on the head.
27. At this time the unit may be reassembled and checked out to see if the bind has been cleared.

#### 583 HEAD RE-ASSEMBLY

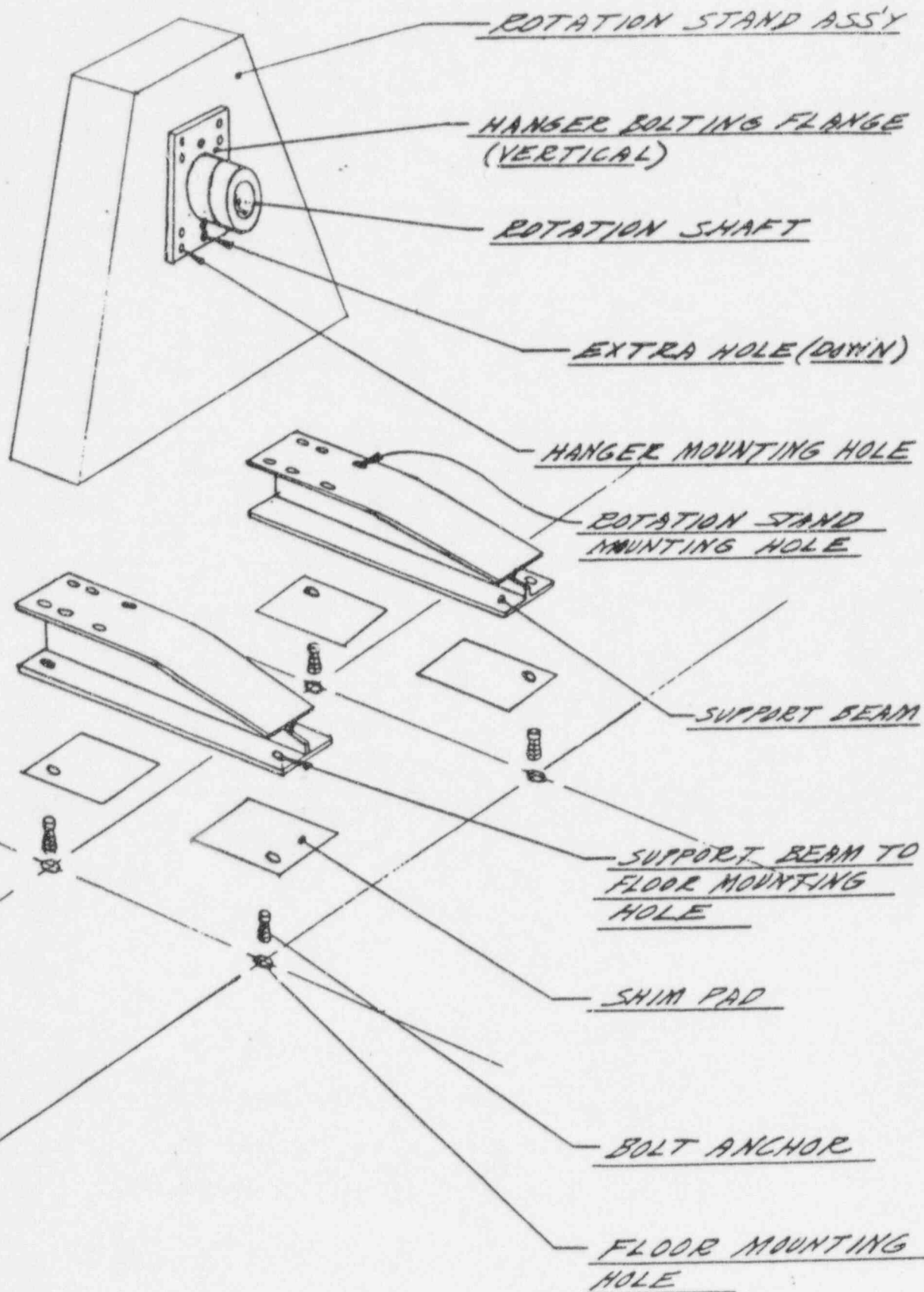
1. Clean and remove all burrs from all pieces. Check for indications of wear.
2. Replace the outboard bearing retainer plate by locating the two 3/8 locating pins and 5 allen bolts.
3. Install the outboard bearing onto the shutter wheel shaft. Lift the shutter wheel while tapping the bearing in. Replace the snap ring.
4. Replace the spring hub and line up the groove pin. Drive the groove pin in thru the hub and shaft supporting other side of the shutter shaft so it will not bend. Reset the shutter off switch actuator screw, by turning it 6 turns clockwise. Replace the locking allen.
5. Replace the rear spring retainer and its four counter sunk screws. Clean and lubricate shutter spring and replace it. Tighten it full and back off 185°. Replace the front spring retainer. Center the spring on the hub so as not to touch the front or rear retainer. Bend the pin to prevent the spring from touching the retainer.
6. Clean the hardened lubrication from the gear. Position the taper lock into the gear and replace its screws. Do not tighten the screws. Replace the gear with the flange inboard. Alternately tighten the screws and tap the gear using a 1" pipe between the gear and the hammer to hammer against. If the gear is properly seated, the outboard spring retainer should be snug and not drop off the large shaft.

7. Replace the switches making sure that they are in their proper places.
8. Replace the magnet assemblies. The outboard face of the lock plates, not the lock face, should be flush with the outboard face of the head.
9. Replace the cable clamps. The wires must be kept flat through the 3" wide cable clamp.
10. Check the motor assembly and gear box. Install the motor assembly making sure the gears are meshed. Alternately tighten the 3 hex fasteners which fasten the motor assembly to the head.
11. Tape the wires flat to the cover of the motor gear box. These wires must be kept flat to allow the head to swivel.
12. Clamp the cables to the side of the terminal board cover with the round clamp. Reconnect the wires to the terminal board.
13. Roll the head and dolly back into the C-arm, not all the way.
14. Feed the wires back through the hole at the top of the C-arm.
15. Line up the two locating pins and push the head up tight to the C-arm and replace the main bolts.
16. Complete reassembly of the unit and check the shutters operation.

INSTALLATION  
ACCESSORIES



BASE SUPPORTS & ROTATION  
STAND INSTALLATION

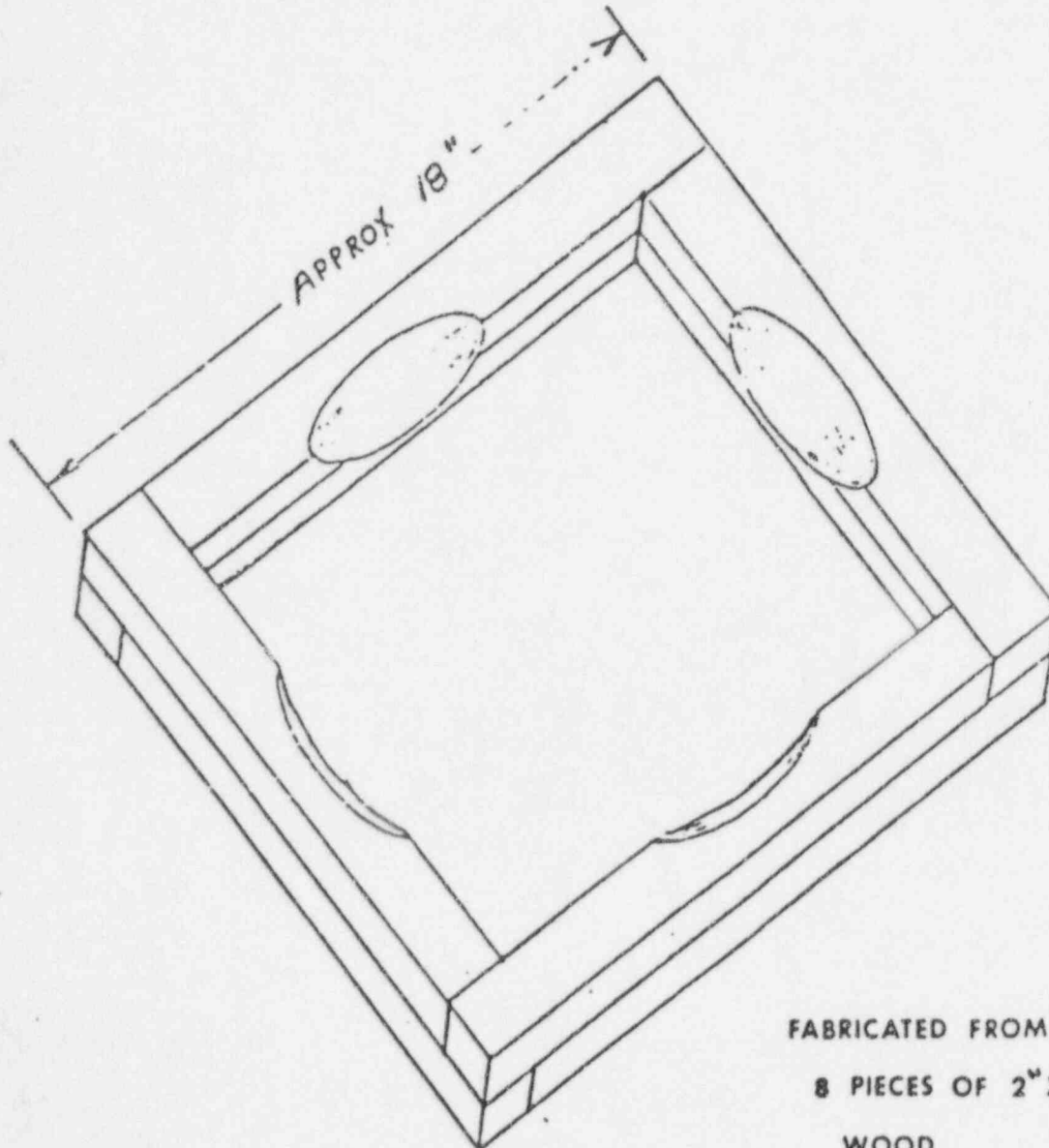


T55-142

FIG. 2

Figure #3

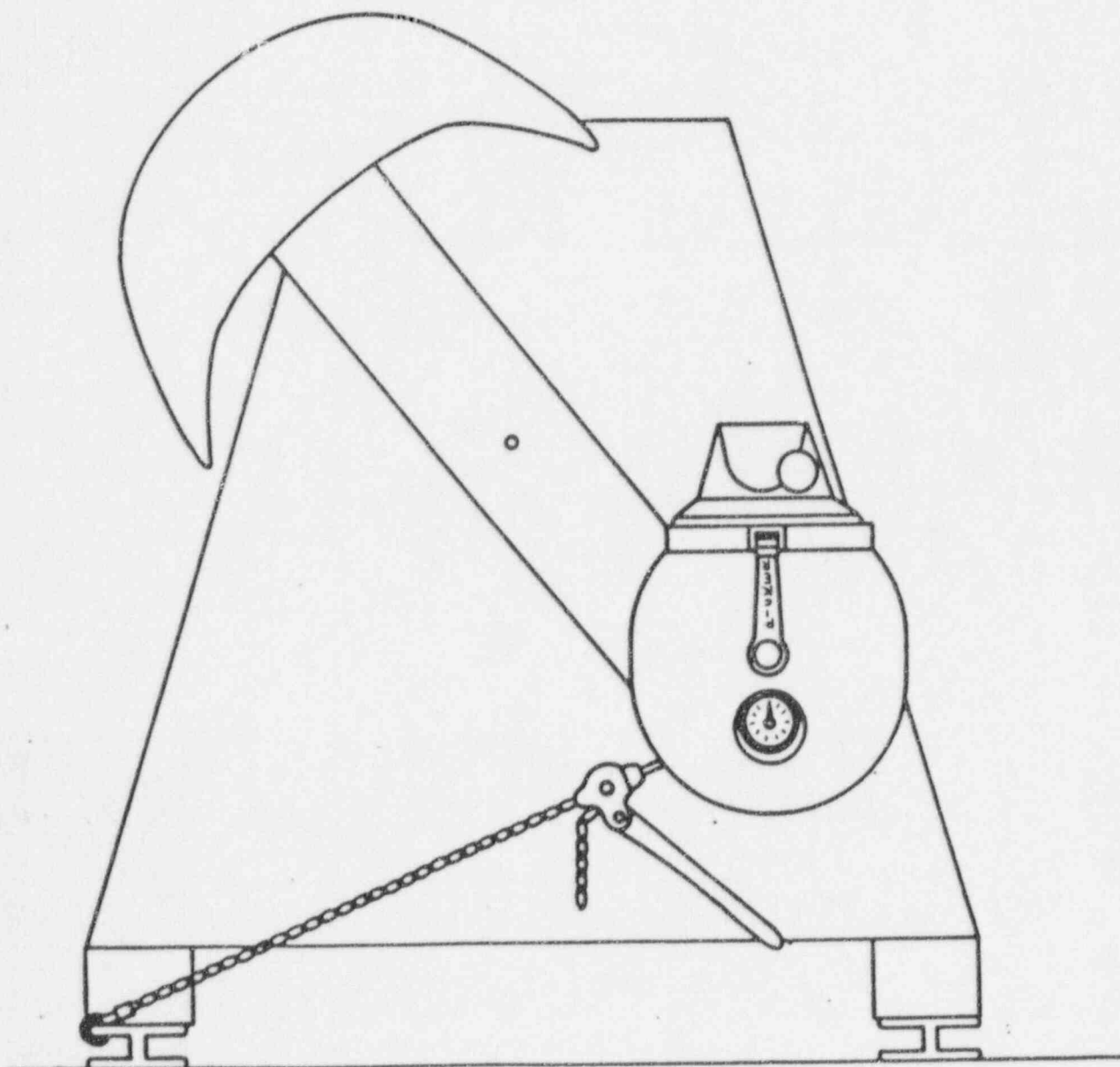
CRADLE FOR  
C 1000 OR C 2000  
COBALT HEAD



FABRICATED FROM  
8 PIECES OF 2" X 4" X 14"  
WOOD

Figure # 4

Position of head and "C"  
arm for removal of head





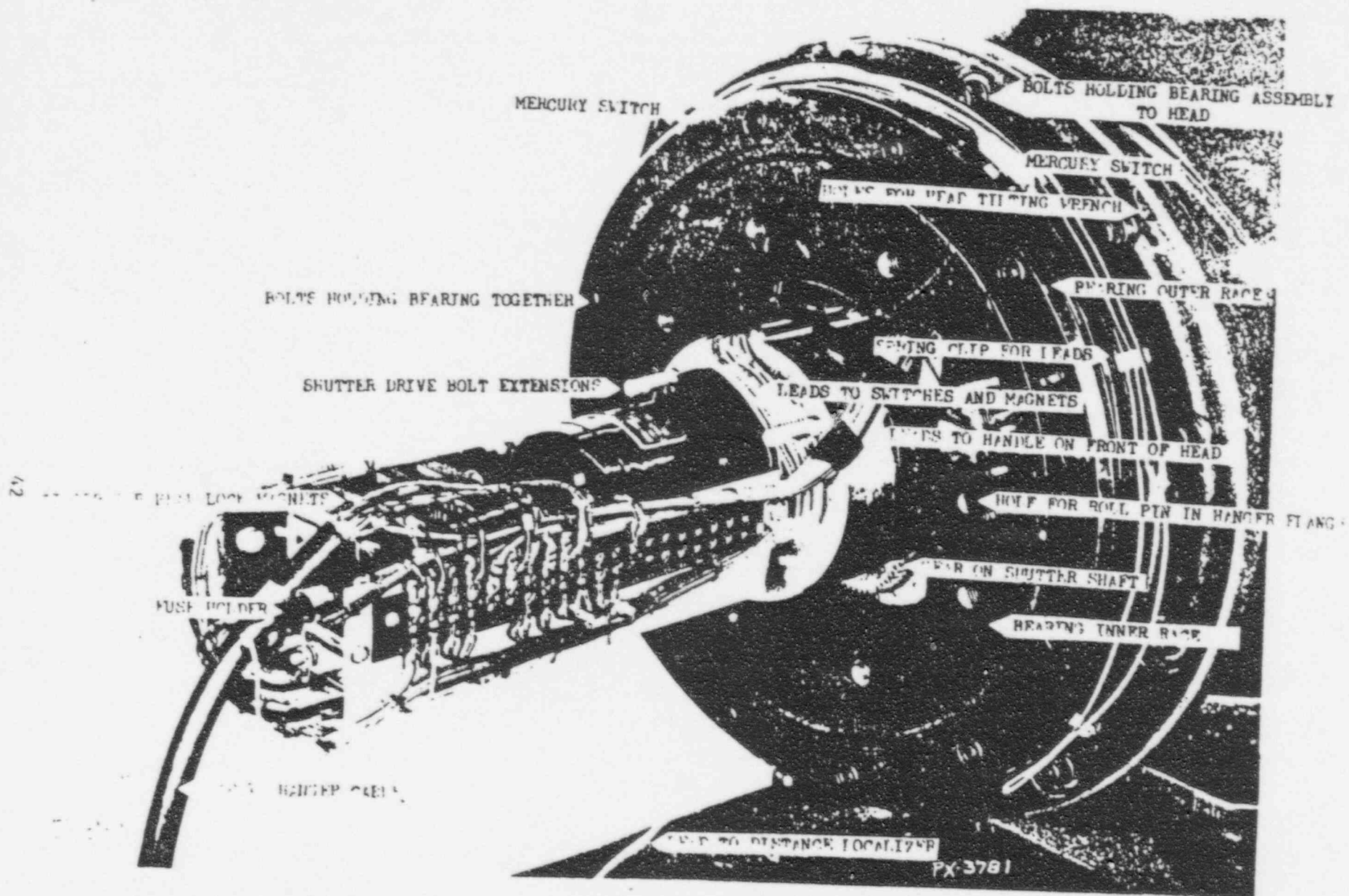
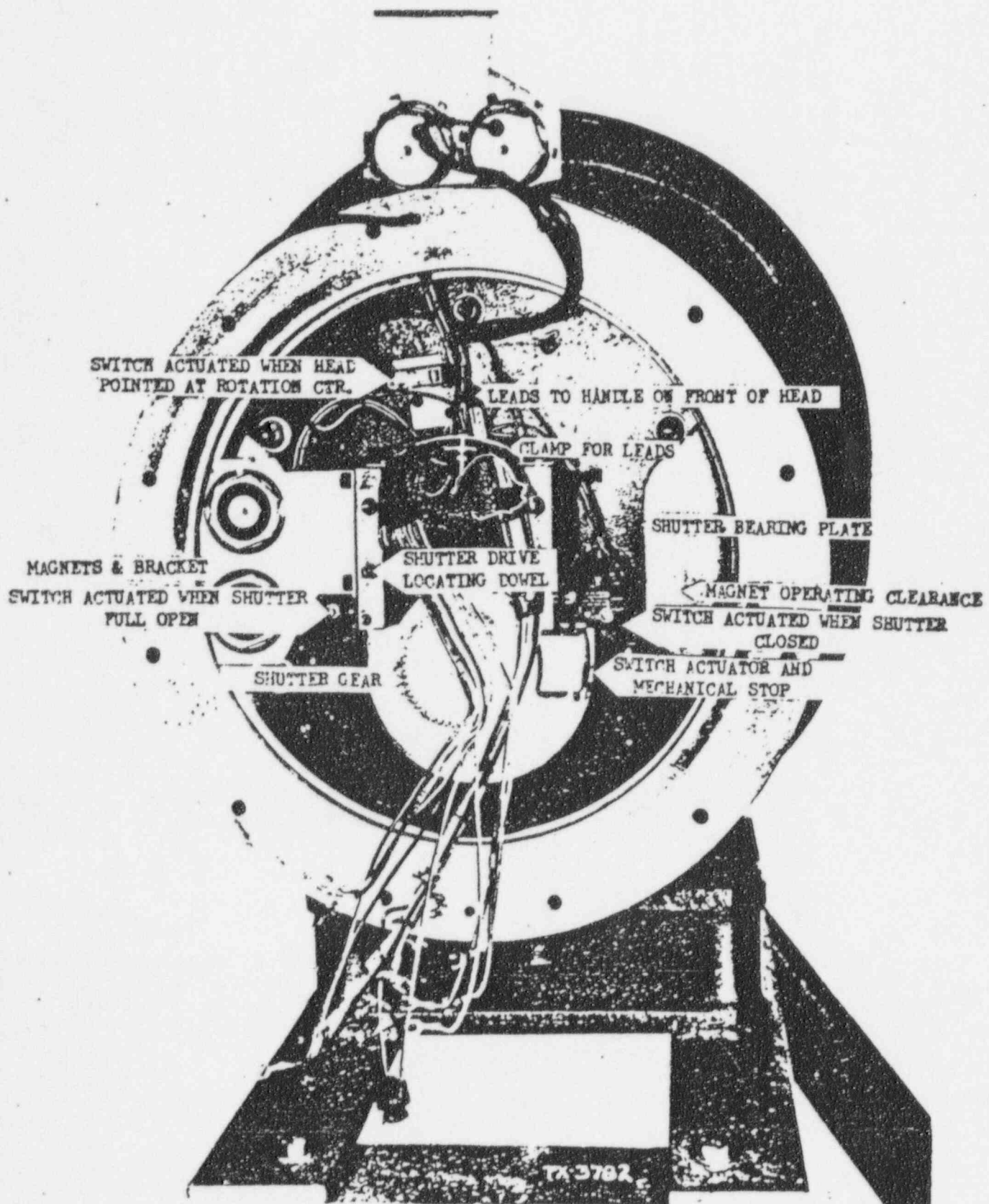


FIGURE 4R

583 HEAD



T55-142  
5-57

483 Head

Fig. 5

Lubrication Procedure  
Inboard Bearing

590C, D & E Heads Loaded With a Source  
TO BE PERFORMED BY LICENSED PERSONNEL ONLY  
V4 - C4 - C8 - V9 & C9 UNITS

1. Install the shutter locking bar.
2. Close the collimator and securely fasten a 2" lead block over the center beam.
3. Remove the large brass drive pulley.
4. Mark the position of and remove the micro switches for open and closed lights.
5. Remove the shutter power spring covers, power spring, brass anchor block.
6. Remove the cap screws from the shutter stop arm assembly.
7. Remove the taper pin from the shutter stop arm assembly.
8. Insert the special stop tool into the outermost taper pin hole and secure to 1/4-20 hole for socket head cap screw used to secure the front cover on the head.
9. Remove the shutter locking bolt and move the shutter stop arm assembly back to the special stop tool. Then take the bolts out of the outer bearing retainer plate and move it back also.
10. Insert a 2nd special stop tool into the inner taper pin hole and anchor the same as the first one.
11. Remove the first special stop tool and take the stop and bearing retainer plate off the rotor shaft.
12. Insert the first special stop tool again and remove the second special stop tool.
13. Remove four 5/16-18 cap screws used to secure the shutter plug assembly and replace with 5/16-18 x2" bolts.
14. Install the special bearing puller onto the shutter rotor shaft using the holes for the outer bearing retainer plate.
15. Press the shutter shaft with the bearing puller until the shutter plug moves back about one inch.
16. Remove the bearing puller. Then press the shutter plug back into the head. This will remove the outer bearing from the shutter shaft.

17. Put a small amount (about 10 drops) 3 in 1 oil (USE NO SUBSTITUTES) down the shaft. Use liquid for biplane heads and drop straight down the shaft with the shaft pointed up. For fixed head and vertical units use aerosol can and catheter and spray in. The catheter may have to be flattened.
18. Put the outer bearing on the shutter shaft and rotate slightly (about  $\pm 45^\circ$  from full off) to work in the lubrication. For this the stop tool may be removed from the anchor bolt. NOTE!! The position of the source must be carefully observed using a survey meter. Replace the anchor bolt.
19. Reassemble the unit making sure that the shutter plug is accurately lined up in the head.
20. Check out electrically from outside the room with the voltage to the motor set at 80 V AC. NOTE!! The shutter opening and closing times at the  $0^\circ$  position should be about equal and not exceeding 3 seconds. As the "C" arm is rotated the times will vary with the worst positions being from  $135^\circ$  through  $225^\circ$ .

### Service Manuals

There are individual manuals for each of the Picker and AMS teletherapy units. The chart on the following page lists the various units, component catalog numbers, manual numbers, and schematic diagrams. Copies of these manuals are available from the National Field Service Office on a lending library type basis.

The service technician should familiarize himself with the manual for each type of equipment he encounters in the field.

Included in this section of the Service Procedures Manual are copies of manuals and parts lists for the most frequently encountered equipment.



# LIST OF GAMMA THERAPY UNITS

CKER  
UNITS

UNIT TYPE	UNIT CAT.	STAND CAT.	COLL. CAT.	HEAD CAT.	CONTROL CAT.	SCHEM.	MANUAL
C 3 00	6096	1364	3313	581	VG3	CT61-340A	T55-102
C 5000	6096	1364	3313	581 & A	VG3 & A	CT61-340A	T55-102
C 5000	6096A	1364A	3313	581 & A	VG3 & A	CT61-340A	T55-102
C 5000	6096B	1364B	3313	581 & A	VG3 & A	CT61-340A	T55-102
C 1000	6103	1365 & A	3347	583	VG5 & A, B, C	CT61-477	T55-142
C 2000	6150	1365B & C	3347B	583 A & B	VG5 & A, B, C	CT61-478	T55-142
C 3000	6183 & A	1365D	3347B	590A	VG5 & A	DT61A-37/39	T55-286
C 3000	6183 B & C	1365E	3347B	590A	VG5A	DT61A-37/39	T55-286
C 3000	6183 D & E	1365F	3347B	590A	VG5A	DT61A-37/39	T55-286
C 3000	6183 F & G	1365G	3347B	590A	VG5A	DT61A-37/39	T55-286
C 3000	6204 & A	1365H & J	3347B	590A	VG5A & C	DT61A-37/39	T55-286
V 3000	6202	1373B	3347B	590A	VG6	DT61A-123	T55-311
V 4	6235	1373C	3347D	590C	VG8D	CT61B-364	T55-426
V 10000	6177	1373A	3313A & B	581B	VG8D	DT61A-875	T55-275
C 10000	6182	1381 & A	3313B	581B	VG8 & A	ET61A-200 202	T55-326
C 4M/60	6234	1385 & B	3347D	590C	VG8B	ET61A-444	T55-672
C 4M/60	6234A	1385 & B	3347D	590C	VG8B	ET61A-444	T55-672
C 8M/80	6223	1385A	3317D	590D	VG8B	ET61A-444	T55-425
C 8M/80	6223A	1385A	3347D	590D	VG8B	ET61A-444	T55-425
C 9	6296	1385C & D	3706A	590E	VG8B	ET61B-590	T55-570
C 9	6296A	1385C & D	3706A	590E	VG8B	ET61B-590	T55-570
V 9	6268	1373D & E	3706A	590E	VG8D	DT61B-364	T55-571
V 4					VG8D	DT61B-364	T55-673
CS600	6152			592	VG8	CT61A-797	T55-226
V2000	6156	1373	3347B	583C	VG6	CT61-948	T55-276
C 12	6376 A	183445	183435	182972 A	3930		T55-775A
C 9	76296D,E	1385F	3706E	590G	VG8F,G	E200070	T55-570A
C 9	76296F,G	1385F	3706D	590G	VG8F,G	E200070	T55-570A
V 9	76268	1373E	3706D	590G	VG8D,E	DT61B-364	T55-571

S UNITS

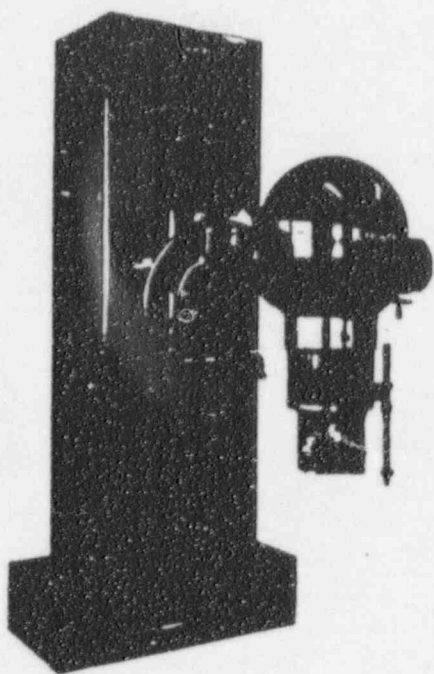


EXPLANATION OF C3000 DESIGNATIONS

Unit Cat. #	Rotation Drive	Head Drive	Rad. Barrier
6183	Yes	Yes	Yes
6183A	No	Yes	Yes
6183B	Yes	No	No
6183C	No	Yes	No
6183D	Yes	No	Yes
6183E	No	No	Yes
6183F	Yes	No	No
6183G	No	No	No
6204	Yes	Yes	Yes
6204-A	Yes	Yes	No

Fig. 1b

# COBALT UNITS



C-5000, Cat. 6096, A, B Vertical Stand Unit  
 Original Capacity - 3,000 RHM  
 Later Capacity - 5,000 RHM  
 (Disc. 1960)



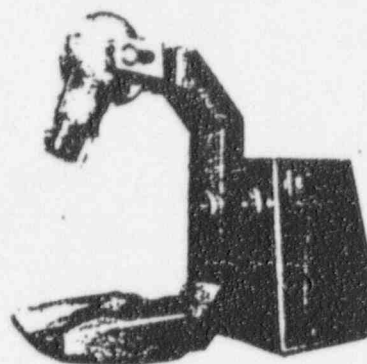
C-1000, Cat. 6103, A  
 C-2000, Cat. 6150 series  
 55 CM Rotational Units  
 Capacity 1,000 - 2,000 RHM

(Disc. 1960)



V-2000, Cat. 6156 Vertical Stand Unit  
 Capacity - 2,000 RHM

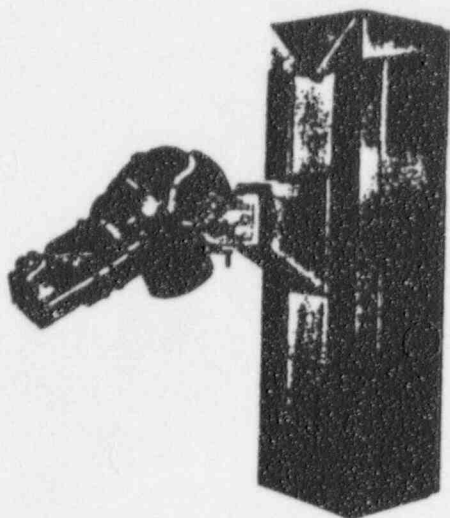
(Disc. 1961)



C-10,000, Cat. 6182 95 CM Rotational Unit  
 Capacity - 10,000 RHM

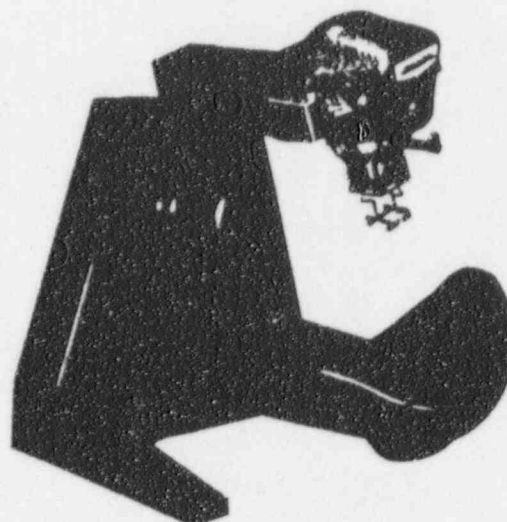
(Disc. 1964)

# COBALT UNITS



V-10,000, Cat. 6177 Vertical Stand Unit  
Capacity - 10,000 RHM

(Disc. 1967)



C-3000, Cat. 6183 Series 55 CM Fixed and  
Biplane and Cat. 6204 75 CM Biplane Rota-  
tional Units  
Capacity - 3,000 RHM

(Disc. 1964)



V-3000, Cat. 6202 Vertical Stand Unit  
Capacity - 3,000 RHM

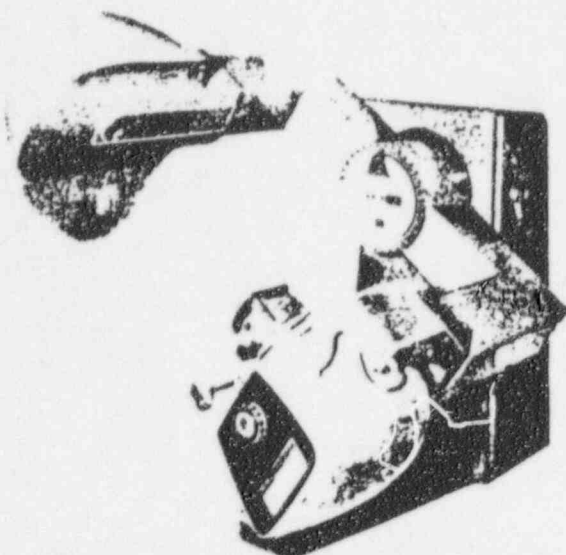
(Disc. 1963)



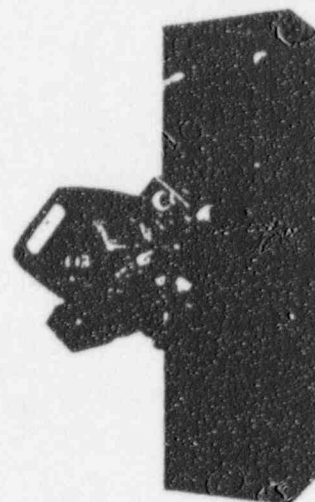
C8M/80, Cat. 6223, A 80 CM Rotational Unit  
Capacity - 8,000 RHM

(Disc. 1968)

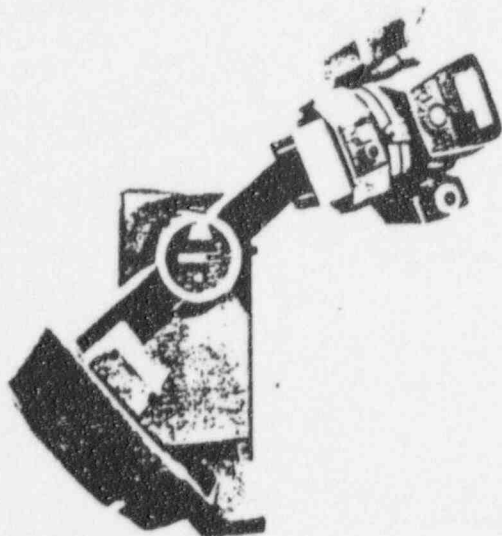
# COBALT UNITS



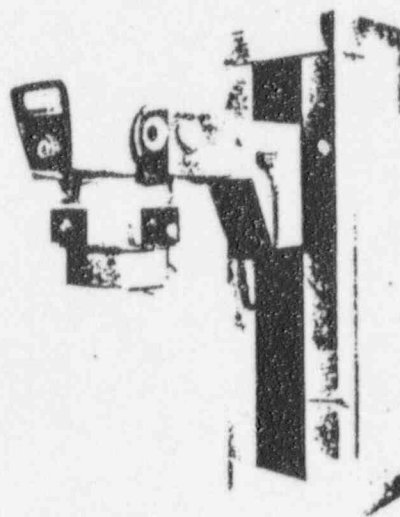
C4M/60, Cat. 6234, A 60 CM Rotational Unit  
Capacity - 4,000 RHM  
(Active)



V4M/60, Cat. 6235 Vertical Stand Unit  
Capacity - 4,000 RHM  
(Active) **HJ**

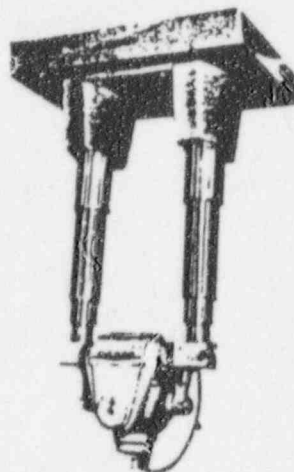


C-9M, Cat. 6296, A 80 CM Rotational Unit  
Capacity - 9,000 RHM  
(Active)



V/9, Cat. 6268 Vertical Stand Unit  
Capacity - 9,000 RHM  
(Active)

## CESIUM UNIT - TREATMENT TABLES



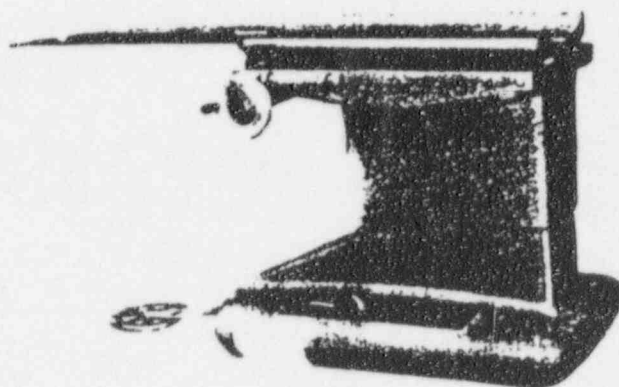
CS-600, CAT. 6152 CEILING MOUNTED CESIUM UNIT  
Capacity - 600 RHM

(Disc. 1968)

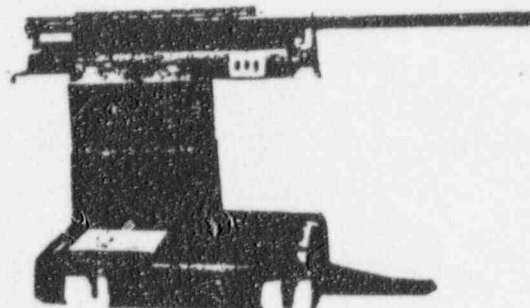


CAT. 3345 VANGUARD THERAPY STRETCHER  
(Disc. 1962)

CAT. 3345A VISCOUNT THERAPY STRETCHER  
(Disc. 1967)



CAT. 3324 MANUAL PRECISION TREATMENT TABLE  
(Disc. 1968)



CAT. 3702 ISOCENTRIC MOTOR DRIVEN TREATMENT  
TABLE

(Active)

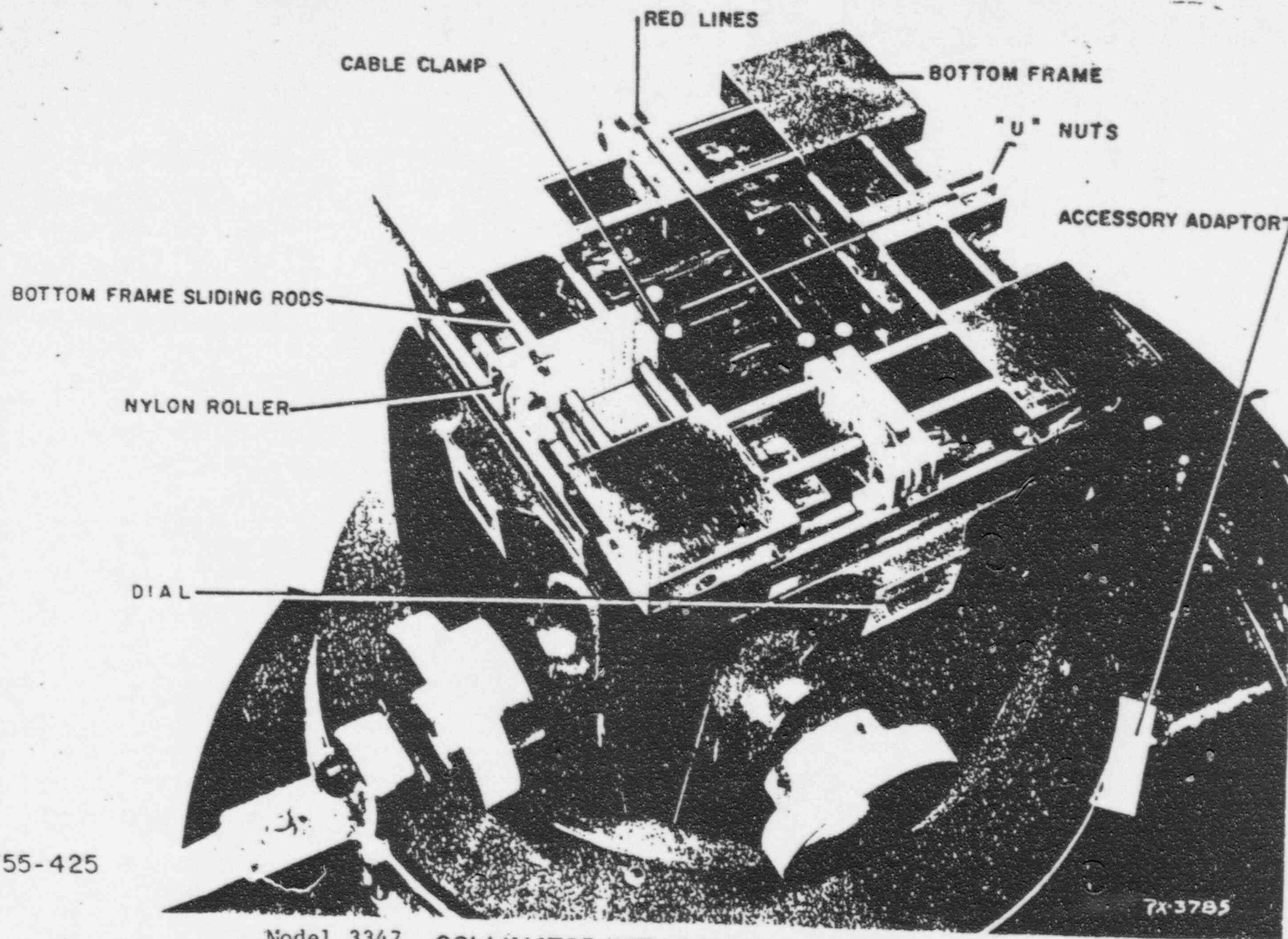
## GENERAL

BEAM COLLIMATOR

The collimator is shown in Figure 4A. The collimation of cobalt radiation presents a difficult problem because of its high energy, and because of the relatively large area of the face of the source. Experiment shows that a distance of 15 to 20 cm between the last diaphragm and the skin is necessary to minimize scattered electrons in the beam, but this distance coupled with a large diameter source and a relatively short SSD (source-to-skin-distance) can mean that a serious penumbra may be present around the beam. Furthermore, making the field size adjustable usually means that the collimator will be bulky and will interfere with proper "porting" of patients. The collimator used on the Picker Cobalt-60 Unit has been so designed that it in large measure overcomes the above problems. The system of articulating stainless-steel-faced lead plates, some of which are edged with tungsten, yields more than adequate attenuation of the beam outside the desired field (about 1.3 percent of primary beam is transmitted 6 cm outside a 10 x 10 cm field, by measurement) and at the same time permits the over-all size of the collimator to be conveniently small. The last collimating edge on the collimator alone is 25 cm from the source, or 25 cm from the skin when using a 60 cm SSD. Additional mechanical structure extends beyond this for 2 cms, so the distance from the bottom of the collimator to the source is 27 cm. When the collimator adjusting knob is turned, all of the lead plates and extenders move as if they were pivoted about the corresponding edges of the source. In this way all of the plates and extender bars act to define the beam regardless of field size, and a very small over-all size is achieved, particularly for small fields. The C3M/80 has a collimator extender consisting of collimator-driven tungsten bars which are calibrated to give field sizes at 60, 70, and 80 cm. The first set of bars are exactly 40 cm from the source at their outermost end. The bars are 42 cm from the source.

The compression cones (optional equipment on C4M/60 for 40 SSD) are made slightly larger than the total field, including penumbra, to avoid electron scattering from them. For the same reason, the compression cones are made with open ends. Note that the compression cones provide no radiation protection and do not act to define the beam. Each cone has four indexing holes which engage the dimples on the collimator covers. It is impossible to mount a cone unless the field size adjusting knobs have first been set to the field dimensions corresponding to that particular cone. These cones cannot be used with extender in place. Figure 12 shows the optical back pointer which gives the alignment of the exit beam. The scales on the collimator or collimator extender should be used to set the field size, rather than the field size illustrator, even though the latter gives an accurate representation of the radiation field without decreasing field illumination.

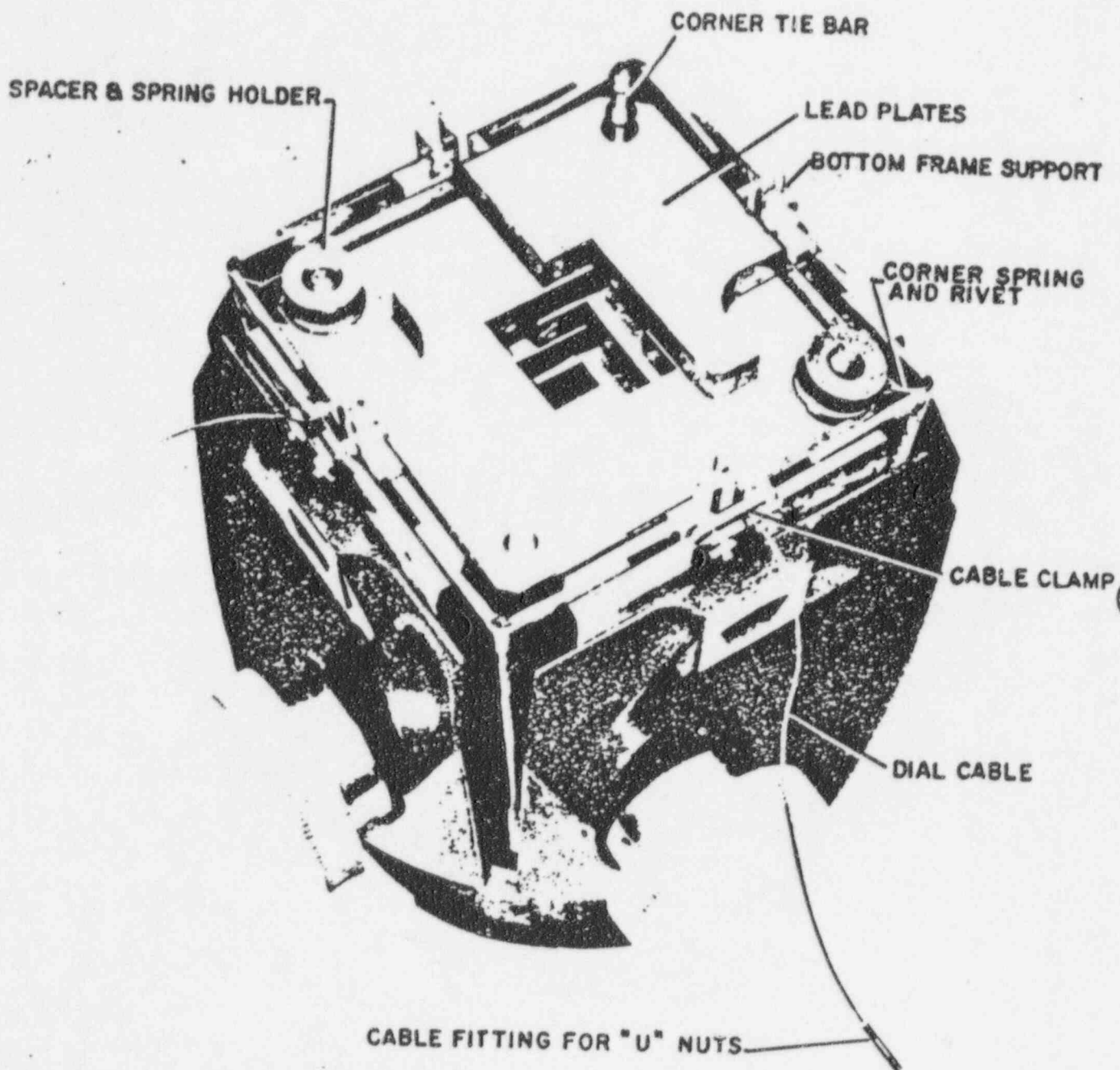




T55-425

7X-3785

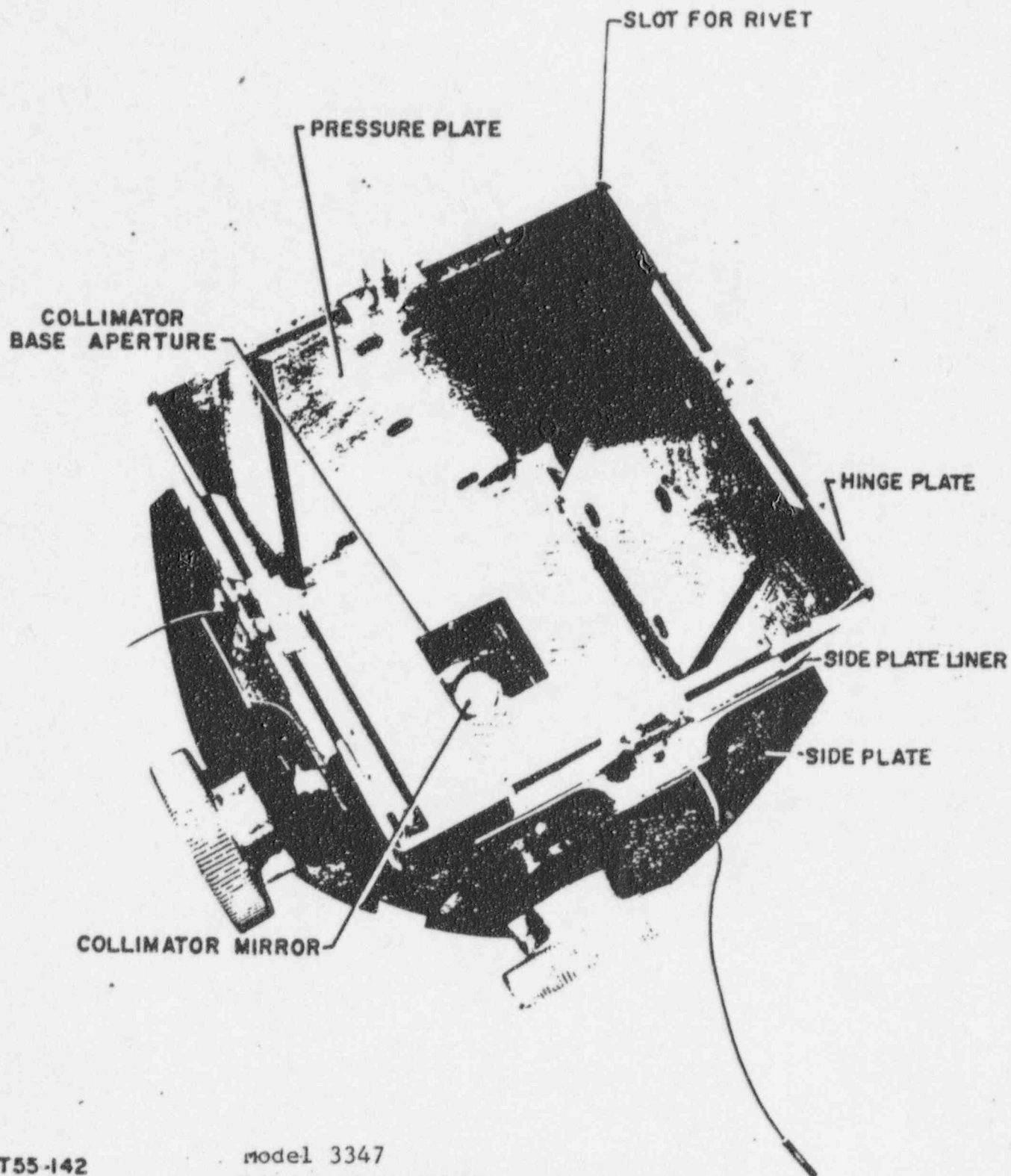
Model 3347 COLLIMATOR WITH CABLE CLAMPS  
FIG. 4A



T55-142  
T55-286

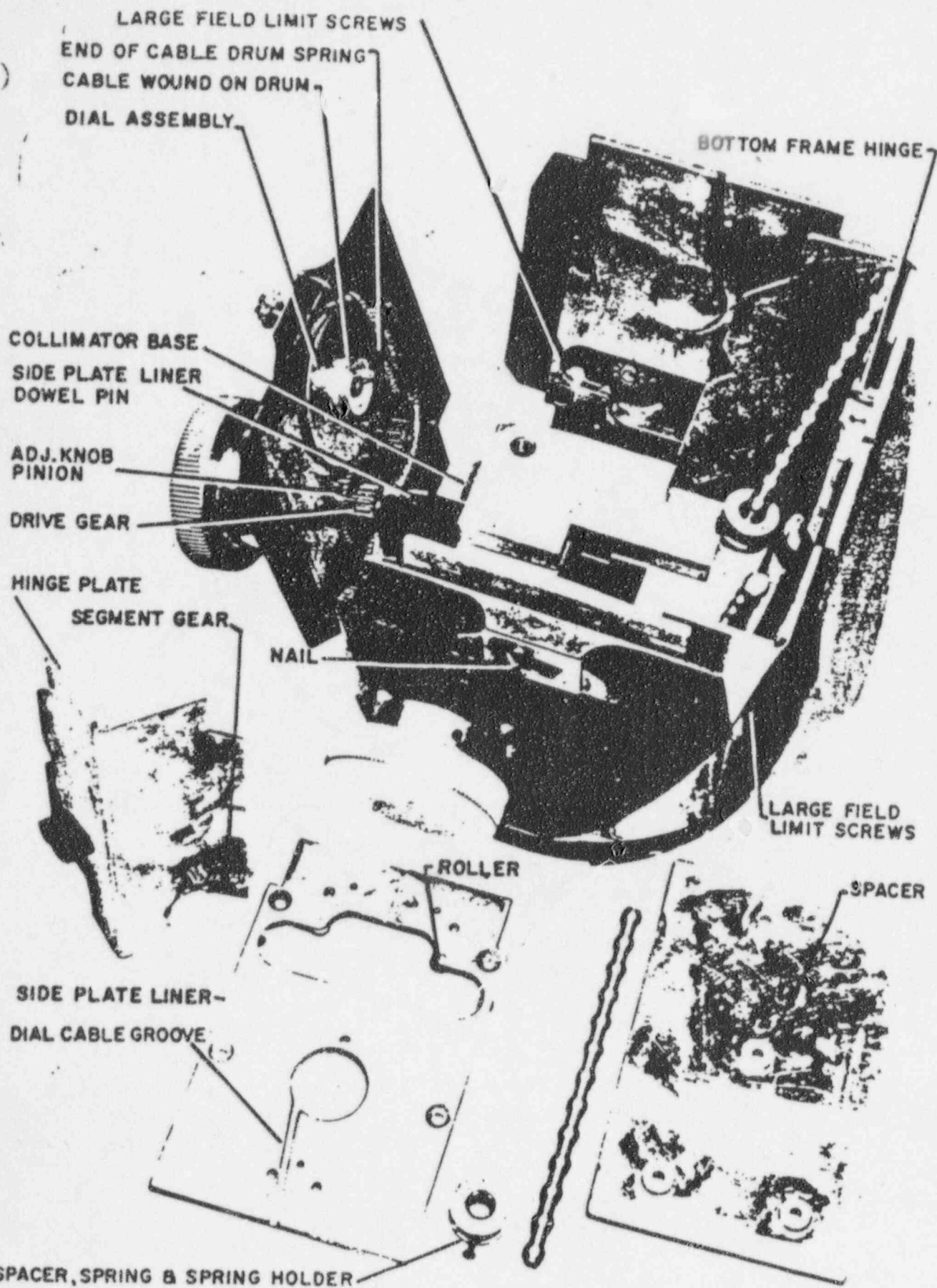
Model 3347  
COLLIMATOR - LEAD PLATES

Fig. 4B



T55-142  
T55-286

model 3347  
COLLIMATOR PARTLY ASSEMBLED  
FIG. 4C



T55-286 Model 3347 COLLIMATOR INTERNAL MECHANISM  
 T55-142 FIG. 4D



The collimator (Fig. 4E) is shown schematically in Fig. 4F. The collimation of cobalt radiation presents a difficult problem because of the penetrating power and because of the relatively large area of the face of the source. Experiment shows that a distance of 15 to 20 cm. between the last diaphragm and the skin is necessary to minimize scattered electrons in the beam, but this distance coupled with a large source usually means that a serious penumbra will be present around the beam. Furthermore, making the field size adjustable usually means that the collimator will be bulky and will interfere with proper "porting" of patients.

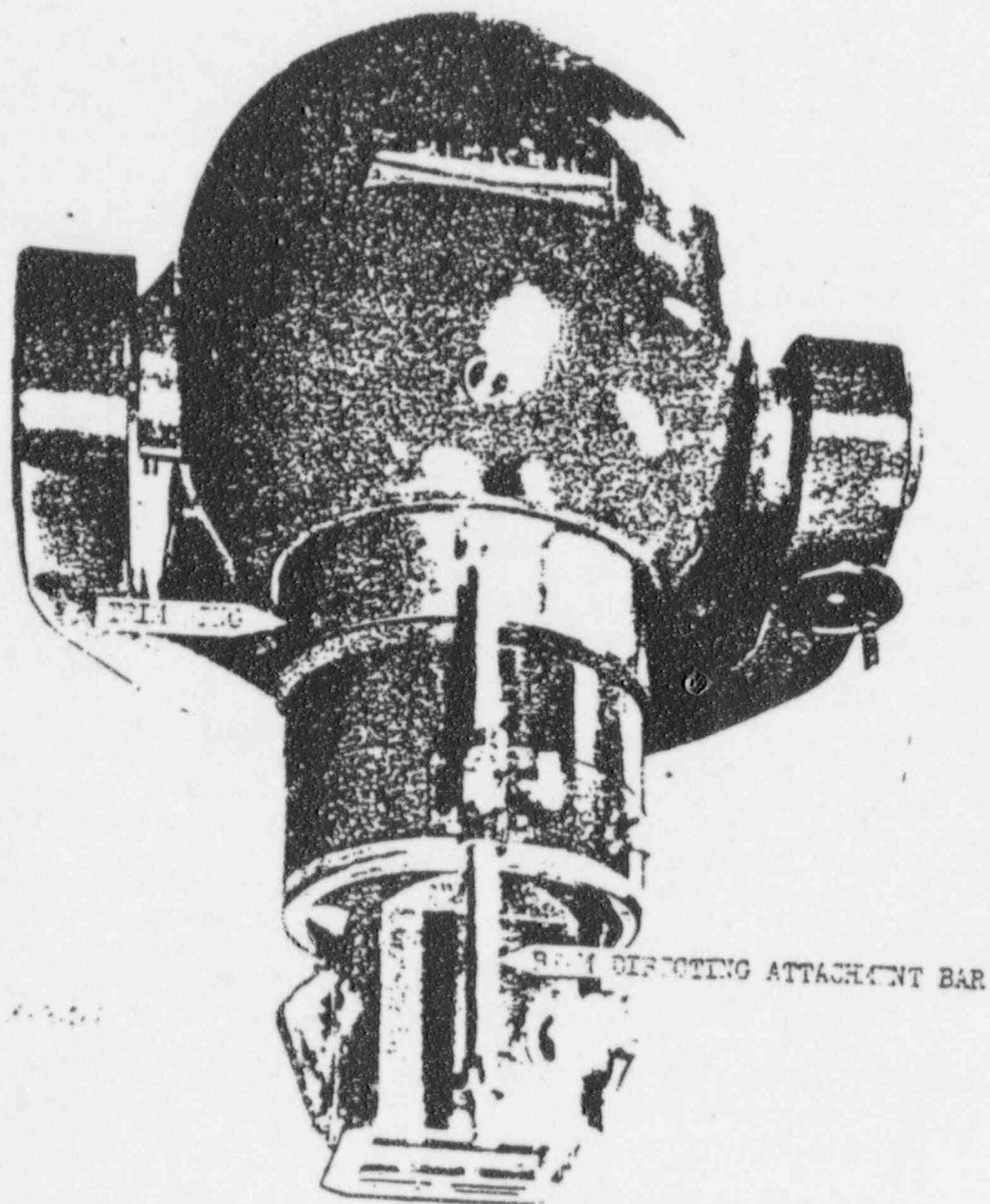
The Johns-MacKay collimator used on the Picker Cobalt-60 Unit has been so designed that it in large measure overcomes the above problems. The system of moving bar diaphragms interleaving the fixed bars yields more than adequate attenuation of the beam outside the desired field and at the same time permits the overall size of the collimator to be conveniently small.

In Fig. 4F the moving bars are shown set for a field size of 10 cm. This is a nominal field size determined by lines drawn from the center of the source through points YY, and extended to the skin surface. It is this field dimension that is marked on the field size control dials. The edges of the diaphragm bars are shaped to lie along the lines Y, Z and Y'Z', that is, lines from Y to the edges of the source. The slope of the faces of the bars actually changes midway along the thickness of each bar. On the upper half of the bars the slope corresponds to the line Y, Z when the diaphragms are set for minimum field size, and the slope of the lower half corresponds to the line Y, Z when the device is set for maximum field size.

When the field size adjusting dial is turned, all of the moving sets of bars move as if they were pivoted about the corresponding edges of the source. In this way all of the bars act to define the beam regardless of field size. Because of the finite size of the source, a small penumbra exists at the edges of the beam. The penumbra on one edge is defined by lines drawn from Z through Y' and Z' through Y' to the skin. The point Y' is 20 cm. from the skin, and the source is 80 cm. from the skin, so the width of the penumbra is  $20/80=20\%$  of the source diameter. For a 2.0 cm. source the penumbra is 0.66 cm. wide. This means the dosage rate starts to fall 0.33 cm inside the edge of the field, reaching 50% at the center of the penumbra and zero at a point 0.33 cm. outside the nominal field (neglecting scattering).

The compression cones are made slightly larger than the total field including penumbra to avoid electron scattering from them. For the same reason, the compression cones are made with open ends. Note that the compression cones provide no radiation protection and do not act to define the beam. Each cone, however, has notches in its mounting plate which engage the pins B and B' on the collimator. It is impossible to mount a cone unless the field-size adjusting knobs have first been set to the field dimensions corresponding to that particular cone.

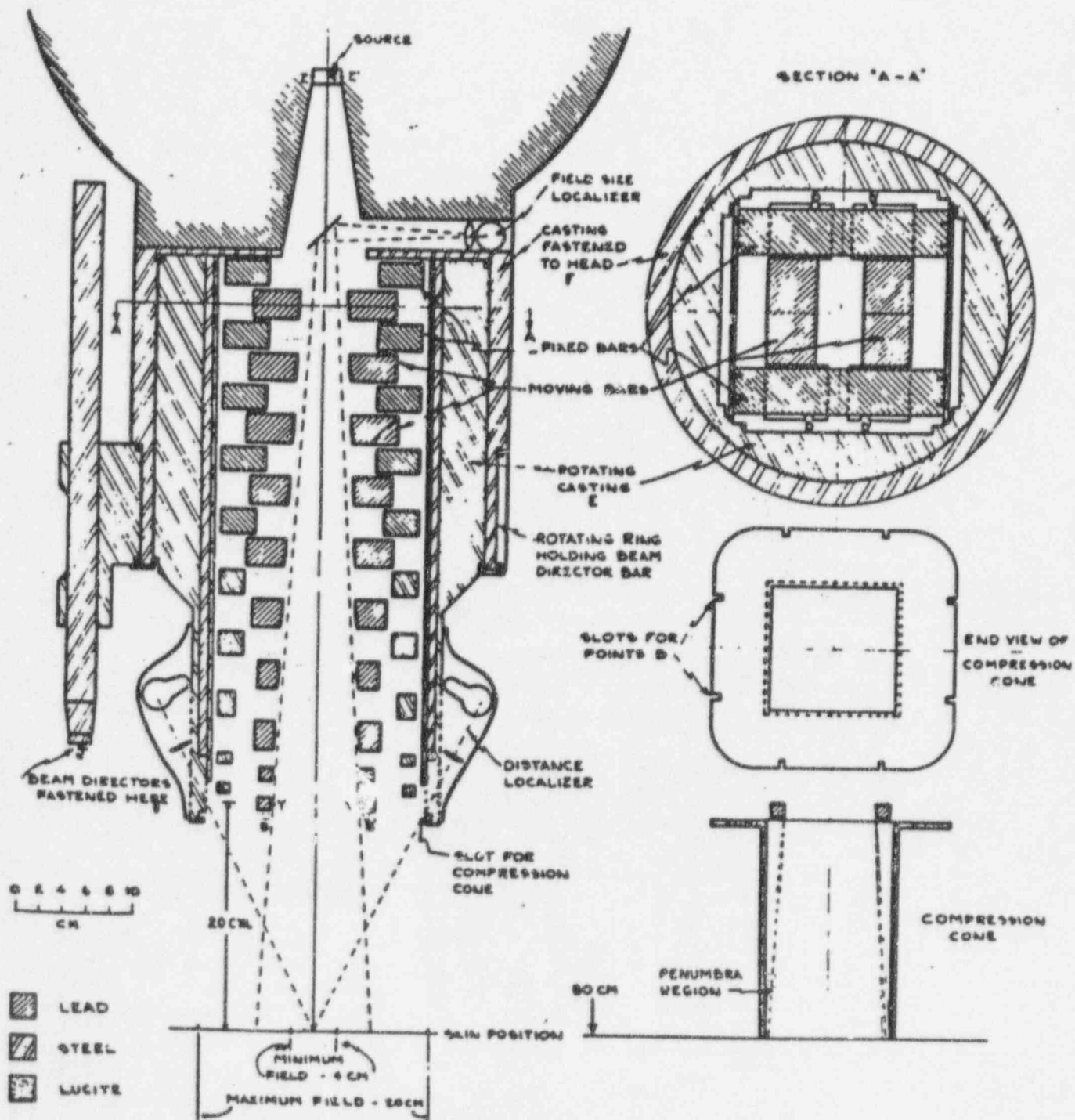
The localizer lights for field size and distance are shown in Fig. 4F and in Fig. 4G.



Model 3313 Collimator

Fig. 4E

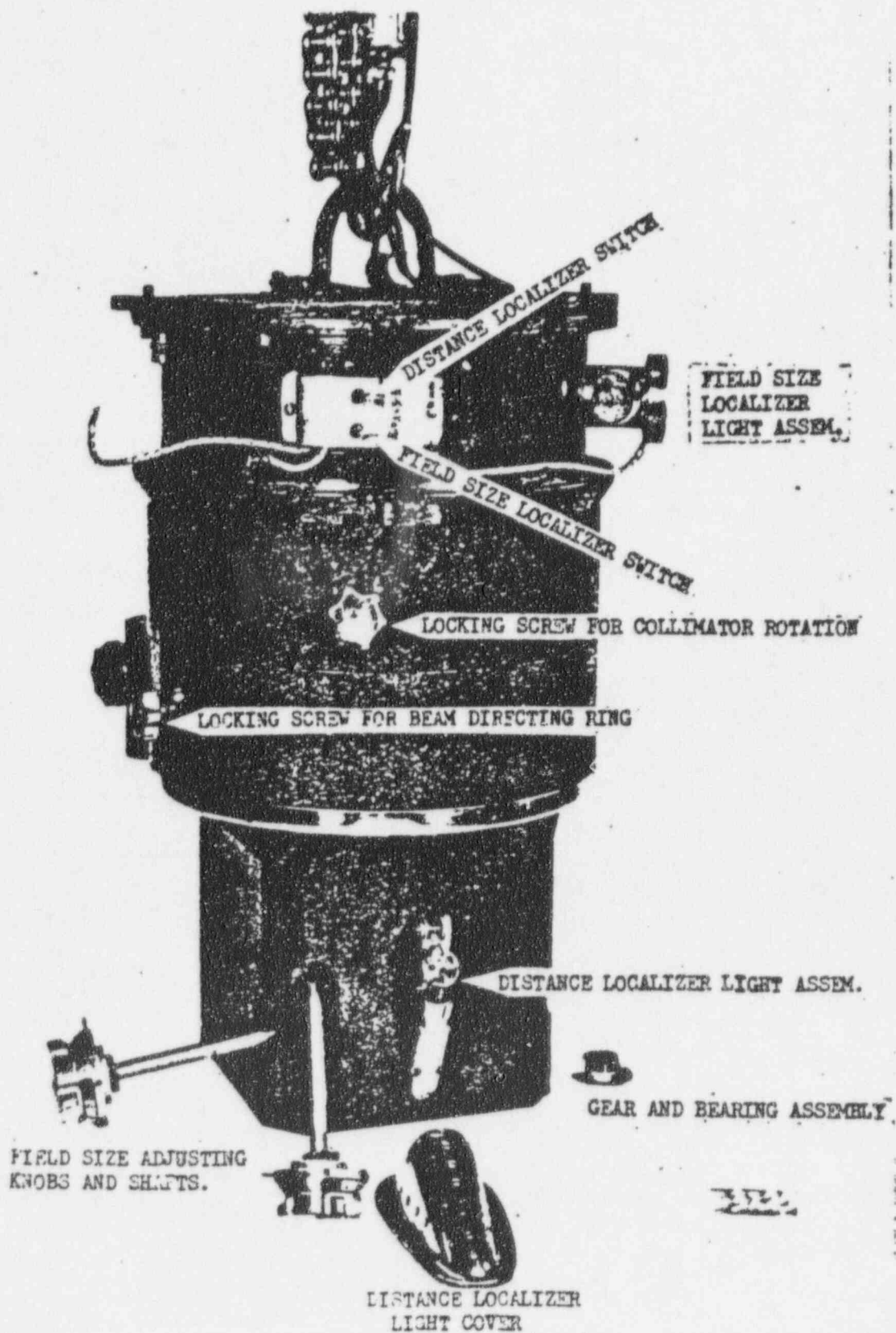




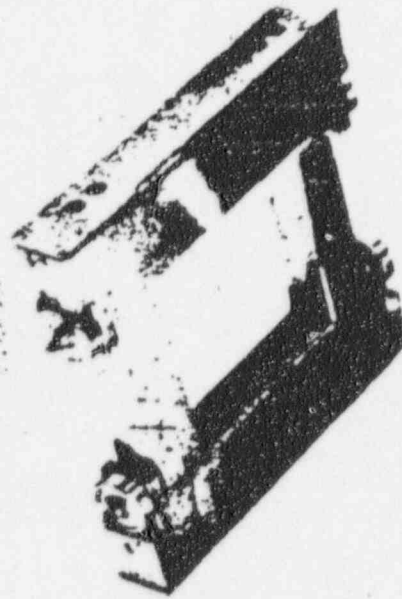
SCHEMATIC OF  
MECHANICAL CONSTRUCTION

Model 3313 Collimator

Fig. 4F

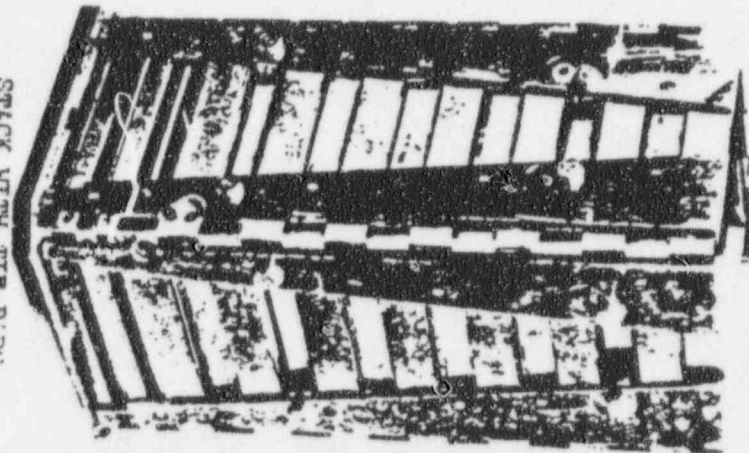


Model 3313 Collimator  
Fig. 4C

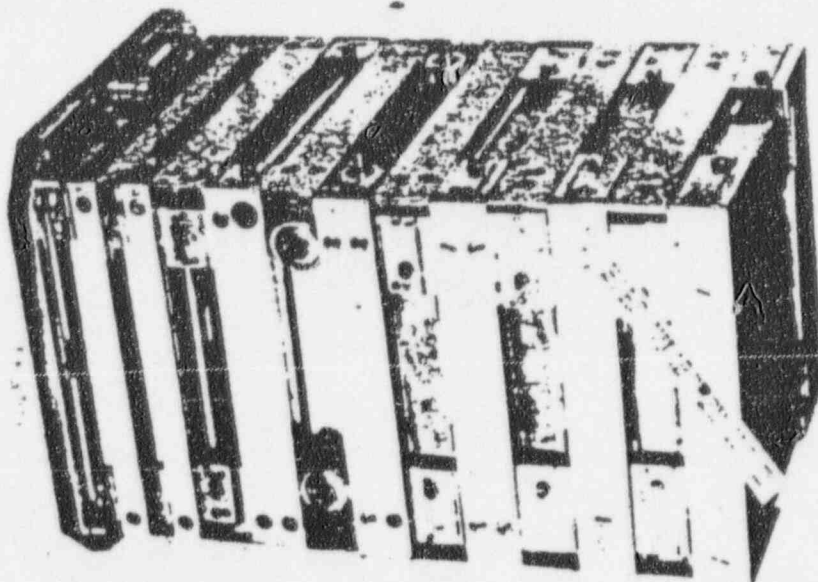


L/D FILLED BAT ASSEMBLY

PX 3227



STACK WITH TIE BARS  
IN PLACE



STACK WITH TIE BARS  
REMOVED

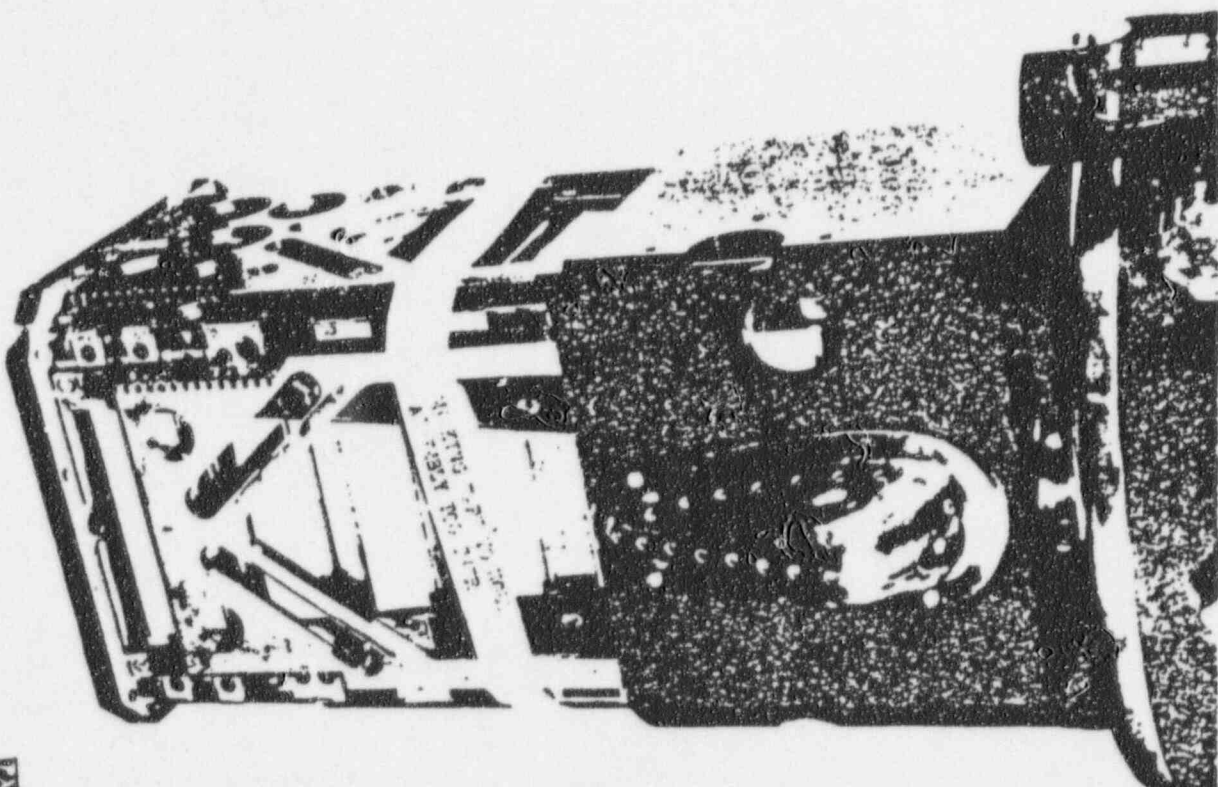


RACK PLATES



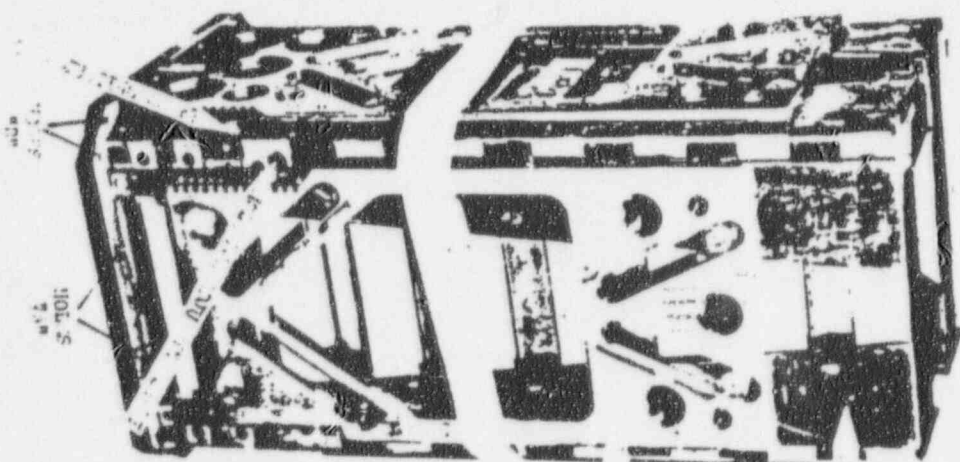
Model 3313

Fig. 4J

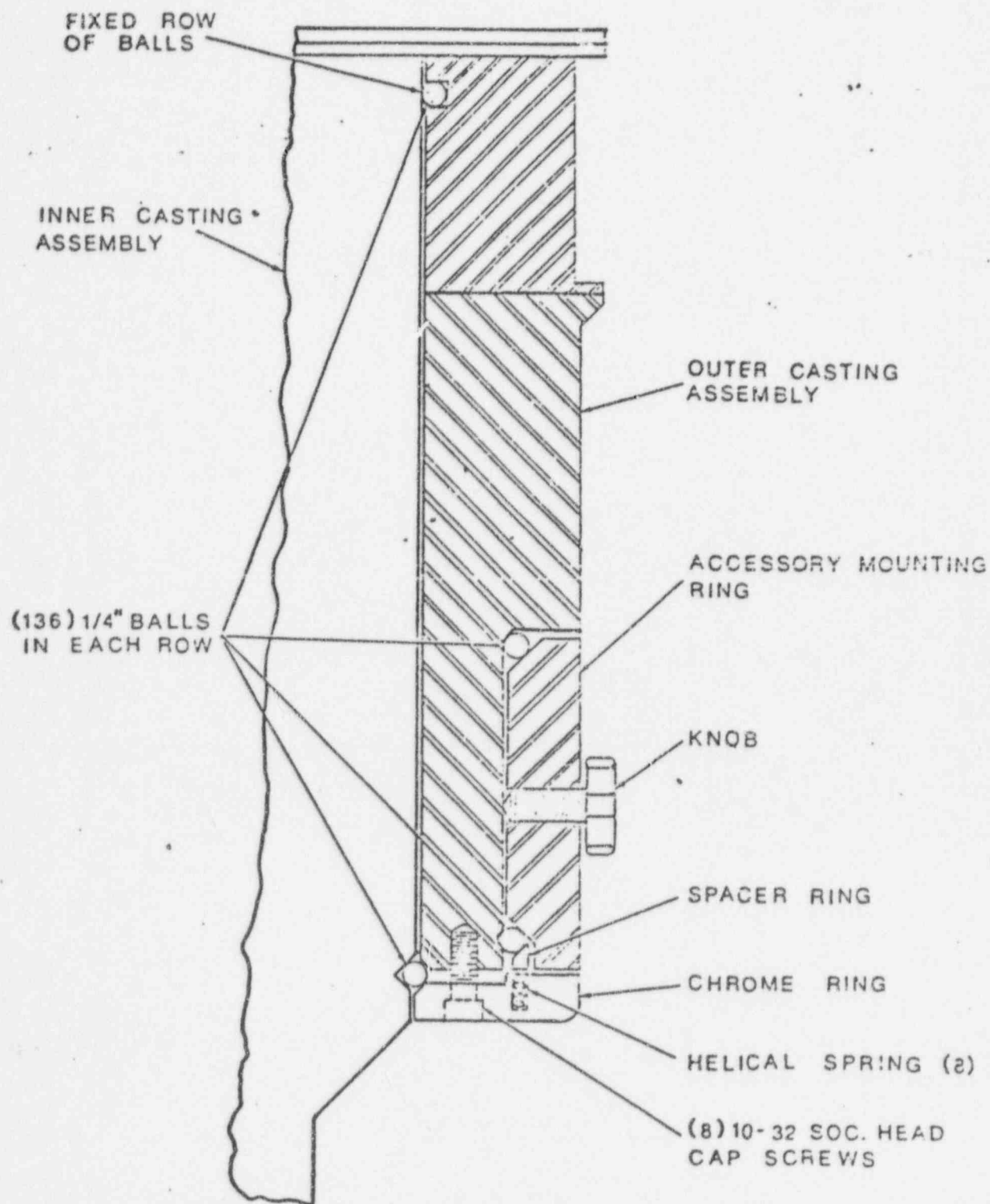


PA-3226

Model 3313 Collimator  
Fig. 4H



PA-3226



ACTUAL CONSTRUCTION OF  
 3313 SERIES COLLIMATORS



## JOHNS MCKAY COLLIMATOR

### REMOVAL OF THE INNER CASTING ASSEMBLY FROM THE OUTER CASTING ASSEMBLY

Procure a 8" pipe spacer 10" long.

1. Be sure the shutter is closed and locked in place.
2. Turn head so that the collimator points vertically downward.
3. Remove the hanger shaft covers and install the yoke rotation locking bolt. (Prevent head and yoke from flipping over.)
4. Bring a hand truck or dolly underneath the collimator and vertically position the collimator so that it is resting on the 8" dia. pipe spacer. It must be perfectly level to prevent the inner casting assembly from toppling over.
5. Lock the head tilting gear train and remove the collimator rotation lock knob.
6. Remove any accessory device that may be attached to the collimator accessory ring and lock the ring in place with the locking knob. Tape as necessary.
7. Remove the two collimator knobs and shafts by first removing the flange screws, end covers and small gears with keys and chrome cover.
8. Remove the distance indicator covers and bulbs if necessary and the copper contact on the outer casting.
9. Make alignment marks on tape between the chrome compression ring and the lower edge of the outer casting assembly.
10. Make a paper catch-all for the 1/4" balls of the assembly.
11. Carefully remove the 8 screws on the chrome ring. Tape the floating ball track ring, located above the chrome ring and the lower section of the accessory ring, into place as each screw is removed.
12. Lower the chrome ring till it is below the squared chrome base and around the 8" pipe.



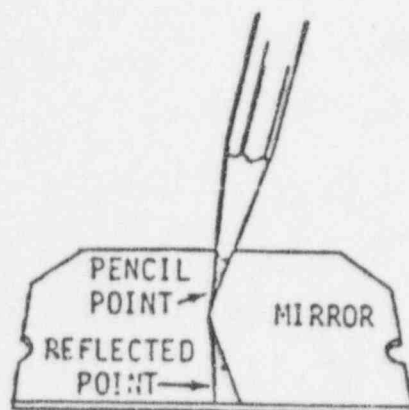
13. (2 men required) Remove the tape on the floating ring and carefully lower the ring to its lowest position. The balls will tend to fall out into the paper catch-all. There are about 136 in each V-grooved section. (Check for damage and clean - track and balls) DO NOT USE A MAGNET ON THE STEEL BALLS TO PREVENT A MAGNETIC TRANSFER ACTION.
14. Very slowly raise the outer track assembly about 1/4 to 3/8". (Another section of 136 (1/4") balls will be exposed. Allow these to fall into catch-all for inspection and cleaning.
15. (2 men required) Remove all tape from accessory ring. Firmly hold the lower edge of the accessory ring and loosen the clamping knob.
16. Lower the accessory ring, until the steel balls fall out of the upper grooves into the catch-all, and place in its lowest position.
17. Slowly raise the outer casting assembly until it clears the top of the inner casting assembly by about 2 inches.
18. Inspect, clean and lubricate the contained row of balls on the upper section of the inner casting assembly and the copper ring.
19. Inspect, clean and lubricate the lower ball grooves of the inner casting assembly and the outer surface too.
20. Inspect and clean the upper internal ball surface of the outer casting assembly.
21. Inspect and clean the floating ball track, the bearing grooves of the accessory ring and the chrome compression ring with the springs. Check the length of the springs and depth of spring holes.
22. Carefully lower the outer casting onto the inner casting until it (outer) is about 1" from being seated.
23. Install the 136 steel balls into the lower inner casting groove and then lower the outer casting until seated. (To contain the lower balls into position.)

24. (2 men required) Raise the accessory ring until it is 1/2" from its upper-most position and lock in place with tape or locking knob. Insert and position the 136 balls in place and then raise the accessory ring until seated. Lock in place and tape.
25. (2 men required) Apply grease to the floating ring and install the balance of the balls. Carefully raise the floating ring into its upper-most position and tape in place.
26. Vertically raise the chrome compression ring until it is properly aligned, and partially engage the socket head cap screws into place.
27. Remove the floating ring, tape and secure the compressing ring screws. Firmly seat.
28. Install the distance light covers and the two collimator shafts (with its gear) into place. Install the collimator rotation lock knob, the copper contact and the chrome ring.
9. Raise the collimator up off of the 8" pipe spacer, remove the yoke rotation lock bolt and partially loosen the head tilt gear mesh.
30. Check the inner casting assembly for shift by rotating the head till the collimator is aiming upward.
31. Check the rotation action of the inner casting assembly.
32. Install the accessory gear rack onto the accessory ring and check its rotation action.
33. Recalibrate the collimator field sizes and dials by adjusting the gear train to the collimator gage.
34. Readjust the distance localizer lights to focus at 80 cm from the source or 6-7/8" from the end of the collimator. Use a 4 x 4 field to center the filament images.

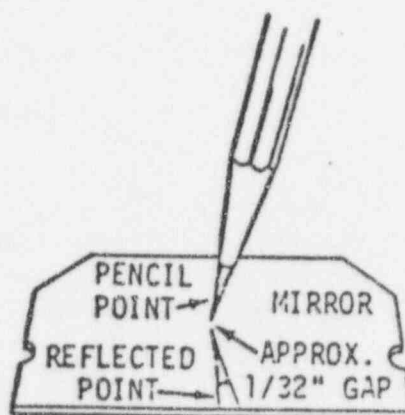
## MIRROR REPLACEMENT

When replacing a mirror (Part no. 41772) it is of the utmost importance to distinguish between the "front" and "rear" sides of the mirror. The "front" side exposed to the radiation has a hardened aluminized surface and must be positioned so it is facing toward the field lamp projection assembly. If the mirror is reversed (not installed properly) the glass becomes discolored in a short time losing its reflective ability.

To distinguish between the "front" and "rear" side of the above mirror, hold an ordinary lead pencil perpendicular to the mirror so the point is resting on the mirror surface. (See sketch below).



FRONT SIDE



REAR SIDE

If the reflected pencil point meets the pencil point without any spacing, this is the front side of the mirror. If a space exists of approximately 1/32-of an inch between the reflected point and the pencil point, this indicates the rear. Discolored mirrors will cause a reduction in the intensity of the illuminated field and can be corrected by reversing the mirror.

INSTRUCTION MANUAL

MULTIVANE COLLIMATOR FOR COBALT<sup>60</sup> WITH  
BEAM DIRECTING DEVICES

## TO ASSEMBLE COLLIMATOR

Procure a piece of 8" pipe about 6 to 8" long with both ends faced square. Cover one end with paper or some material that will not mar the finish on the end plate. Place pipe in convenient place under a chain hoist or if the castings of the collimator are attached to the Cobalt machine, place in a position that the castings can be let down vertically using the vertical travel of the machine. Check pipe for level and shim bottom if any rocking is present.

Center the end plate on pipe with the catch spring up and in the position indicated. The corners of end plate should be clear of pipe to allow room to assemble corner screws. Install the two cross wires onto end plate.

Start assembling lead filled bar assemblies. An O will be found on corner of end plate which should match up with the No. 1 on the first assembly. Center assembly as accurately as possible on end plate. The large end of taper on the movable lead bars should face the end plate on all the assemblies.

Continue placing No. 2 and No. 3 etc. on top of each other.

Make sure all numbers are right side up and appear at the corner indicated. When the 18 assemblies are stacked on top of each other, try moving the movable bars one at a time by holding opposite ends. They should all be free. If any stick, find and remove the cause. It may be a nick or some foreign material on the guide bars. Oil the outside surfaces of the guide bars and the sliding surfaces with a thin film of special oil. CAUTION: Do not use regular oils on any of the inner bars or bearings which are exposed to radiation. The intense radiation will oxidize and gum ordinary oil. Use only Teresso 43 by Standard Oil or Socony #V:77 Oil, which will not creep, oxidize or gum.

Assemble the 8 tie bars. 8 letters are stamped on the end plate which should match with the letters on the tie bars. Note the relative position of the indentation on one edge. Make sure the tie bar is correctly oriented.

Assemble bearing to shafts protruding through tie bars, making sure that the bearings are on all the way.

Assemble rack plates on bearings. The letters on the end plate should match with the letters on the rack plates. Carefully push all rack plates all the way down. Tie a wire around the whole assembly to hold it together.

Shows the correct position of the outer castings with respect to the inner assemblies. Note relative position of holes.

Shows the correct position of the castings and the inside assemblies. Note relative position of holes. Position casting vertically and directly over inside assembly.

Carefully lower outer casting making sure that the square formed by the lead bar assemblies slips in the corner groove of the casting. Continue to lower till casting comes within  $\frac{1}{4}$ " of the rack plates.

Raise rack plates and insert them in the grooves in the castings. Push them up as far as they will go taking care that opposite plates are moved up together. This will close the lead bars to the 4 X 4 Field size.

Continue lowering casting holding up rack plates with two hands. Rack plates may stick. A slight movement on the bottom will line them up. Watch that one rack plate does not move down and its mate on the opposite side stay up. This will jam the movable bars and may seriously damage them.

Continue lowering casting. When rack plates disappear into casting, hold tie bars closed with two fingers till casting reaches end plate.

Assemble end plate to casting by inserting two 8/32 X 3/4 Fillister head screws in each corner.

Push each pairs of rack plates up as far as they will go, making sure they both move at the same time. Use two screw drivers. They should not be tight.

Select gear assembly for "A". It is the one with the tops of the number closest the knob of the dial. Remove gear from the end of this assembly. Insert it in hole "A" and the corresponding dial assembly in "B". Place the corner block "C" between the dials and assemble both dials with 6/32 round head screws, making sure the screws are less than 3/8" long. Insert gears as indicated by the hand showing. Make sure both rack plates are all the way up and that key in shaft enters keyway in gear. Then add the two bearings. Turn dials. They should move easily with a torque of about two to 3 in lbs. Play between the rack plate and the gears may be adjusted by loosening the three screws for each bearing.

Remove screw and washer on the end of the dial assembly. Remove knob. Loosen three clamping screws for the dial. Adjust angular position of dial so that there is the same amount of overtravel past 4 in the closed position and past 20 in the open position. Tighten 3 clamping screws and put the knob settings back on. Field sizes will now correspond to dial settings. Insert cellophane dust cover in the slot provided in the end plate if this has not been done before. (Not used on later units.)

### Beam Directing Devices

1. Back Pointer The back pointer should be correctly adjusted. If the ring R is rotated, the line defined by the back pointer should remain on the axis of the Unit at all times. If this is not so the necessary adjustments are obvious. These are three of them.

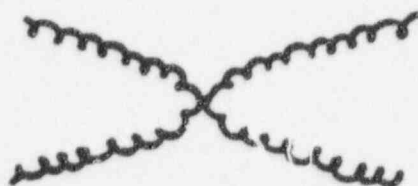
2. Compression Indicator This should require no adjustment but some is provided on the position of the index on the attachment rack bar. Pull out catch C and pull compression rod R out until catch C falls into a groove. Now turn the rack dial until the end of compression rod R is 80 cm from the source or 6-7/8" from the end of the collimator. Move the index until it is opposite zero. The compression rod is now adjusted. There is a scratch on the attachment rack bar where the zero of your scale should go.



## Light Localizers

Two switches are provided. Switch A turns on the distance localizers. It is an "on" & "off" switch. Switch B is a spring switch and is on only when held on. It controls the field size localizer and is normally required on only when "setting up" the patient. The distance localizer which also marks the centre of the field may be left on continuously and watched from the control room. Both localizers should be excited with a 5 volt 10 amp transformer. 5 Volts gives sufficient light although both bulbs are designed to run off 6 - 8 Volts. With 6 - 8 volts the life of the bulbs is short (50 hours). Clinical experience shows that 5 Volts is sufficient.

Distance Localizers - Uses two 21 c.p. bulbs Eveready #1129. They are focussed at a point 80 cm from the source or 6-7/8" from the end of the collimator. In this position the tips of the two filaments should be made to touch as indicated.



To adjust bulbs, remove cover plates. By loosening two screws the required number of adjustments can be made. Adjustments of this kind will be required whenever a new bulb is installed as no two are exactly identical. Select a bulb with the plane of the ring at the end of the V of the filament in the same plane as the V filament. To centre marker use a 4 X 4 field outlined by field size localizer. The tips of the filaments can be centered in this field by inspection.

Field Size Localizer - This uses 50 c.p. Eveready 1183. Use 5 Volts.

To get at the field size localizer remove cover plate (Fig. 17). The optical system for the light localizer can be removed by loosening two screws. Ground the device to light the filament. The focussed image should appear as two images of the filament one from the filament and a less intense inverted one from the spherical mirror. These should be super-imposed as indicated. If such an image is not obtained loosen the screws holding the bulb and move it slightly until such an image is obtained.



If the image from the mirror is larger than the direct image, move the lamp away from the mirror. The mirror need not be adjusted. Now move the lamp side ways until the images are superimposed correctly. The plane mirror in the X-ray beam is set correctly at 45 degrees and normally need not be adjusted. If required the mirror may be removed as follows: Set field size to 20 X 20. Remove field size light localizer. Remove dust cover. Now with a bar, loosen the slotted nut through the hole from which the light localizer was removed and reach away up inside the collimator and remove the mirror assembly.

#### Pin and Arc

This is set and should require no adjustment. Test setting as follows: Fasten Pin and Arc to attachment rack bar. Rotate Cobalt Unit until Collimator is pointing horizontally. Make this adjustment with a level. Rotate ring R (Fig. 17) until plane of arc is approximately vertical. Now move rider on arc until level on the rider shows zero. This means pin is at right angles to collimator. Check the line of the pin to see if it passes through the axis of the collimator. If it does not, loosen clamping screws S and adjust. Before tightening screws S retract attachment rack bar until it reads zero. Now slide "pin and arc" device in clamp S until pin is 6-7/8" from end of collimator. Tighten S. Now set the 90 degree of your arc scale under the index. Some adjustment is provided for this index. Adjust the pin so its end is on the axis of the beam. Place your scale in the pin and adjust the zero opposite index. A slight adjustment is provided for this index. All adjustments are now made.

#### Summary

1. The position of the rack bar scale index is determined from the compression rod.
2. The arc angular scale is adjusted by making the pin perpendicular to the axis and setting 90 degrees under the index.
3. The "pin and arc" is moved parallel to the axis screws S until the adjustment is correct.
4. The vertical scale in the pin and arc is adjusted to read zero when end of pin is on axis. The end of pin should stay on the axis as the rider moves over the arc when the pin is set at zero.

## 3347 COLLIMATOR

### 3347 COLLIMATOR INSTALLATION

- 1 To attach the collimator, rotate the teletherapy unit (help will be needed) so that the head is in an upside-down position which in effect put the counterweight or barrier up in the air. Watch head, yoke and skid clearance on C&M/80. Brace or tie the hanger securely, since it will be top-heavy when the head skid is removed and there will be a strong tendency for the barrier end to swing to the bottom. REMOVE THE HEAD SKID ONLY AFTER THE HANGER HAS BEEN SECURELY BRACED OR BOUND TO PREVENT ANY ROTATION. LIFT SKID STRAIGHT UP CAREFULLY; WEIGHT 280 POUNDS. As soon as the skid is removed it will mean that shielding built into the skid no longer be there. Radiation from the bottom of the head will be unusually high until the collimator is installed. Do not stay in the path of the head bottom recess. The radiation port at the bottom of the head has been sealed with tape at the factory to exclude dirt, and so forth. REMOVE THIS TAPE AND BE EXTREMELY CAREFUL NOT TO GET ANY CHIPS OR DIRT INTO THIS PORT. The collimator bearing is bolted to the head with the socket head cap screws by rotating so that the notch in the painted ring exposes one bolt hole at a time.
- 2 The collimator, collimator bearing ring and collimator light will be shipped as a single factory aligned assembly. This assembly weighs 250 pounds which means that three or four men will be required to lift it up and place it into position, or else a sling-boom portable crane will be required. BE SURE THE BOTTOM IS CLEARED. The collimator and bearing ring is to be carefully placed into the head recess with the lead wire on the ring centered within the milled slot at the rear of the head. Be careful of all wires during this operation. To install bearing ring bolts, rotate the collimator until collimator light chrome cup is in line with milled slot. Carefully loosen central screw and gently remove collimator field light and lay down in safe place. Rotate collimator to line up bolt loading slot with mounting holes. All bolts must be seated all the way at each position before moving on to the next. When all bolts are tight, repeat tightening all around and then carefully re-install pre-aligned collimator field light assembly. Remove collimator service wrench. Store it and mounting screws in the base of the machine if needed for further service.
- 3 An alternate way of installing the collimator is to separate the collimator from the bearing ring and install the bearing ring first and then the collimator back into the bearing ring. This will reduce the weights lifted to 150 pounds for the collimator and about 100 pounds for the bearing ring. The collimator can be removed by backing out the four set screws and locking set screws located down in the 45 degree conical area of the bearing ring. The collimator field light also has to be removed. Install the bearing ring as in 2 by loading and completely fastening one screw at a time. Stay out of the way of the recessed area at the bottom of the head because of excess temporary radiation.

After re-installing collimator tighten set screws and lock screws but be sure that collimator light is in position and installed first. Make sure collimator is clean on the bottom. Make rough adjustment of yoke drive.

The four-handled wrench and the fiber cable clamps should be stored and saved as collimator servicing tools.

If for any reason the collimator stainless covers have to be removed, always be sure to first open the collimator all the way and then fasten the cable clamps to the cables

at the side of the collimator openings where the cables go to the dials. Then remove covers, otherwise the cables may be pulled into the side plate holes requiring dismantling of collimator. Note that two of the four covers marked with a number "2" have right angle legs which are  $3/64$  longer than the others. These two covers are fastened to the slotted cable guides LAST and should be fastened to the two cable guides that stick out a little further than the other two.

Note that removing the very heavy collimator produces a serious unbalance of the head about its center of rotation as well as a serious unbalance between the head and the barrier or counterweight, whichever the case may be. It is imperative that whenever the collimator needs to be removed, the head and hanger are so positioned that the head is at its lowest position and the the collimator is pointed straight up. The hanger should be locked in this position and braced against rotation.

With the collimator attached, the head is now balanced. The head tilting brake screws are adjusted to provide the proper friction to get smooth and jerk-free motion of the head when tilted with the hand wheel.

## COLLIMATOR REPAIR AND SERVICE

### a. Lubrication

Collimators have a teflon lining on one side of the lead plates. This eliminates the need to lubricate the plates. The bottom frame may still require lubrication after about one year of service. This is readily done by removing bottom covers and brushing Lubri-Plate onto the sliding rods with the collimator fully open as in Figure 4A. If the collimator gets too loose it may be necessary to spring the rods out of alignment in order to add friction.

### b. Replacement of Lead Plates, Bottom Frame Assembly, Spring and Spacer Assembly

Removal of the plates is accomplished by revolving the head so that collimator points up. The bottom frame cover pieces are removed, at which stage the collimator will look like Figure 4A. Note: There are eight plates which have flat head screw heads showing on their inner edges. These are the tungsten-edged plates and should go in last. The dial cables must be clamped on as shown in Figure 4B. The four roll pins which hold in the bottom frame are then removed by pushing out with one inch long 10-32 screw and a pair of slip-joint pliers (do not hammer them out or you may damage the machine.) Then the bottom frame is lifted off (do not let it fall apart). The two exposed spacers and spring holders with attached springs are then pulled out, and the bottom two plates removed, then the next two exposed spacers and springs. Now close collimator almost completely, holding down on stack of lead plates to prevent them from buckling. Pull on exposed ends of corner tie bars (Figure 4B) wiggling as you pull, and holding down on stack of lead plates to prevent them from lifting and jamming in that corner where you are pulling. When the four tie bars are removed, open collimator wide and pick out the lead plates and spacers. Clean them carefully, inspect for wear and damage, replace any damaged parts. The teflon coating will become crazed due to radiation, especially near the source end of the collimator. This is normal and does not effect collimator operation. Check tightness of hexagon socket flathead screws that hold on pressure plates, (Figure 4C).

Now slip in four spacer and spring assemblies, one in each corner, two above the plates you just put in, and two flush with them. The heads of the rivets to which the springs are hooked must slide into the dovetail slots in the corners. (Figure 4-A,B,C). Make sure the plates are laid in with the covered corners down, so that when the collimator is open, the corner of the lead plate bearing against the pressure plate is covered not exposed.

Drop in the next pair of plates so that the rounded cutout in the corner clears the spacers on top of the last two plates (see Figure 4D) and making sure the covered corner is down as before. Add two spacers on top of this pair of plates, lubricate, and continue in this manner, adding the four pairs of tungsten-edged plates last. Keep plates pushed out into the frame corners as they are stacked in. Now close collimator carefully (do not force it if it jams — something must be caught that shouldn't be if it sticks) moving both sides at once, until fully closed. Then push in the corner tie rods, lubricating them first. Slightly opening the collimator may help be allowing some clearance for wiggling the rods as they go down — wiggle them down instead of hammering or violently pushing.



Reassemble bottom frame and covers after lubricating sliding rods on bottom frame. Check setting of large field limit screws (See Figure 4D) which are accessible with a hexagon key when collimator is fully open. There are eight altogether, and each set of four (two each on opposite sides) should be adjusted so that all four are in contact with the ends of the respective gear segments (Figure 4D). This adjustment should be made with collimator pointing up, down, and sideways, with other side of field both open and closed, so that in the position where the lead plates open up the most the ends of the outer layer still overlap the ends of the layer underneath by about 1/32 inch.

Repeat for the other side of the collimator. Now close collimator completely and adjust dial cable U-shaped nuts (Figure 4A) so both dials read at 4.0 on the 55 cm SSD scale. The bottom cover opposite the dial has to be removed to make this adjustment. The 4.0 setting is done with the collimator gage clamped in the collimator plates.

Now check maximum field size again, and, if necessary, readjust limit screws so that a reading of 17.9 is obtained on the 55 cm SSD scales at the largest setting.

#### c. Replacement of Dial Cable

Dismantle as in "b", then remove pressure plate over cable to be replaced by loosening completely the five hex socket flat head screws, BUT DO NOT REMOVE THE LOWER THREE SCREWS. Underneath the pressure plate on the lower three screws are round spacers (see Figure 4D) which may fall into the gap between the side plate (Figure 4C) and the base (Figure 4D) and which are then difficult to remove. Hold your fingers against the heads of the three screws to keep them up against the holes from which you just unscrewed them, and close that side of the collimator, leaving the other side open. Tip the pressure plate in while keeping the screws in place so that the spacers are left hanging on the screws, and remove all at once the plate, three screws, and three spacers. The dial cable is now completely exposed (see Figure 4D). Remove and replace by pushing the brass ferrule on the new cable into the round hole in the cable drum, then kink cable next to ferrule so it leads out the slot to the rim of the drum, and feeds onto the circumference. Wrap cable around drum in a counterclockwise direction with each turn behind the previous one until about three turns are on the drum. Now pull cable to see if sufficient travel is remaining in spring for complete scale coverage on the dial. If not, remove one turn of the cable. Then turn dial so hole in scale shows in window of side plate and insert nail (head outside) to lock spring. Put cable clamp (Figure 4B) on cable and fasten down with adhesive tape to outside of side plate so cable lies snugly on drum and in groove of side plate liner (Figure 4D).

Reassemble pressure plate, being sure not to pinch cable with bottom frame hinge (Figure 4D) which also acts as a spacer for outer end of pressure plate. Make sure gear segments on hinge plate assemblies are properly mated with pinions on drive gear assemblies (Figure 4D) if they have come off, before completing this assembly by tightening screws holding pressure plate in position. Pull on dial cable to release the nail holding dial, remove nail, and gently release cable until cable clamp rests against side plate and bottom frame hinge and thus restrain cable. Reassemble collimator as in "b". All gears have timing marks which should be noticed and



repeated when assembling.

d. Replacement of Hinge Plate

Remove both pressure plates covering that hinge, insert new hinge plate assembly (Figure 4D). The position of the gear segments on the new hinge plate may be different than on the old one. This may necessitate retiming of the drive gear assemblies. The pinions should engage the gear assemblies. The pinions should engage the gear segments so that the hinge plates on each side of the side plate will move away from or towards the center line of the side plate by the same amount simultaneously. To do this, make a trial assembly of the new hinge plate, leaving only one of the pressure plates off. Close the collimator and observe if the inner edge of the new hinge plate is the same distance from the scribed center line on the side plate liner as the one on the other side of the side plate (Figure 4D). If it is further away, then the drive gear assembly must be rotated in such a direction as to move it in further, without moving any of the other gears. To move the right hand hinge plate in, the drive gear must move clockwise, and so forth. To do this, remove the side plate liner by removing the four hex socket flat head screws which fasten it to the side plate, then lift it off the two dowel pins at the bottom (Figure 4D). Mark the teeth of the main gear on the drive gear assembly where they mate with the other gear (or gears, depending which drive gear is to be moved), then holding position of other gears firmly, lift out drive gear enough to clear and rotate one tooth in the direction you wish to move it, and slip back into engagement. It should have moved one tooth in the same direction on each gear with which it mates — check by means of the marks you made. (NOTE: The position of the adjusting knob pinion is immaterial). Reassemble side plate liner and hinge plates, and check position of the two hinge plates as before. If more adjustment is needed, repeat. When the adjustment is as close as possible to correct, reassemble that pressure plate and remove pressure plate over other leg of the new hinge plate and repeat the procedure. When timing is complete, reassemble collimator.

e. Replacement of Side Plate Assembly - Licensed Work

The collimator must be removed to do this. When it is removed, unscrew the four flat head screws which hold the cadmium plated steel ring to the base, and remove the steel ring from the tungsten base. This sleeve is a snug fit on the collimator base, and if it becomes slightly cocked, will be very difficult to remove. If it is done carefully it should not be too difficult.

When the sleeve is removed, take out the lead plates (see "b") and remove the pressure plate from that side of the collimator. Drive out the long 1/4 inch pin through the bottom of the side plate which engages in holes in the base casting on either side. Use a 3/16 inch rod to do this, being careful not to damage the end of the 1/4 inch pin. It may be driven out from either end. Pull out the side plate assembly and replace with the new one, being careful to engage the square rod properly with the square broached hole in the universal joint on the lower end of the side plate.

NOTE: Each side plate is different — be sure to order the correct one. A letter is stamped on them, A, B, C or D. Reinsert the hinge pin, time the gears as in "C" and reassemble.

f. Replacement of Collimator Mirror - Licensed Work

Remove collimator and turn upside down. Remove the four hex socket head cap screws in the tungsten block in source end of the base. Lift the tungsten block out of the tungsten base casting. CAUTION! DO NOT DROP THIS BLOCK, OR IT MAY CRACK! It is very expensive. Lift out the defective mirror and replace with new mirror. NOTE: Mirror must be oriented so the tilted polished surface faces the hole in which the collimator lamp is placed. Make sure the mirror is properly seated in its recess, then drop in gently the tungsten block and replace the screws. Mirror will become dull in time due to accelerated oxidation caused by irradiation. It can be repolished by a skilled jeweler without distorting the mirror surface.

#### g. General Data About Collimator

Though there will always be some backlash and "springiness" in the "feel" of the adjusting knobs, the dial system has been made so that it is independent of the adjustment system, and will always give a true indication of field size if the cable is properly adjusted. The scales should be used to set the field size rather than the field illumination, since the scales give a slightly more accurate indication of field size. The gage supplied with the collimator must be used to set the field sizes. The scales set with the collimator gage give the field size as specified by the 50 percent geometric penumbra. These sizes agree with the optical field illumination and as such are defined as the size of field that a point source would make.

The lead blocks must follow the housing as it expands. This is achieved by means of the springs pulling the spacers into the corners of the hinge plates. The spacers in turn pull on the corner tie bars which pull on the lead plates. If excessive friction is present in the stack of lead plates, they will not pull back snugly against the pressure plates when the collimator is open, and thus the field size will be distorted from that shown on the scales.

The bottom frame assembly provides an expansible platform to support the stack of lead plates when the collimator is pointing downwards, and also restrains the stack of plates from buckling outwards when the collimator is opened or closed. It must operate very freely or the collimator will be very difficult to adjust. Never turn the collimator end down when the bottom frame assembly is not attached.

The dial and cable assemblies serve two functions; they provide a means of measuring the collimator aperture independently of the adjusting mechanism, and they provide "cross hairs" so a shadow is formed showing the central axis of the beam. For this latter purpose they must be free of kinks and centered across the aperture. A gage is provided for this. Kinks should be carefully straightened out. The centering is accomplished by shifting the bottom frame hinge (Figure 4D) so that the cable lies across the center of the opening and is parallel to the side plates. The spring on the cable drum (Figure 4D) should be tight enough to keep the cables taut when the collimator is closed, but no tighter, since it adds to the effort required to open the collimator.

The hinge plates must slide freely in the space between the pressure plate and the side plate liner, yet if there is too much slack it increases the "sponginess" of the "feel" of the adjusting knob. The gear trains in the side plates should turn very freely under no load, (i.e., with lead plates

out of the collimator).

The universal shafts, with their telescoping connection through the collimator base, transfer the movement from the gear train on the side plate with the adjusting knob to the opposite side plate gear train. If the collimator drive gears and the gear segments of the hinge plates are not properly timed as marked, when the adjusting knob is turned, only one pair of hinge plates and one gear train are carrying the load of opening the collimator, and a pronounced "springy" feeling is imparted to the "feel" of the knob. In a properly adjusted collimator this will be minimized.

Since the weights of the lead plates on either side are balanced against each other in any position of the collimator, there should be no tendency of the collimator to open or close when adjusted to a given field size and then placed in a different orientation. This could happen if the dial cable spring was so strong that it could overcome the friction required to change the collimator setting, or if the collimator was improperly timed, or the connection from one side plate to the opposite through the gear train and universal shaft system was not functioning. The spring in the hinge plates could then permit an unstable condition for a particular field size setting resulting in a tendency for the field to decrease in size if the collimator was moved or jarred.

#### h. Replacing Collimator Light

- (1) Turn the power off.
- (2) Remove the halo switch assembly at the back of the head.
- (3) Rotate the collimator until the light cup appears in the switch opening. Remove the button head screw from the cup, then pull the bulb and socket assembly out of the collimator. Replace the bulb and reassemble the socket into the collimator.
- (4) Check collimator light adjustment. Use the special cross hair gage supplied with the collimator. Open the collimator side plates enough for the gage to be inserted, then retighten until the side plates grip the gage prongs on all four sides. The cross hairs should be in the exact center of the gage hole. A piece of paper placed on the floor and in the light beam will provide a clear view of the cross hair shadow.

ADJUSTMENT — Turn both adjusting screws in or out to position the bulb at the required depth in the light well. For side adjustment turn either screw separately to move the bulb as required. If more side adjustment is needed, crimp the sides of the bulb socket slightly to move the bulb in the desired direction.

#### **IMPORTANT!**

When the light is projected on the barrier the cross hairs must not move more than 1/8 inch off center during one complete revolution of the collimator.

The adjustments to the light bulb are limited by the adjusting screws and the space available for the bulb. Total adjustment for the optical projections of the cross hairs are as follows:

DISTANCE TO FIELD	SIDE ADJUSTMENT	ADJUSTMENT ALONG BULB AXIS
80 cm	1.2 cm (.472 inches)	0.47 cm (.187 inches)
60 cm	0.9 cm (.35 inches)	0.35 cm (.140 inches)

Additional adjustments can be made by tipping the mirror as required to allow the above mirror adjustments to become effective.

#### 9.0.2 OPTICAL ALIGNMENT

##### a. Collimator Field

The wire cables on the collimator which project the cross hairs onto the field must be mechanically centered on the axis of the collimator. Small variations in machining and bulb manufacture will cause the intersection of the cross hairs, when projected, to wander when the collimator is revolved. This intersection should not wander in a circle bigger than 1/8 inch in diameter at 80 cm. This can be minimized by adjusting the light bulb along its axis. This is done by turning a screwdriver in the two small holes on either side of the button head screw. Turning the screwdriver clockwise brings the bulb closer to the screwdriver and will cause the cross hairs perpendicular to the bulb to move away from the screwdriver. This adjustment has been made at the factory for the bulb in the collimator and may not have to be made even if a bulb is replaced.



b. Collimator Cross Hairs and  
Back Pointer Cross Hairs Alignment

With the hanger rotation dial reading zero degrees and the head tilting scales reading zero degrees, the cross hairs from the collimator and back pointer lamp should be nearly superimposed. If a piece of translucent white paper is held between them then both sets of cross hairs can be seen. The cross hairs from the barrier seen through the paper fade out as we move the paper toward the collimator and conversely as we move the paper toward the barrier.

It is common for the cross hairs from the barrier to be closer to the front of the machine in this position and for the collimator cross hairs to be back about 3 mm maximum from the barrier cross hairs as seen on the translucent white paper. With the barrier and head inverted, that is with the hanger rotation dial reading 180 degrees, and the head pointing toward the center of rotation the cross hairs reverse themselves with the collimator cross hairs coming forward and the barrier cross hairs moving back. This is due to natural deflections in the arms of the hanger and similar deviations occur at other positions. All deviations fall within the  $\pm 3$  millimeter range.

# SERVICE NOTE



**SUBJECT:** LOOSE BEARING RINGS OR COLLIMATORS ON COBALT UNITS  
#14188 Series Bearing Assembly and Cat. #3347 Series Collimators

**EQUIPMENT:** C-1000 (#6103), C-2000 (#6150), V-2000 (#6156)  
C-3000/55 (#6183), C-3000/75 (#6204), V-3000 (6202)  
C-4M/60 (#6223), C-8M/80 (#6234), and V4M/60 (#6235)

**PROBLEM:** Unable to maintain beam on isocenter due to shifting of bearing ring assembly or collimator. Assemblies shift as much as 1/16 inch during angulation or rotation because of loose mounting hardware or wear of the ball tracks.

**CORRECTION:** Non-licensed service personnel can inspect the #14188 series Bearing Assembly and tighten the bolts. Shutter locking bolt or bar *must be installed* before attempting the procedure. Refer to drawing of bearing ring assemblies (Fig. 1).

1. Rotate C-arm or position head so the collimator is pointing at the ceiling. (6 o'clock position on rotational units.) Turn off power and put key in pocket.
  - A. Remove halo switch assembly (if applicable) and remove field light assembly. The mounting bolts are now accessible.
  - B. Tighten the (8) 1/4-20 SHCS which attach the outer bearing ring to the head.
  - C. Remove the (4) 1/4-20 locking Allen set screws from Adaptor Ring #37846.
  - D. Tighten the (4) 1/4-20 Allen set screws which secure the collimator to the adaptor ring. Reinstall the locking set screws. Do not install field light and leave collimator pointing toward the ceiling.
2. Bearing inspection—all units. On C4, V4 and C8 units, rotate collimator until the gap between the outer bearing ring and the head adaptor ring is visible through the field light cavity. *Do not* use a metal feeler gauge. Place strips of paper into the gap until it is completely filled. Place paper in two places 180° apart. Rotate head until collimator points down. If more than .015 inch of paper can be added to the gap, contact the isotope operation to arrange for licensed personnel to repair or replace the bearing ring assembly.

**TOOLS REQUIRED:** Allen wrenches, micrometer.

**TIME REQUIRED:** Variable—depends on type of unit. Charge time to the customer.

- NOTE -

Service personnel must comply with all radiation safety regulations during service operations on cobalt therapy units. Effective September 26, 1971, violators of AEC Rules and Regulations can be fined up to \$5000 per violation. Refer to Manual T55-443.



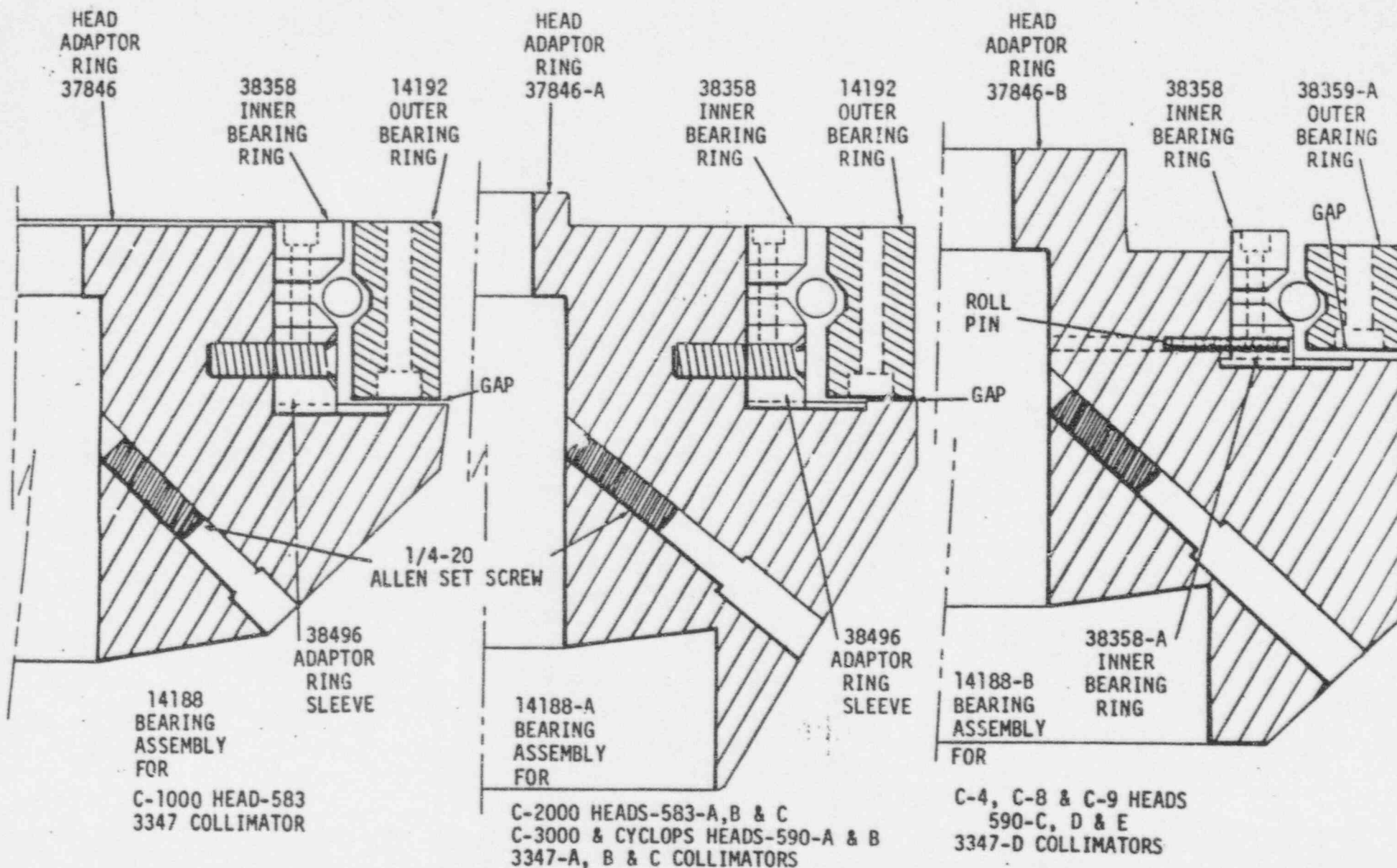


Figure 1

3347D Light Field  
Alignment Procedures

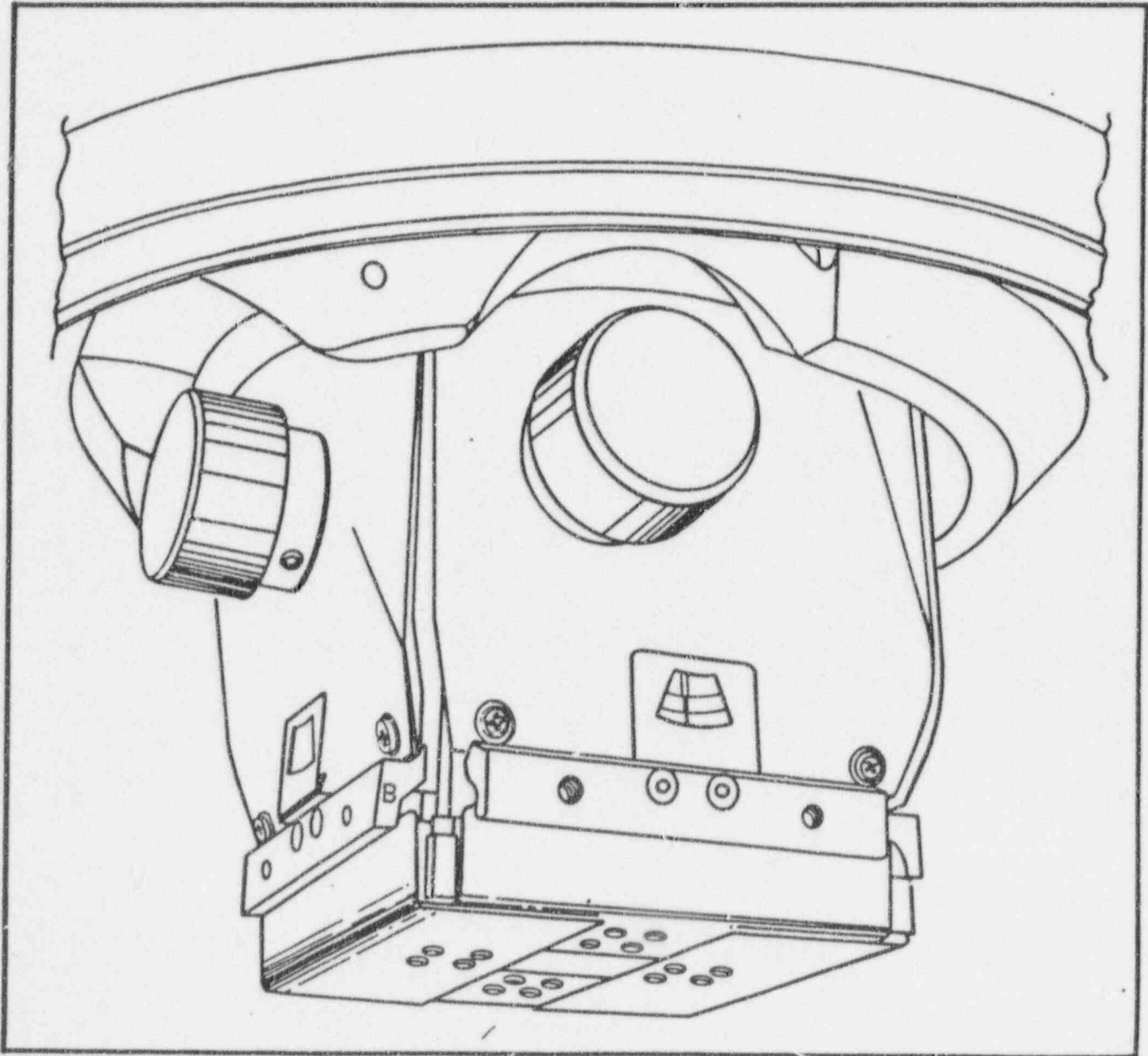
1. Remove the old mirror carefully and lay on a flat surface.
2. Lay the new mirror on top of the old mirror and check that it is flat across it. Adjust the new mirror to the same angle as the old mirror.
3. Put in the new mirror.
4. Back off the adjusting screws in the collimator lamp assembly.
5. Measure and mark a 10cm X 10cm area on a piece of paper.
6. Adjust the collimator to illuminate this 10cm X 10cm field at a source to skin distance which corresponds to the scale of the collimator which you are using.
7. Rotate the collimator 180 degrees.
8. If the field shifts bend the mirror to correct.
9. Repeat steps 6, 7, and 8 until the adjustment is very close.
10. Check dial readings versus light field. Adjust cables if off.
11. Put in the collimator aperture alignment tool with a piece of tape or paper over the outside circle.
12. Check the image on the tape and see if you have a circle with the crosshairs in the center. If not bend the cables, where they are welded to the adjusting screws, to get the centering. Work from corner to corner when adjusting.
13. Remove the alignment tool and put a dot on a piece of paper and check the run out of the crosshairs. Adjust the screws in the lamp assembly to correct. If not enough range try turning the lamp 180 degrees (or another bulb) and adjust the screws again.
14. Check the 10cm X 10cm field again.
15. Check the distance localizer and adjust if necessary.
16. Make film tests to check radiation field versus light field.

# COBALT COLLIMATOR

Cat. No. 3347D

## PARTS LIST

H106:P



PICKER CORPORATION  
MEDICAL PRODUCTS DIVISION  
595 MINER ROAD, CLEVELAND, OHIO 44143

# CONTENTS

- ① introduction
- ③ collimator  
[part no. 3347D]
- ⑤ lamp holder assembly  
[part no. 14172]
- ⑦ collimator "C" side plate  
[part no. 14175C]
- ⑦ DDS 301 - collimator "D" side plate  
[part no. 14175D]
- ⑨ collimator "E" side plate  
[part no. 14175E]
- ⑨ DDS 401 - collimator "F" side plate  
[part no. 14175F]
- ⑪ head to collimator bearing ring  
[part no. 141888]

## INTRODUCTION

### PURPOSE

This parts list was written with the intent of providing the user with a complete listing of all parts and components used in the assembly of this unit, with the exception of hardware items such as screws, nuts, bolts and washers. The contents of this manual has been so arranged as to offer maximum usability to all users. Suggestions on improving the format, and/or corrections to this manual are welcome and encouraged. Send all correspondence concerning this book to Picker Corporation, Medical Products Division, National Service Department, 595 Miner Road, Cleveland, Ohio 44143, attention Parts Listing.

### USE OF PARTS LIST (See Fig. 1)

This parts list incorporates the indenture or assembly, subassembly method of parts listing. With this method of listing indenture 1 is the primary assembly for the indicated figure, indenture 2 is either a direct part or subassembly of indenture 1, and indenture 3 is either a direct part or subassembly of indenture 2, which is a subassembly of indenture 1, etc. This system is also useful because the user knows what parts are a part of which assemblies. All indent 2 items are a part of indent 1 and will be found on the indent 1 Bill of Material. All indent 3 items are a part of the preceding indent 2 item and will be found on that indent 2 Bill of Material. All parts are identified once and only once and in their proper sequence.

### DIFFERENCE DATA SHEET

The Difference Data Sheet (DDS) is a supplement to an existing parts list and is referenced to the existing list by Figure No.

The DDS does not list any parts which are common to both units, but only those parts which are different. If the word "delete" is used then that part is not used on the unit of the DDS but is used on the referenced unit. If an item number is found on the DDS and not on the referenced parts list then that part is found on the unit of the DDS but not on the referenced unit.

### NOTE

All parts found on the parts list of the referenced unit apply to the unit of the DDS except those parts indicated on the DDS.

### ORDERING

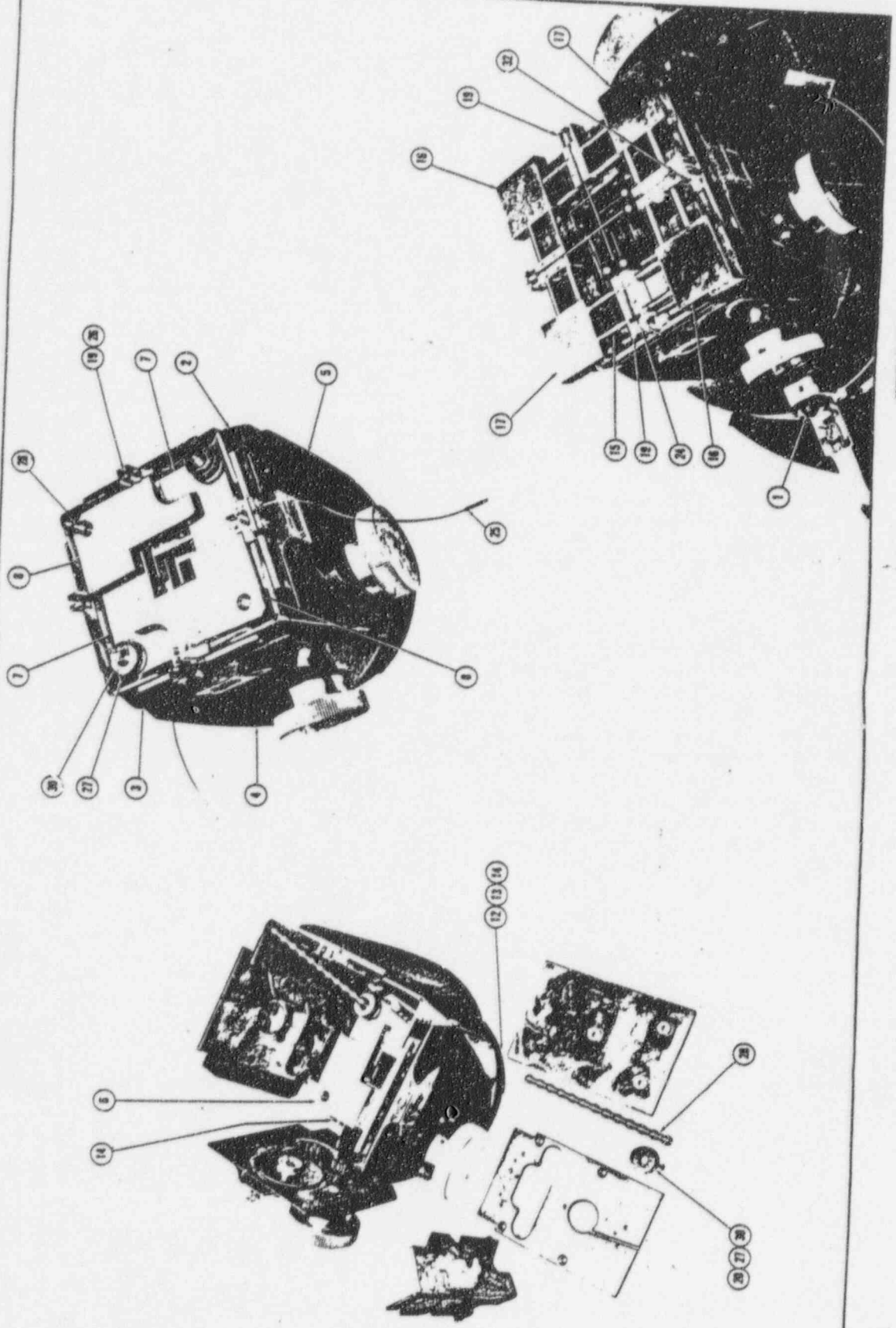
When ordering parts include the Parts List DRS No. and Date of Publication, Figure and Item No., and Part Description. If the part cannot be found in the parts list, include the Catalog Number of unit, Serial Number, and detailed description of part in question.

EXAMPLE:

FIGURE 1

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	1348L		Mobile Chassis and Tubestand	1
- 1	13559		Cover, Back	1
- 2	T7D-117		Filter, 1/2 mm	2
- 3	11337A		Indexing Plate, Tube Arm, and Locking Assembly	1
- 4	27904		Nameplate	1
- 5	37797		Plug, Tube End	2
- 6	T5-204		Spring, Front Stop	1
- 7	T54-3		"O" Ring, 1 x 1-1/4"	2
- 8	40822		Bracket, Transport	1

FIG. 1 - COLLIMATOR  
Part No. 31470



PROPERTY OF PICES CORPORATION  
April 1972



FIG. 1 - COLLIMATOR  
Part No. 3347D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	3347D		Collimator	1
1	14172		Holder Assembly, Lamp (See Fig. 2)	1
2	14175C		Plate, Side "C" - Collimator (See Fig. 3)	1
3	14175D		Plate, Side "D" - Collimator (See DOS 301)	1
4	14175E		Plate, Side "E" - Collimator (See Fig. 4)	1
5	14175F		Plate, Side "F" - Collimator (See DOS 401)	1
6	14176A		Plate, Lead without Tungsten	18
7	14176B		Plate, Lead with Tungsten	6
8	14176C		Plate, Lead with Tungsten	2
9*	14188B		Bearing, Head-to-Collimator (See Fig. 5)	1
10*	43346A		Mirror, Collimator	1
11*	43347		Base, Collimator Mirror	1
12	38281A		Aperture, Collimator Tungsten	1
13*	38298A		Sleeve, Collimator Base	1
14	38299B		Base, Collimator	1
15	38300		Rod, Guide - Bottom Frame	3
16	38302A		Corner, Bottom Frame	2
17	38302B		Corner, Bottom Frame	2
18*	38303		Rod, Square - Universal	2
19	38305		Support, Bottom Frame	2
20	38306		Holder, Spacer and Spring	15
21*	38308		Pin, Hinge - Side Plate	4
22*	38362		Cover, Bottom - 1-5/64 Lip, Farthest from Source	2
23*	38363		Cover, Bottom - 1-1/32 Lip, Closest to Source	2
24	38406		Idler, Dial Cable	2
25	38407		Nut, Dial Cable Adjust - C-750 Collimator	2
26	38408		Support, Bottom Frame	2
27	38694		Eye, Spring Retaining	2
28	38732		Bar, Corner Tie	4
29*	T2-304		Screw, Nylon Set - 10-32 x 3/8	4
30	T5-446		Spring, Spacer	15
31*	T14A-76		Pin, Roll - 3/32 x 1/2	1
32	T14A-86		Pin, Roll - 1/4 x 3/4	4
33*	T32-395		Decal, Rotation Scale	1
34*	T92-29		Nameplate, Patent Pending	1
35*	T92-176		Nameplate, Oval	1

\*Not shown.

FIG. 2 - LAMP HOLDER ASSEMBLY  
Part No. 14172

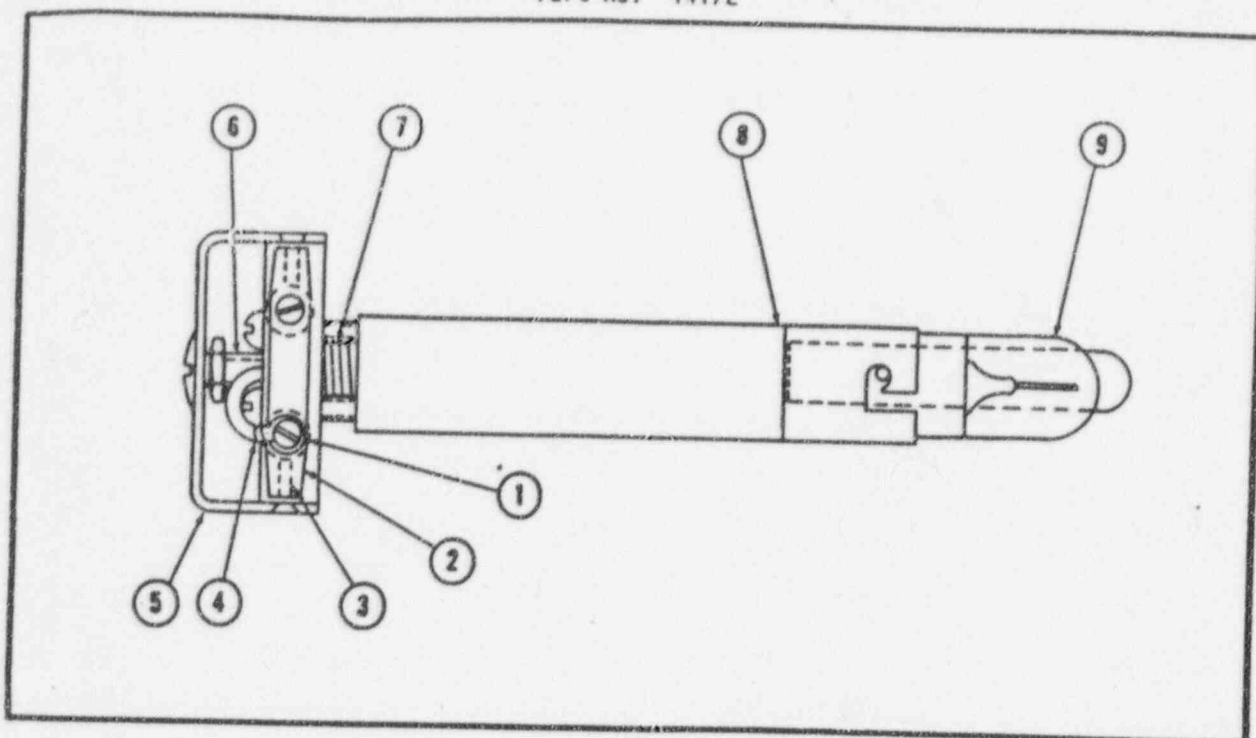
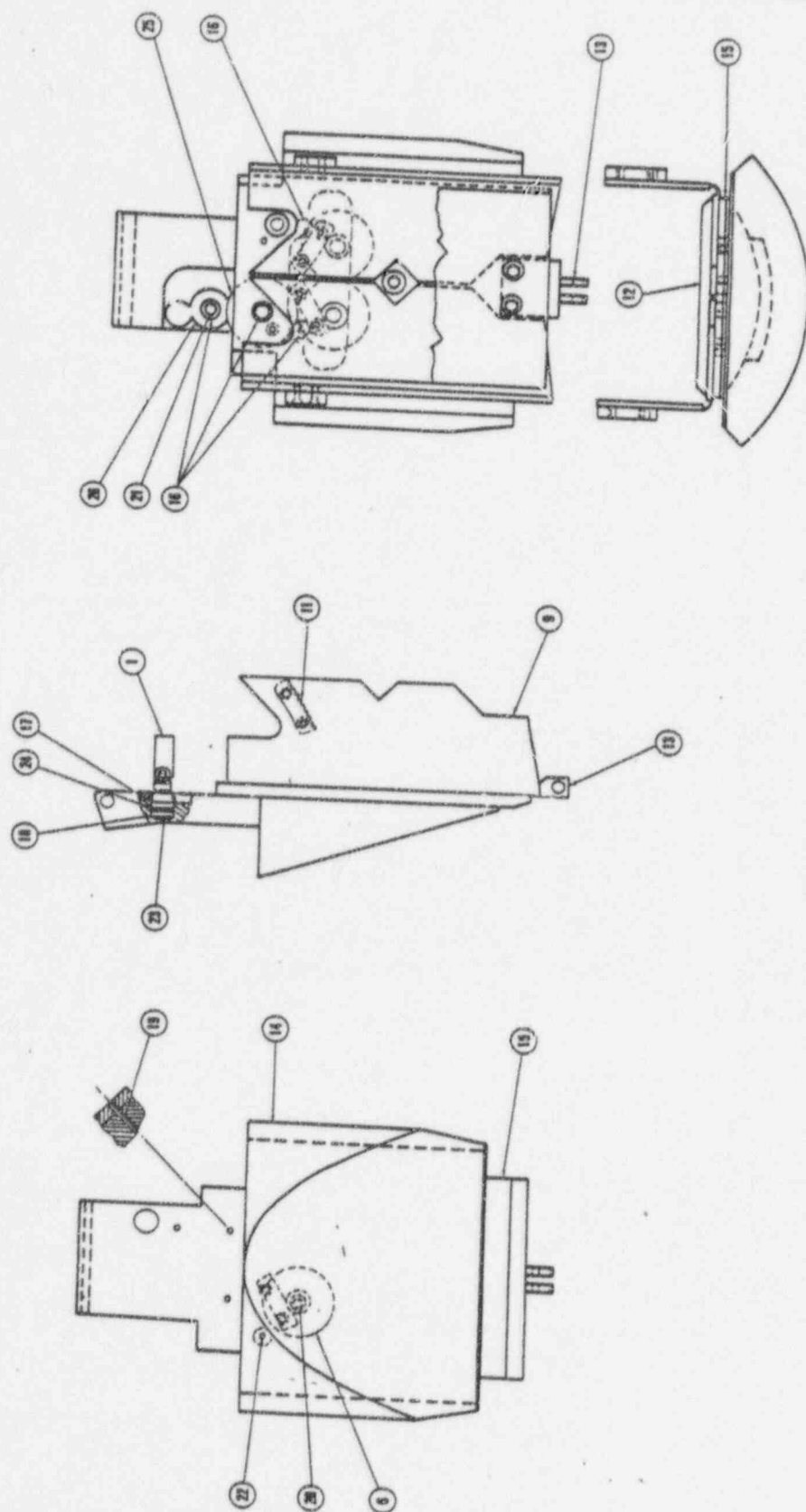


FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
2 -	14172		Holder Assembly, Lamp (See Fig. 1, Item 1)	1
1	T2A-61		Screw, Button Head - 4-36 x 3/8	2
2	38278		Holder, Brush	1
3	38280		Brush	1
4	T18-63		Lug	1
5	38279		Cover, Brush Holder	1
6	T2A-82		Screw, Button Head - 8-32 x 1	1
7	T5A-190		Spring	1
8	14171		Rod Assembly, Socket Holder - Lamp	1
9	T72-34		Bulb, G.E. 1489	1

5

FIG. 3 - COLLIMATOR "C" SIDE PLATE  
Part No. 14175C



PROPERTY OF PIERCE CORPORATION  
JAN 11 1977

FIG. 3 - COLLIMATOR "C" SIDE PLATE  
Part No. 14175C

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
3 -	14175C		Plate, Side "C" - Collimator (See Fig. 1, Item 2)	1
1	14179		Shaft Assembly, Universal	.
2	T77-94		Gear, Universal Shaft	.
3	T14A-57		Pin, Roll - 3/32 x 5/16	.
4	38321		Joint, Universal	.
5	T11-15		Washer, 3/16 x 19/32 x 3/64	1
6	14180		Gear Assembly, Drive	1
7	T77A-15		Gear	2
8	T12-176		Bearing	1
9	14276		Plate Assembly, Hinge	1
10	38691		Plate, Hinge - Collimator	2
11	38317		Rack, Curved	1
12	14558		Plate Assembly, Pressure	2
13	38309		Hinge, Bottom Frame	1
14	38094C		Plate, Side - Collimator	1
15	38312		Liner, Collimator Side Plate	1
16	T12-65		Bearing, Ball - 3/8 x 1/8	1
17	T12-97		Bearing, Ball	4
18	T12-108		Bearing, Ball	1
19	T14-891		Pin, Dowel - 1/8 x 3/4, Hardened	1
20	T14-892		Pin, Dowel - 3/16 x 3/4, Hardened	2
21	T14-904		Pin, Dowel - 1/8 x 1/2, Hardened	2
22	T14A-83		Pin, Groove - 1/8 x 1/4, Type 1	1
23	T22-36		Ring, Retaining	2
24	T22-40		Ring, Retaining	1
25	T77-91		Gear, Idler - 1.5 P.D.	1
26	T77-92		Gear, Idler - 0.750 P.D.	1

DDS 301 - COLLIMATOR "D" SIDE PLATE  
Part No. 14175D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
3 -	14175D		Plate, Side "D" - Collimator (See Fig. 1, Item 3)	1
9	Delete			
10	Delete			
11	Delete			
14	38094D		Plate, Side - Collimator	1
26	T77-93		Gear, Idler - 0.625 P.D.	1

FIG. 4 - COLLIMATOR "E" SIDE PLATE  
Part No. 14175E

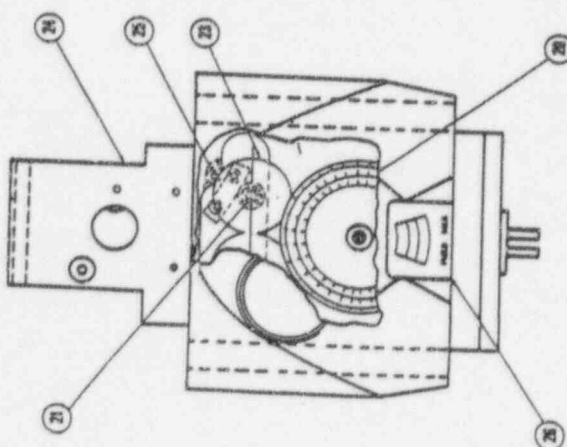
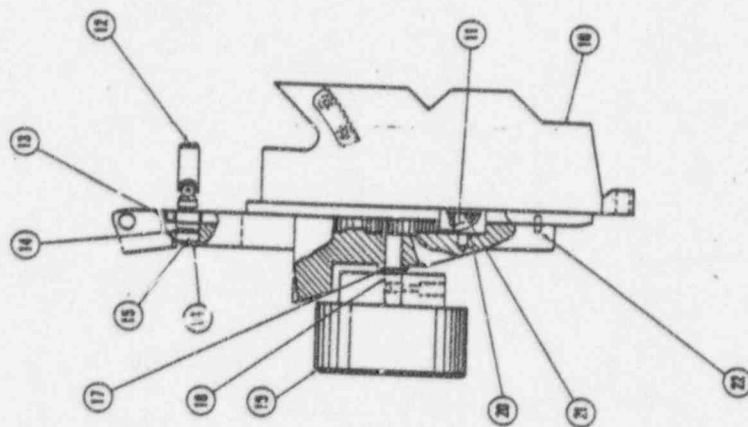
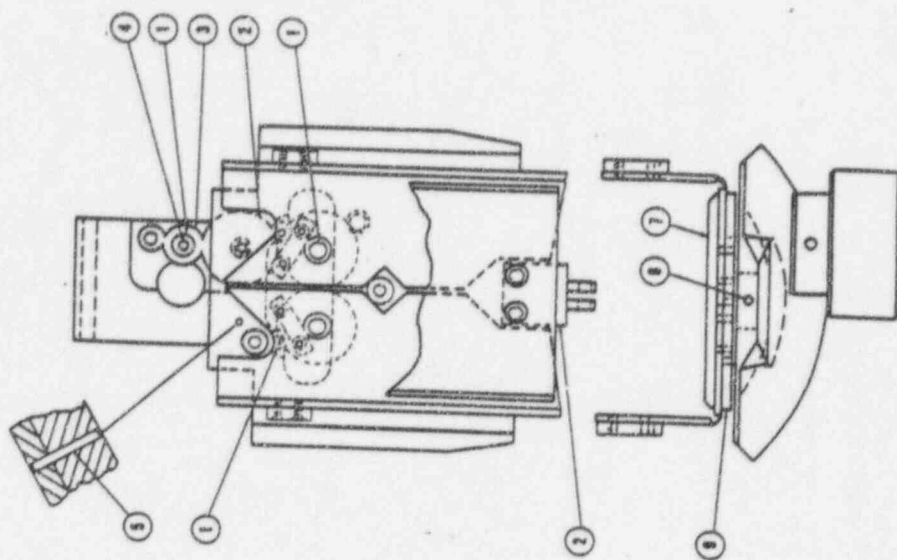


FIG. 4 - COLLIMATOR "E" SIDE PLATE  
Part No. 14175E

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
4 -	14175E		Plate, Side "E" - Collimator (See Fig. 1, Item 4)	1
1	T12-65		Bearing, Ball - 3/8 x 1/8	4
2	T77-91		Gear, Idler - 1.5 P.D.	1
3	T77-92		Gear, Idler - 0.750 P.D.	1
4	T14-904		Pin, Dowel - Hardened and Ground, 1/8 x 1/2	1
5	T14-891		Pin, Dowel - Hardened and Ground, 1/8 x 3/4	2
6	38309		Hinge, Bottom Frame	1
7	14558		Plate Assembly, C-1000 Pressure	1
8	38322		Pin, Index - Collimator Dial	1
9	38312		Liner, Side Plate - Hect. Coll.	1
10	14276		Plate Assembly, Hinge	2
11	T22-65		Ring, Grip	1
12	14179		Shaft Assembly, Universal	1
13	T12-97		Bearing, Ball	1
14	T22-40		Ring, Retaining	1
15	T12-108		Bearing, Ball	1
16	T22-36		Ring, Retaining	1
17	T22-25		Ring, Retaining - Knob Shaft	1
18	T77-95		Shaft, Collimator Knob	1
19	T3A-52		Knob, Collimator	1
20	14181A		Dial Assembly, 50, 55, 60	1
21	T14-892		Pin, Dowel - Hardened and Ground - 3/16 x 3/4	3
22	T14A-84		Pin, Roll - 1/8 x 3/8	1
23	14180		Gear Assembly, Drive	2
24	38094A		Plate, Collimator Side	1
25	T14A-83		Pin, Groove - 1/8 x 1/4, Type 1	2
26	38413A		Plate, Index - Collimator, 50, 55, 60	1

9

DDS 401 - COLLIMATOR "F" SIDE PLATE  
Part No. 14175F

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
4 -	14175F		Plate, Side "F" - Collimator (See Fig. 1, Item 5)	1
3	T77-93		Gear, Idler - 0.625 P.D.	1
10	Delete			
24	38094B		Plate, Collimator Side	1



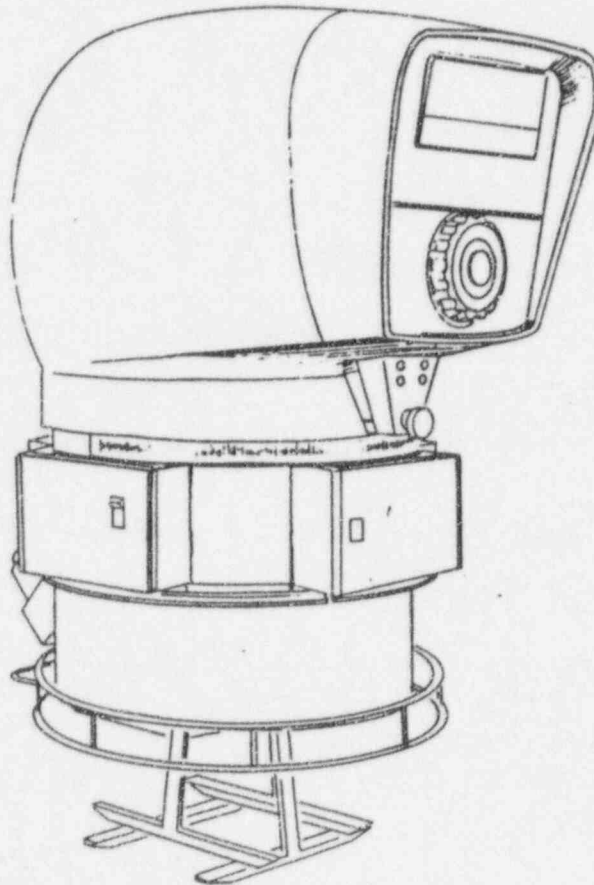
FIG. 5 - HEAD TO COLLIMATOR BEARING RING  
Part No. 141888

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
5 -	141888		Bearing Ring, Head to Collimator (See Fig. 1, Item 9)	1
1	378468		Ring, Adapter - Head	1
2	38358		Ring, Inner Bearing - Head	1
3	38358A		Ring, Inner Bearing	1
4	38359A		Ring, Outer Bearing	1
5	43872A		Finger, Brush	1
6	46935		Printed Circuit, Slip Ring	6
7	T1A-5		Ball, Steel - 3/8	1
8	T14A-106		Pin, Roll - 1/8 x 7/8	97
9	T20D-1		Helicoil, 1/4-20 x 3/4	8
10*	T20D-2		Helicoil, 8-32 x 1/2	8
11	S45-3		Screw, Set - 1/4-20 x 1/8 Locking	1
				4
			*Not shown.	

# PARTS LIST

H57:TM/H59:TM

JUN'77



1374

COBALT THERAPY COLLIMATOR

CAT. NO. 3706D,E FOR C9,V9

# CONTENTS

4	Fig. 1	Cobalt Therapy Collimator	3706D
11B	DHS 101	Cobalt Therapy Collimator	3706E
12	Fig. 2	Optical Distance Indicator	181010
14	Fig. 3	Bearing Ring	181459A
16	Fig. 4	Rotational Brake	181464
17	Fig. 5	Motor Mount Assembly	182095
18	Fig. 6	Halo Switch Assembly	181558
20	Fig. 7	Rear Plate, Opposite Dial	182184A
22	Fig. 8	Localizer Mounting Bracket	182250
24	Fig. 9	Front Plate Assembly	182276A
26	Fig. 10	Rear Plate Assembly	182277A
28	Fig. 11	Vane Assembly, "Y" Motion Side, Opposite Dial	183031

## INTRODUCTION

### PURPOSE

This parts list was written to provide the user with a complete listing of all parts and components used in the assembly of this unit, with the exception of hardware items such as screws, nuts, bolts and washers. The content of this manual has been arranged to offer maximum usability.

### USE OF PARTS LIST (See Fig. 1)

This parts list incorporates the indenture or assembly/subassembly method of parts listing. With this method indenture 1 is the primary assembly for the indicated figure; indenture 2 is either a direct part or subassembly of indenture 1; indenture 3 is either a direct part or subassembly of indenture 2 -- and so on. This method indicates which components are a part of which assemblies. All indent 2 items are a part of indent 1 and will be found on the indent 1 Bill of Material. All indent 3 items are a part of the preceding indent 2 item and will be found on that indent 2 Bill of Material. All parts are identified only once, and in their proper sequence.

### DIFFERENCE DATA SHEET

The Difference Data Sheet (DDS) is a supple-

ment to an existing parts list and is referenced to the existing list by Figure Number.

1. The DDS does not list any parts which are common to both units, but only those parts which are different.
2. All parts found on the list of the referenced unit apply to the unit of the DDS, except those parts indicated on the DDS.
3. If the word "delete" is used, then that part is not used on the unit of the DDS, but is used on the referenced unit.
4. If an item number is found on the DDS and not on the referenced parts list, then that part is found on the unit of the DDS but not on the referenced unit.

### ORDERING

When ordering parts include the Parts List DRS Number and Date of Publication, Figure and Item Number, and Part Description. If the part cannot be found in the parts list, include the Catalog Number of unit, Serial Number, and detailed description of part in question.

### EXAMPLE:

FIG. 1 MOBILE CHASSIS AND TUBESTAND -- PART NO. 1348L

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	1348L		Mobile Chassis and Tubestand	1
- 1	13559		Cover, Back	1
- 2	T7D-117		Filter, 1/2 mm	2
- 3	11337A		Indexing Plate, Tube Arm, and Locking Assembly	1
- 4	27904		Nameplate	1
- 5	37797		Plug, Tube End	2
- 6	T5-204		Spring, Front Stop	1
- 7	T54-3		"O" Ring, 1 x 1-1/4"	2
- 8	40822		Bracket, Transport	1

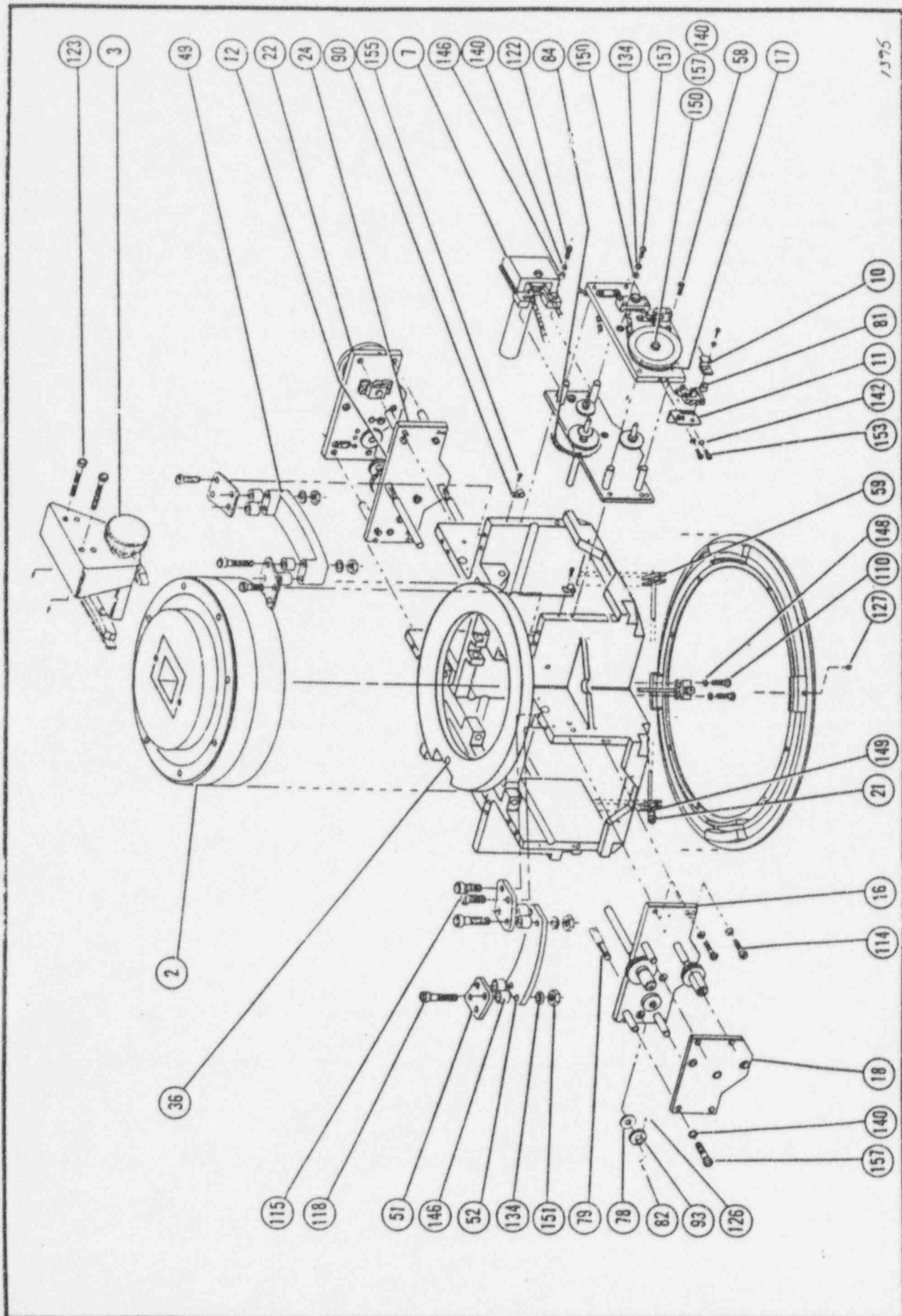


FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

(1 of 3)

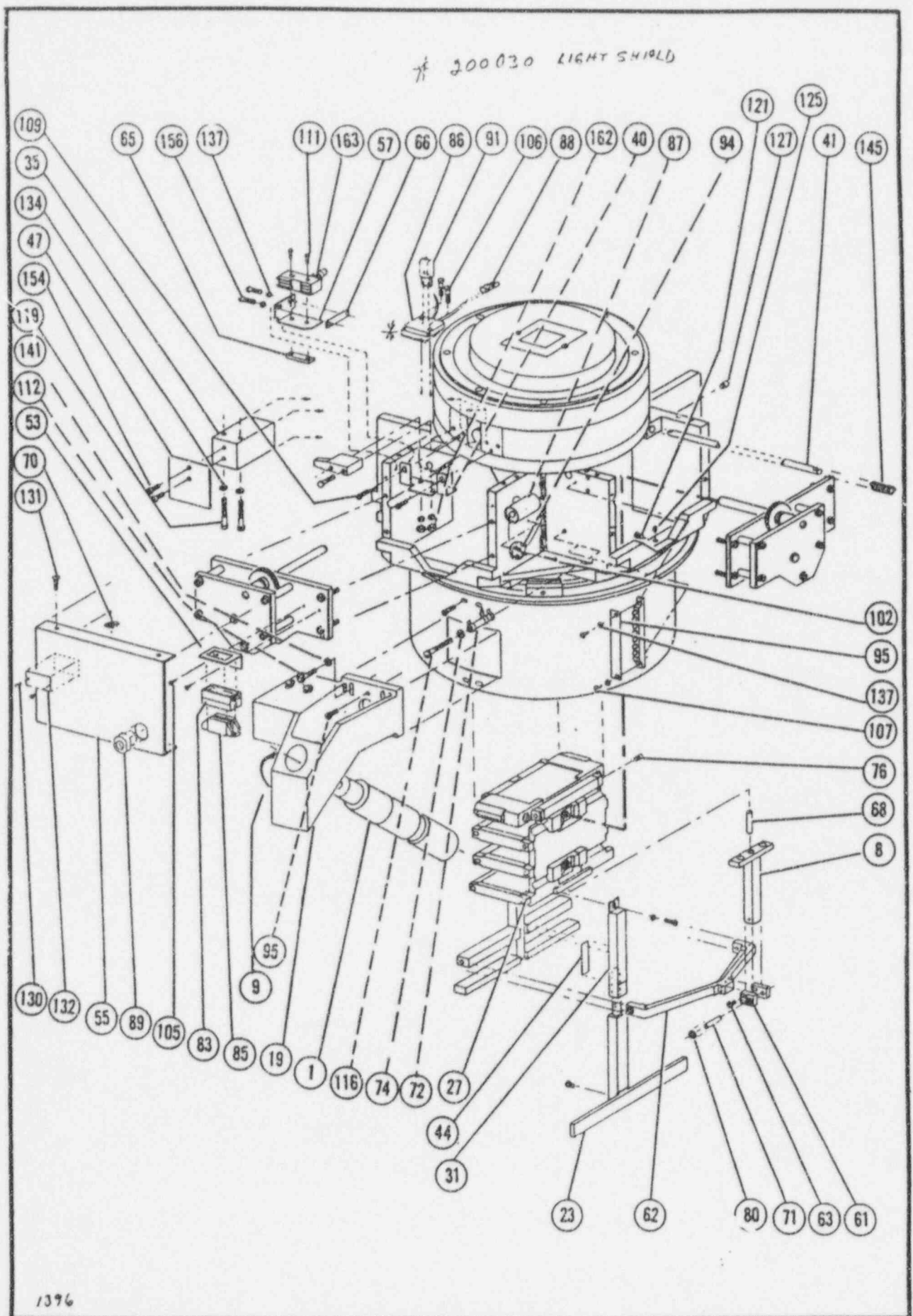
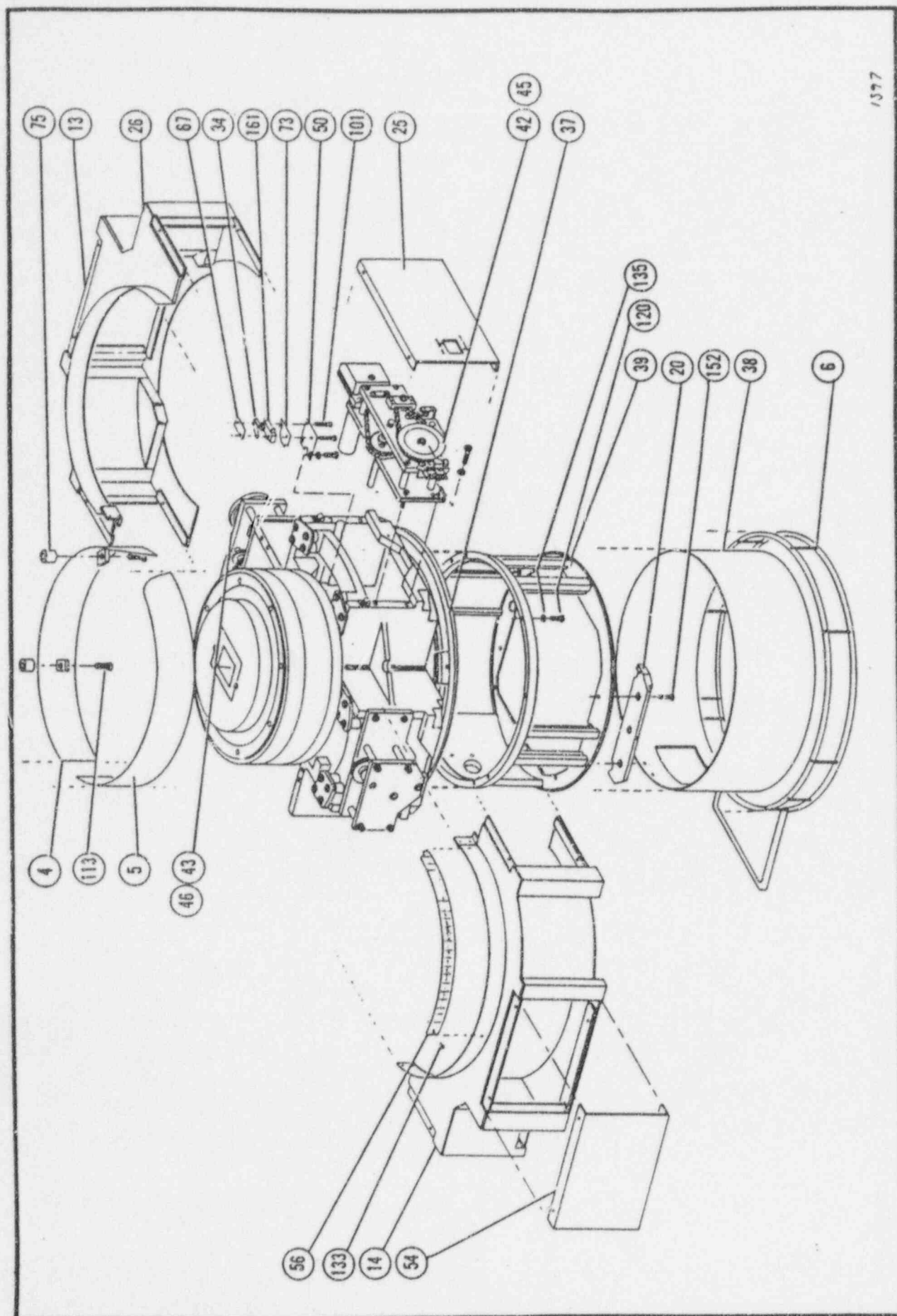


FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

(2 of 3)





1377

FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

(3 of 3)

FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	3706D		Cobalt Therapy Collimator	
1	181010		Optical Distance Indicator (See Fig. 2)	1
2	181459A		Bearing Assembly (See Fig. 3)	1
3	181464		Rotational Brake Assembly (See Fig. 4)	1
4	181473		Skirt Adaptor (R.H.) Assembly	1
	55682		Skirt	1
	55684		Block	2
5	181474		Skirt Adaptor (L.H.) Assembly	1
	55683		Skirt	1
	55684		Block	2
6	181494		Halo Ring Feeler Assembly	1
	55643		Ring - Upper	1
	55922		Ring - Lower	1
	55647		Spacer	9
	55646		Channel	1
7	182095		Motor Mount Assembly (See Fig. 5)	2
8	181462		Support Bar Assembly	4
	55787		Mounting Plate	1
	55957A		Braze Washer	1
	55609		Support Bar	1
9	181558		Halo Switch Assembly (See Fig. 6)	1
10	182091		Pointer Assembly Dial	2
	57424		Pointer	1
	57425		Bracket	1
11	182140		Bracket Assembly - Pointer	2
	57578		Bracket	1
	T4-364		Weldnut - #6-32	1
12	182146		Collimator Gear Assembly	2
	T77-347		Gear	1
	T77-348		Gear	1
	T14A-84		Roll Pin - 1/8 Dia. x 3/8 Lg.	1
13	182150		Shroud Assembly (Right Side)	1
14	182151		Shroud Assembly (Left Side)	1
15*	182183		Gear Assembly (Spacer, Idler)	2
	T77-347		Gear	1
	T10B-580		Set Screw Collar	1
16	182184A		Rear Plate Opposite Dial (See Fig. 7)	2
17	182187		Dial Ring and Socket Assembly	2
	T77D-40		Sprocket	1
	55852A		Plate - Ring	1
	T14A-56		Roll Pin - 1/16 Dia. x 3/16 Lg.	1
18	182241A		Front Plate (Opposite Dial)	2
	T12-450		Bearing - 3/8 ID x 5/8 OD	2
	T12-464		Bearing - 1/4 ID x 1/2 OD	1
	57659A		Front Plate	1
19	182250		Localizer Mounting Bracket (See Fig. 8)	1

\*Not shown.

(CONTINUED)

FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
	3706D	(Continued)		
20	182274		Accessory Mounting	2
	57563		Mounting Block	1
	57565		Accessory Clamp Nut	1
	S33-16		Screw - 8-32 x 3/8 Set	1
21	182275		Cross Hair Assembly	2
	57819		Wire Cross Collimator	1
	57828		Pin	1
	T2-559		Special Screw	1
	S111-11A		Nut - #8-32 Hex	1
22	182276A		Front Plate Assembly (See Fig. 9)	2
23	184228		Extender Assembly	4
	184207		Extension Rod Assembly	1
	62559		Collimator Extender	1
	62562		Shim	IND.
	62562A		Shim	IND.
	62562B		Shim	IND.
	S21-7A		Screw - 8-32 x 3/8 Socket Head Cap	2
24	182277A		Rear Plate Assembly (See Fig. 10)	2
25	182278		Cover Assembly - Shroud Front	1
	57757		Cover - Front	1
	55847		Window - Dial Pointer	1
	S301-87		Elmer's Epoxy	A/R
26	182279		Cover Assembly - Shroud Right Side	1
	57758		Cover (Right Side)	1
	55847		Window - Dial Pointer	1
	S301-87		Elmer's Epoxy	A/R
27	183031		Vane Assembly - "Y" Motion Side, Opposite Dial (See Fig. 11)	1
28*	183032		Vane Assembly - "Y" Motion Dial Side	1
29*	183033		Vane Assembly - "X" Motion Side, Opposite	1
30*	183034		Vane Assembly - "X" Motion Dial Side	1
31	183362		Housing Assembly	4
	59450		Housing (For Extenders)	1
	59451		Plunger	1
	S32-66		Screw - 3/8-16 x 1/2 Socket Set	1
	T5A-288		Compression Spring	1
32*	L-2901		Harness	1
33*	T63B-978		Wiring Instructions	REF.
34	35088		Roller Actuator	3
35	50234		Shield Block	1
36	55166B		Collimator (Casting Machine)	1
37	55575A		Ring - Accessory Mounting	1
38	55583		Shroud - Lower (Extender)	1
39	55589A		Extender - Encloser	1
40	55590A		Bracket - Lamp Mounting	1
			*Not shown.	
			(CONTINUED)	

FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
	3706D	(Continued)		
41	55597		Guide Rod	4
42	55850		Dial Outer (Long Vanes)	1
43	55850A		Dial Outer (Short Vanes)	1
44	62440,A,B		Shim	IND.
45	55851A		Dial Inner (Long Vanes)	1
46	55851P		Dial Inner (Short Vanes)	1
47	55377		Collimator Light Shield	1
48*	56544		Wrench - Allen (20" Long)	1
49	56786A		ARC Barrier (B-56786)	1
50	57339		Mounting Bracket - Switch	3
51	58922		Support - Arc Barrier	8
52	57355		Arc Barrier	3
53	57636		Bracket - Mat-N-Lock Connector	1
54	57759		Cover - Shroud - Left Side	1
55	57760		Cover - Shroud - Rear	1
56	57762		Scale - Rotational Scale	1
57	57801		Mounting Bracket - Zone Guard Switch	2
58	T2-349		Screw - 10-32 x 1/2 Button Head 2/Nylok	8
59	57820		Bracket - Cross Hair Mounting	4
60*	59449		Clamp Block Removable Trimmer	4
61	59512		Block	8
62	59524		Bar Support - Collimator Trimmer	4
63	T2-398		Screw - Pivot Shoulder	8
64*	T2M-24		Screw - 1/4-20 x 5/8 Socket Head Cap - (Lockwell)	8
65	T4-187		Nut Plate - Zone Guard Switch	2
66	T4-275		Nut Plate - Zone Guard Bracket	2
67	T4-279		Nut Plate - Switch	3
68	T14F-35		Pin - Connecting	4
69*	T4-363		Nut Plate - Switch	2
70	T4D-41		Cover - Tinnerman Speed Nut	16
71	T14D-189		Pin - .188 Dia. x 1.00 Lg.	4
72	T6-796		Resistor - Adjustable - 100 Ohms - 25W	REF.
73	T9-74		Switch - Fiber Barrier	6
74	T11L-43		Washer - Fiber	2
75	T10C-585		Skirt - Spacer	4
76	T14D-182		Pivot Pin - Vane	4
77*	T11P-126		Shims	15
78	T14L-86		Spacer (Line Shaft)	4
79	T14L-87		Shaft - Line	2
80	T22-65		Ring - Retainer - Truarc	8
81	T29E-9		Actuator	4
82	T31-52		Key (Line Shaft)	4
83	T36-352		Pin - Mat-N-Lock (HS6)	1
84	T26-144		Chain - Roller Drive	2
85	T36-353		Socket - Mat-N-Lock (HS6)	1
			*Not shown.	
			(CONTINUED)	

FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
	3706D	(Continued)		
86	T36-388		Socket - Lamp	1
87	T45-152		Condenser - Dry	REF.
88	T36N-2		Faston	2
89	T66D-6		Cable Grip	1
90	T66A-33		Cable Clamp (Front & Back)	2
91	T72-109		Lamp - High Silica Halogen	1
92*	T66A-34		Cable Clamp (R & L Side)	3
93	T77-345		Gear (Line Shaft)	4
94	T80-118		Rectifier - Full Wave Silicon	REF.
95	T81B-109		Marker Strip - 10 Position	1
96*	181844		Isodose Curves - 80SS, 65SDD (T55-601)	REF.
97*	181844A		Isodose Curves - 80SSD, 45SDD (T55-602)	REF.
98*	181844B		Isodose Curves - 60SSD, 45SDD (T55-603)	REF.
99*	181844C		Isodose Curves - 80SAD (T55-609)	REF.
100*	T61B-914		Wiring Diagram (Motorized)	REF.
101	S1A-42		Screw - 4-40 x 5/8 Round Head Machine	6
102	S1-69		Screw - 6-32 x 3/8 Round Head Machine	1
103*	S2-194		Screw - 8-32 x 1/8 Flat Head Machine	6
104	S5-102		Screw - 10-32 x 2-1/2 Round Head Machine	1
105	S5A-87		Screw - 8-32 x 3/16 Round Head Machine	2
106	S9A-43		Screw - 4-40 x 3/4 Round Head Machine	2
107	S9-66		Screw - 6-32 x 3/16 Round Head Machine	2
108*	S9-10		Screw - 2-56 x 7/8 Round Head Machine	4
109	S9-67		Screw - 6-32 x 1/4 Round Head Machine	2
110	S21A-4		Screw - 6-32 x 3/4 Socket Head	8
111	S21A-6		Screw - 6-32 x 1 Socket Head	4
112	S21-24		Screw - 1/4-20 x 1/2 Socket Head	4
113	S21-59		Screw - 3/8-16 x 1-1/2 Socket Head Cap	4
114	S22-14		Screw - 10-32 x 1/2 Socket Cap	32
115	S22-15		Screw - 10-32 x 5/8 Socket Head Cap	16
116	S5-102		Screw - 10-32 x 2-1/2 Round Head Machine	1
117*	S22-13		Screw - 10-32 x 3/8 Socket Head Cap	4
118	S22-18		Screw - 10-32 x 1 Socket Head Cap	8
119	S22-22		Screw - 10-32 x 2 Socket Head Cap	6
120	S22-26		Screw - 1/4-20 x 3/4 Socket Cap	8
121	S22-116		Screw - 10-32 x 5/16 Socket Head Cap	8
122	S22A-19		Screw - 10-32 x 1-1/4 Socket Head Cap	4
123	S22A-20		Screw - 10-32 x 1-1/2 Socket Head Cap	8
124*	S33-12		Screw - 8-32 x 1/8 Socket Set Cup Point	4
125	S34-48		Screw - 1/4-20 x 1/2 Socket Head Set	2
126	S36-1		Screw - 6-32 x 1/8 Socket Set	4
127	S36-13		Screw - 8-32 x 3/16 Socket Set	12
128	S36-44		Screw - 1/4-20 x 1/4 Socket Set	3
129*	S39-28		Screw - 10-32 x 1/2 Socket Set	4
130	S66-8		Screw - #2 x 3/16 Drive	2
131	S71B-17		Screw - 6-32 x 1/2 Flat Head PKST	16
			*Not shown.	
			(CONTINUED)	



FIG. 1 - COBALT THERAPY COLLIMATOR - Part No. 3706D

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
	3706D	(Continued)		
132	T92-419		Nameplate	1
133	S73A-14		Screw - #6-1/4 Pan Head Self Tap	2
134	S85-5		Lockwasher - #10	26
135	S85A-23		Lockwasher - 1/4	8
136*	S93-1		Washer - #4 Shakeproof	2
137	S93-2		Washer - #6 Shakeproof	6
138*	S93-3		Washer - #8 Shakeproof	2
139*	S94-1		Washer - #2 Shakeproof	4
140	S94-4		Shakeproof - #10	40
141	S94-6		Shakeproof - 1/4	4
142	S96A-11		Washer - 5/32 x 5/16 x .048 x .027	4
143*	S96A-14		Washer - 13/64 x 15/32 x 1/16	4
144*	S98-10		Washer - #2 Flat	4
145	T5-697		Spring - Compression	16
146	T10C-376		Spacer	12
147*	T10C-401		Spacer	4
148	S98A-11		Washer - #6 Flat	8
149	S98A-12		Washer - #8 Flat	2
150	S98A-15		Washer - #10 Flat	10
151	S111-27		Nut - #10-32 Hex	16
152	S263A-75		Screw - 1/4-20 x 3/4 Flat Head	4
153	S277A-5		Screw - 6-32 x 3/8 Button Head	4
154	S277-8		Screw - 8-32 x 1/4 Socket Head Button	6
155	S277L-10		Screw - 8-32 x 3/8 Button Head	5
156	S277A-12		Screw - 8-32 x 3/4 Socket Button Head	4
157	S277A-27		Screw - 10-32 x 1/2 Button Head	18
158*	S387-3		Screw - 6-32 x 1/4 Cone Point Set	2
159*	S22-16		Screw - 10-32 x 3/4 Socket Head Cap	8
160	T29-272		Toggle Switches	REF.
161	T29A-16		Micro Switch	REF.
162	S111-8A		Nut - #4-40 Hex	2
163	T29A-35		Switch	REF.
*Not shown.				



FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
	3706E		Cobalt Therapy Collimator	
10	182175		Dial Pointer Assembly	2
13	182229		Shroud Assembly - Right	1
32*	L-2902		Harness	1
33*	T63B-979		Wiring Instructions	REF.
164,165	Delete			
166	182178A		Rear Plate - Dial Side	2
167	182177A		Front Plate - Dial Side	2
168	182257		Cover Shroud - Front	1
169	182258		Cover Shroud - Right Side	1
170-173	Delete			
174	55845		Knob - Plug	2
175	T3-166		Knob - Dial	2
176-182	Delete			
183	T61B-915		Wiring Diagram	REF.
184-191	Delete			

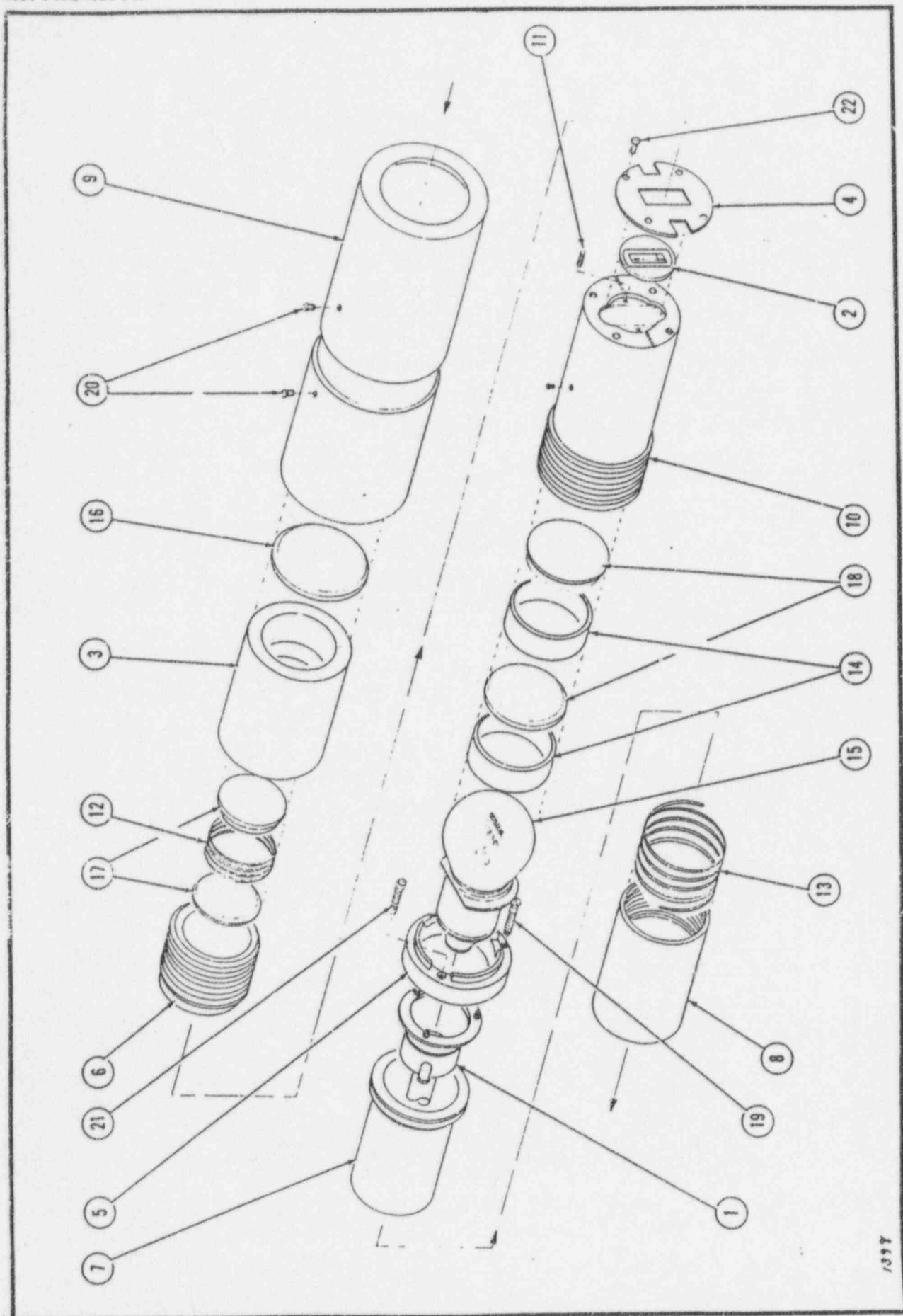


FIG. 2 - OPTICAL DISTANCE INDICATOR - Part No. 181010

FIG. 2 - OPTICAL DISTANCE INDICATOR - Part No. 181010

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
2 -	181010		Optical Distance Indicator (See Fig. 1, Item 1)	
1	L-2580		Socket Assembly	1
2	55546		Reticle	1
3	55829		Holder - Lens Front	1
4	55830		Mask	1
5	55831		Holder - Lamp Base	1
6	55832		Holder - Lens Rear	1
7	55833		Cover - Lamp Base	1
8	55834		Cap - End	1
9	55835		Housing	1
10	55836		Holder - Projection Lens	1
11	T5A-271		Spring Compression	2
12	T5A-272		Spring - Compression Collimator Lens	1
13	T5A-273		Spring - Lamp Base	1
14	T10C-584		Spacer - Condensing	2
15	T72-111		Lamp	1
16	T87-128		Lens - Plano 608mm F.L.	1
17	T87-129		Lens - Plano 39.25mm F.L.	2
18	T87-130		Lens - Plano 63.5mm F.L.	2
19	S239A-23		Screw - 4-40 x 3/8 Flat Head	2
20	S33-1		Screw - 6-32 x 1/8 Socket Set Cup Point	4
21	S21-126		Screw - 4-40 x 3/8 Socket Head Cap	1
22	S277-1		Screw - 4-40 x 1/4 Button Socket Head	4

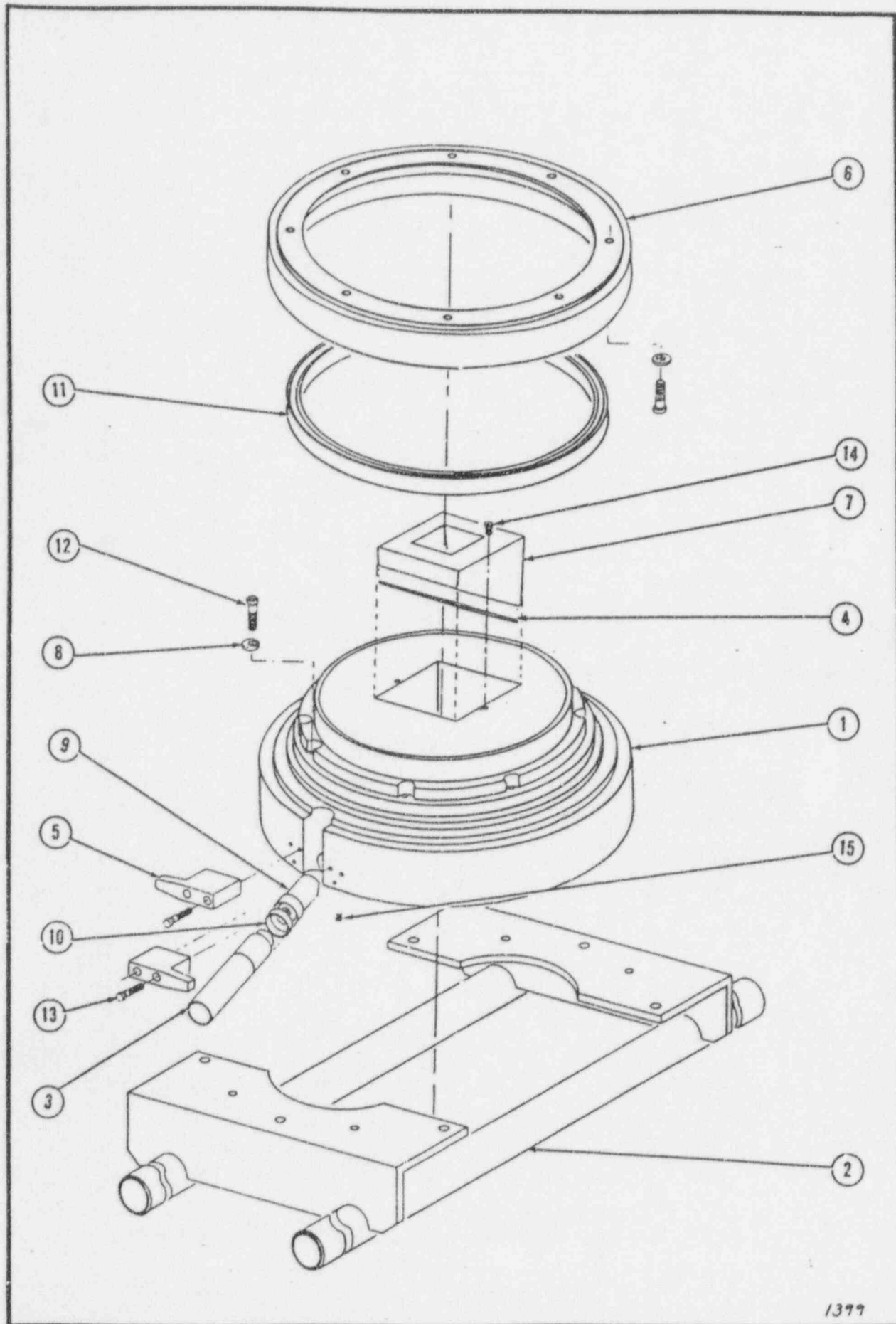


FIG. 3 - BEARING RING - Part No. 181459A

1399

FIG. 3 - BEARING RING - Part No. 181459A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
3 -	181459A		Bearing Ring (See Fig. 1, Item 2)	
1	57843		Bearing Ring - Machined Assembly	1
2	181802		Handle Bar - Weldment	1
3	181461		Field Illuminator Assembly	1
4	55432		Mirror - Collimator	1
5	55748		Block - Rotation Stop	2
6	55591		Ring - Bearing Adaptor	1
7	55592		Retainer - Mirror	1
8	55593		Retainer - Bearing	16
9	55594		Aperture	1
10	56210		Spacer	1
11	T12-438		Ball Bearing - 4 Point Contact	1
12	S21-24		Screw - 1/4-20 x 1/2 Socket Head Cap	22
13	S22-17		Screw - 10-32 x 7/8 Socket Head Cap	4
14	S69-32		Screw - #8 x 3/8 Flat Head PKST	2
15	S33-12		Screw - 8-32 x 1/8 Cup Point Set	1
16*	S301-88		"Locoic" Primer Grade "T"	IND.
17*	S301-97		"Loctite" - Grade "HV"	IND.
18*	T2M-26		Screw - 1/4-20 x 1-1/4 Socket Head(Lockwell)	8
19*	S371-1		Muslin Bag - 2-3/4 x 4	1

\*Not shown.

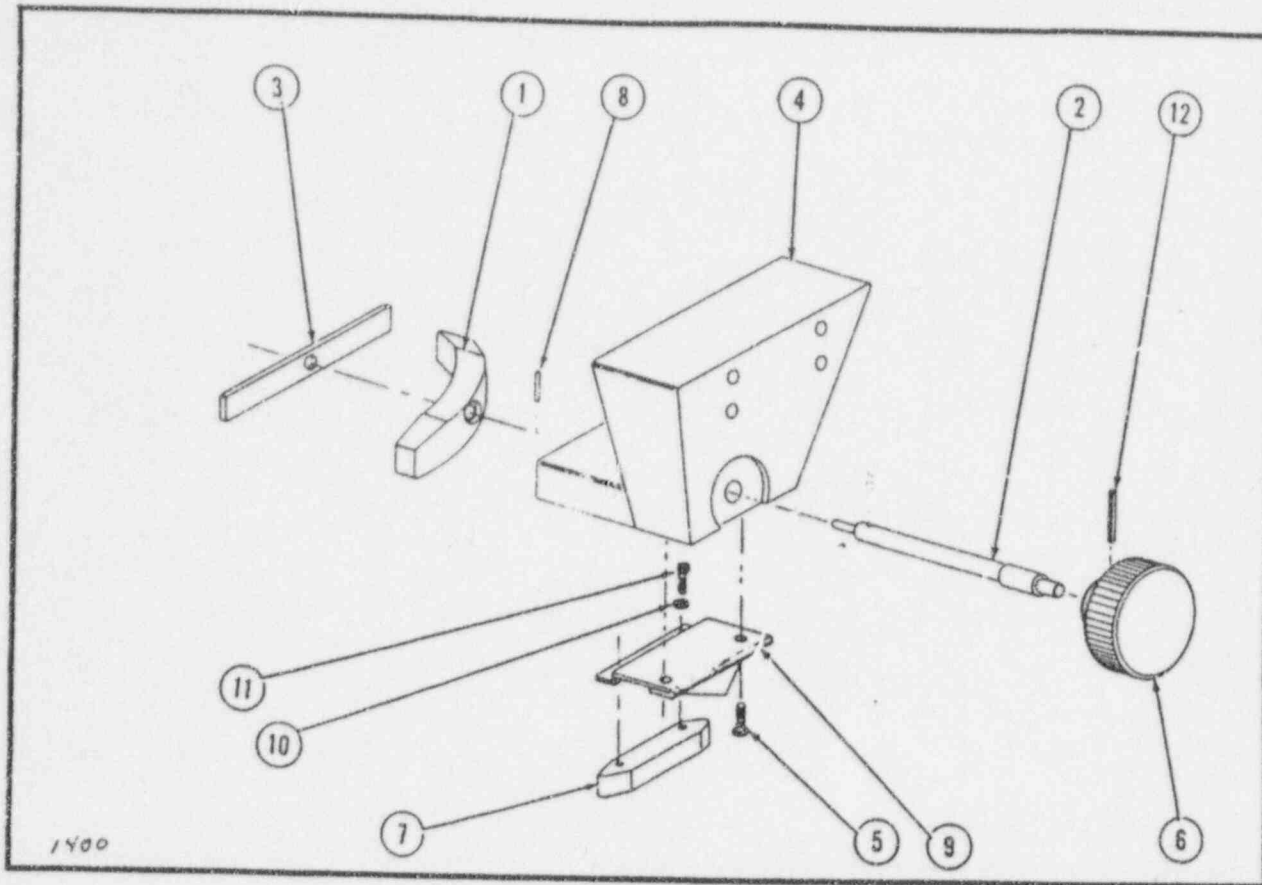


FIG. 4 - ROTATIONAL BRAKE - Part No. 181464

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
4 -	181464		Rotational Brake (See Fig. 1, Item 3)	
1	55656		Shoe - Brake	1
2	55657		Shaft - Brake	1
3	55658		Lining - Brake	1
4	55659A		Housing - Brake (Machined)	1
5	S229C-45		Screw - #6-32 x 3/8 Phillips Binding Head	2
6	T3-185		Knob	1
7	57341		Switch - Actuator Front	1
8	T14A-132		Pin - Roll 1/16 Dia. x 1/2	1
9	57340		Center Actuator	1
10	S85-3		Lockwasher - #6	2
11	S277-5		Screw - 6-32 x 3/8 Socket Button Head	2
12	T14A-55		Roll Pin - 3/32 x 7/8	1
13*	S301-50		Contact Cement - Minn. Mining #EC2099	IND.



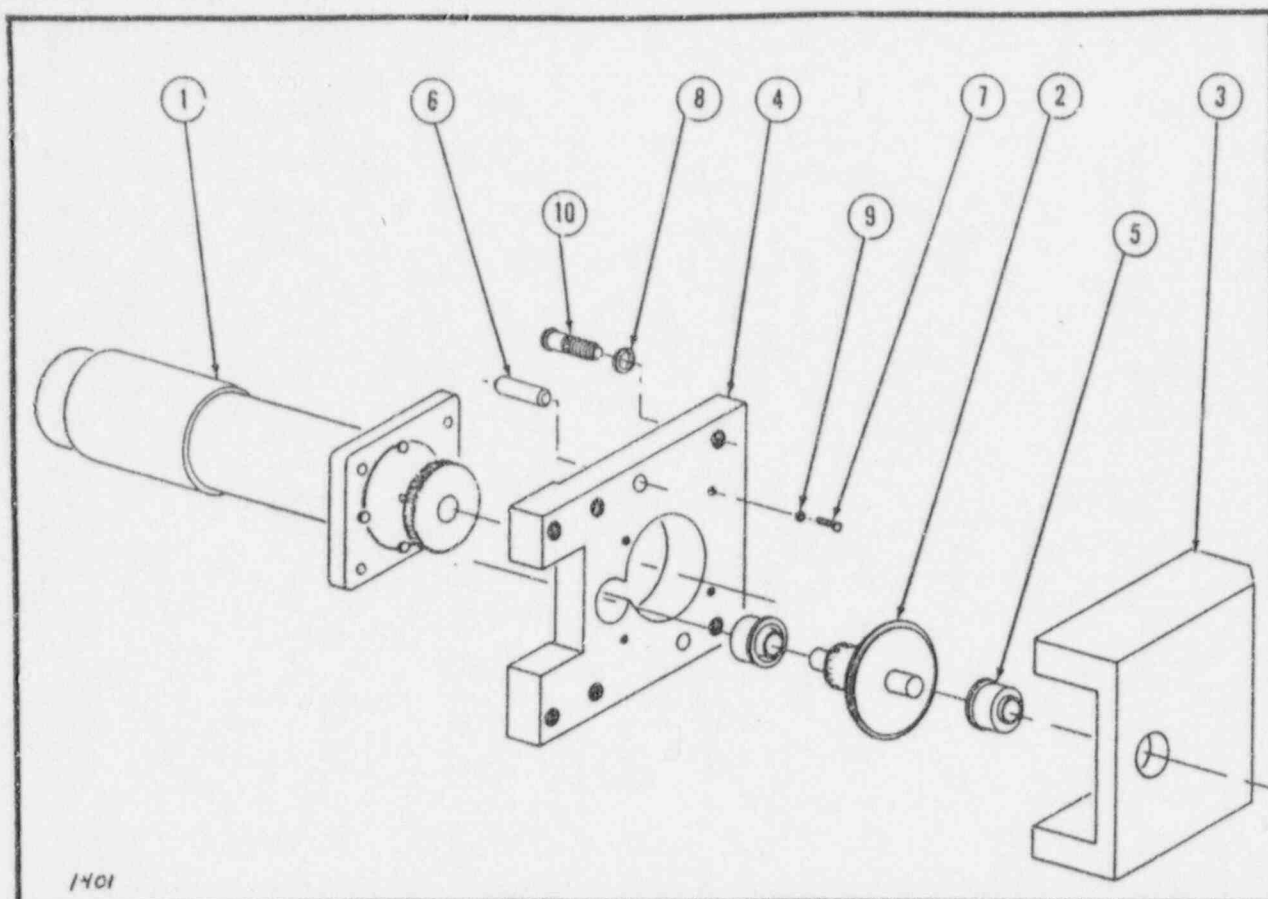


FIG. 5 - MOTOR MOUNT ASSEMBLY - Part No. 182095

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
5 -	182095		Motor Mount Assembly (See Fig. 1, Item 7)	
1	181781		Motor Drive Assembly	1
2	182141		Drive Gear and Shaft Assembly	1
3	57429		Cover (Motor Mount)	1
4	57434		Mount - Motor	1
5	T12-464		Radial Retainer - Flanged	2
6	T14D-197		Dowel Pin - 3/16 Dia. x 1/2	2
7	S21-128		Screw - 4-40 x 1/2 Socket Head	4
8	S85-5G		Lockwasher - #10	4
9	S85-2G		Lockwasher - #4	4
10	S277-29L		Screw - 10-32 x 3/4 Button Head	4

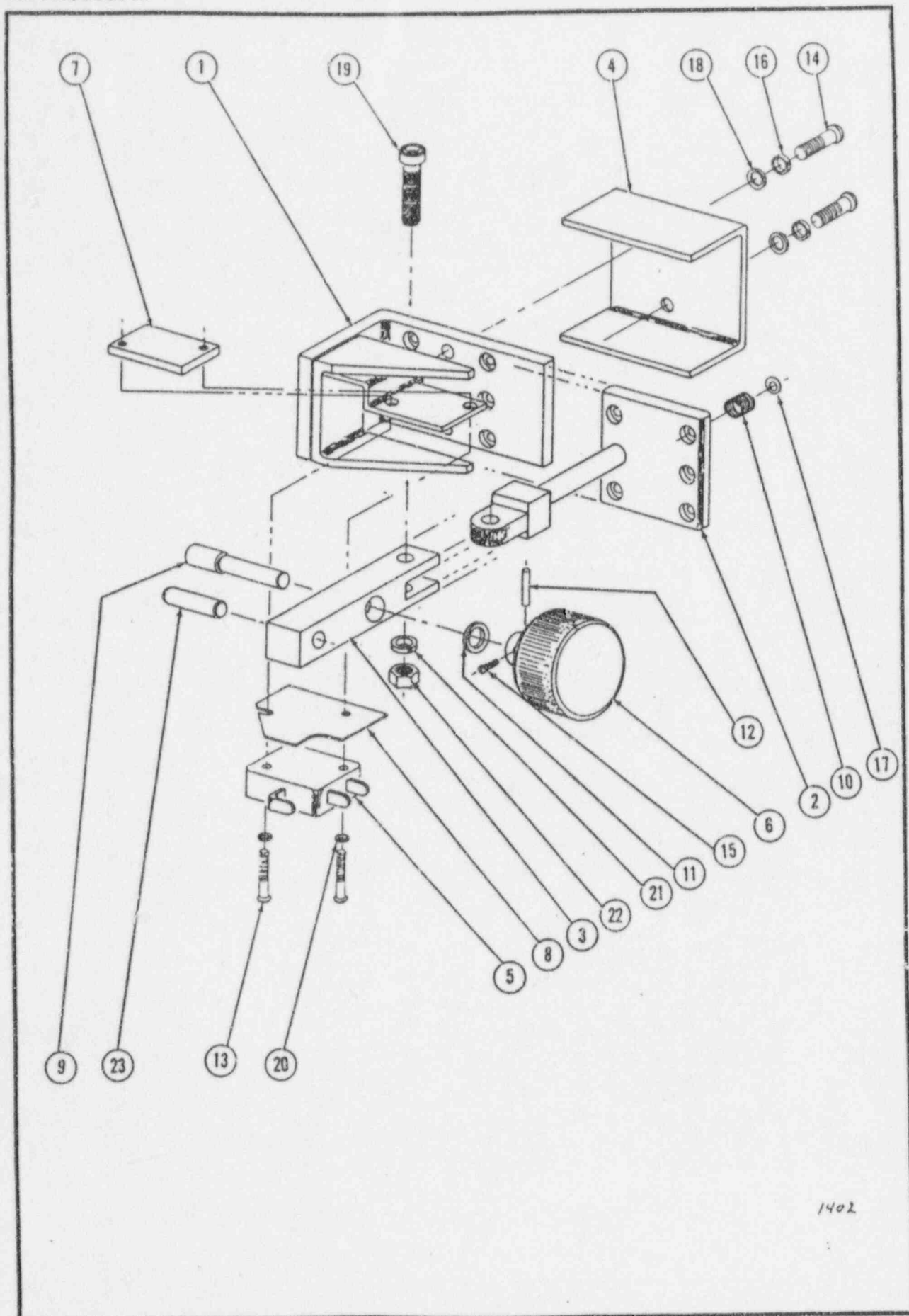


FIG. 6 - HALO SWITCH ASSEMBLY - Part No. 181558

FIG. 6 - HALO SWITCH ASSEMBLY - Part No. 181558

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
6 -	181558		Halo Switch Assembly (See Fig. 1, Item 9)	
1	181562		Angle Bracket (Weldment)	1
2	181563		Mounting Bracket - Halo	1
3	55971		Stem - Adjustable	1
4	55972		Guide - Feeler Plate	1
5	L-2729		Leads - Halo Switch	1
6	T3A-116		Knob	1
7	T4-165		Plate - Nut	1
8	T9-74		Barrier	1
9	T14L-75		Stud	1
10	T5A-93		Spring - Compression	6
11	T11P-67		Washer - Flat	1
12	T14A-76		Roll Pin - 3/32 Dia. x 1/2	1
13	S1A-29		Screw - 4-36 x 3/4 Round Head Machine	2
14	S5A-91		Screw - 10-32 x 1/2 Round Head Machine	2
15	S39-0		Screw - 10-32 x 1/8 Set Cup Point	1
16	S93-4		Washer - #10 External Shakeproof	2
17	S98-3		Washer - #4 Flat	6
18	S98A-7		Washer - 7/32 I.D. Plain	2
19	S22A-27		Screw - 1/4-28 x 7/8 Socket Head Cap	1
20	S98-2		Washer - #4 Internal Shakeproof	2
21	S86-23		Lockwasher - 1/4	1
22	S120A-1		Hex Nut - 1/4-28	1
23	T14A-86		Roll Pin - 1/4 Dia. x 3/4	1

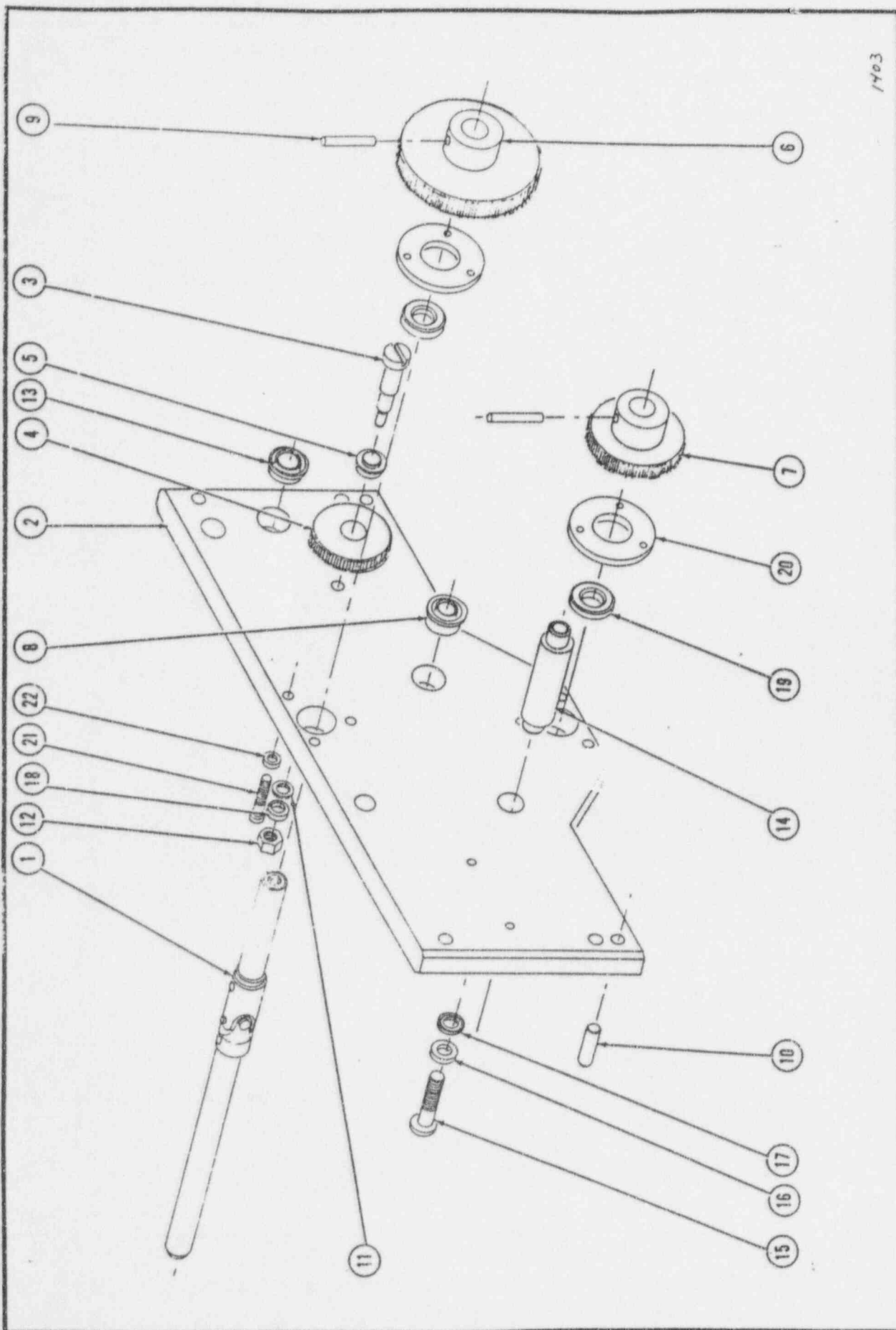


FIG. 7 - REAR PLATE, OPPOSITE DIAL - Part No. 182184A

FIG. 7 - REAR PLATE, OPPOSITE DIAL - Part No. 182184A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
7 -	182184A		Rear Plate, Opposite Dial (See Fig. 1, Item 16)	
1	182182		Universal Screw Assembly (Left Hand)	2
2	57658		Plate	1
3	57622		Shoulder Screw	1
4	T77-345		Gear - Idler (55T 1.187 O.D.)	1
5	T12-467		Bearing - 1/4 I.D. x 3/8 O.D.	2
6	T77-341		Gear (96T 2.041 O.D.)	1
7	T77-342		Gear (66T 1.415 O.D.)	1
8	T12-464		Bearing - 1/4 I.D. x 1/2 O.D.	3
9	T14A-132		Dowel - 1/16 Dia. x 1/2	2
10	T14D-197		Dowel - 3/16 Dia. x 1/2	2
11	S96-11A		Washer - 5/32 x 5/16 x 3/64	1
12	T4A-44		Nut - #6-32	1
13	T12-466		Bearing - 5/16 I.D. x 1/2 O.D.	1
14	57639		Post - Gear Box	4
15	S277-27A		Screw - 10-32 x 1/2 Button Head	4
16	S96-14A		Washer - #10	4
17	S93-4-11100		Washer - #10 Shakeproof	4
18	S93-2-1106		Washer - #6 Shakeproof	1
19	T12-450		Bearing - 3/8 I.D. x 5/8 O.D.	2
20	59388		Retainer - Bearing	2
21	S21A-2		Screw - 6-32 x 1/2 Socket Head	6
22	S85A-3		Lockwasher - #6 Spring	6

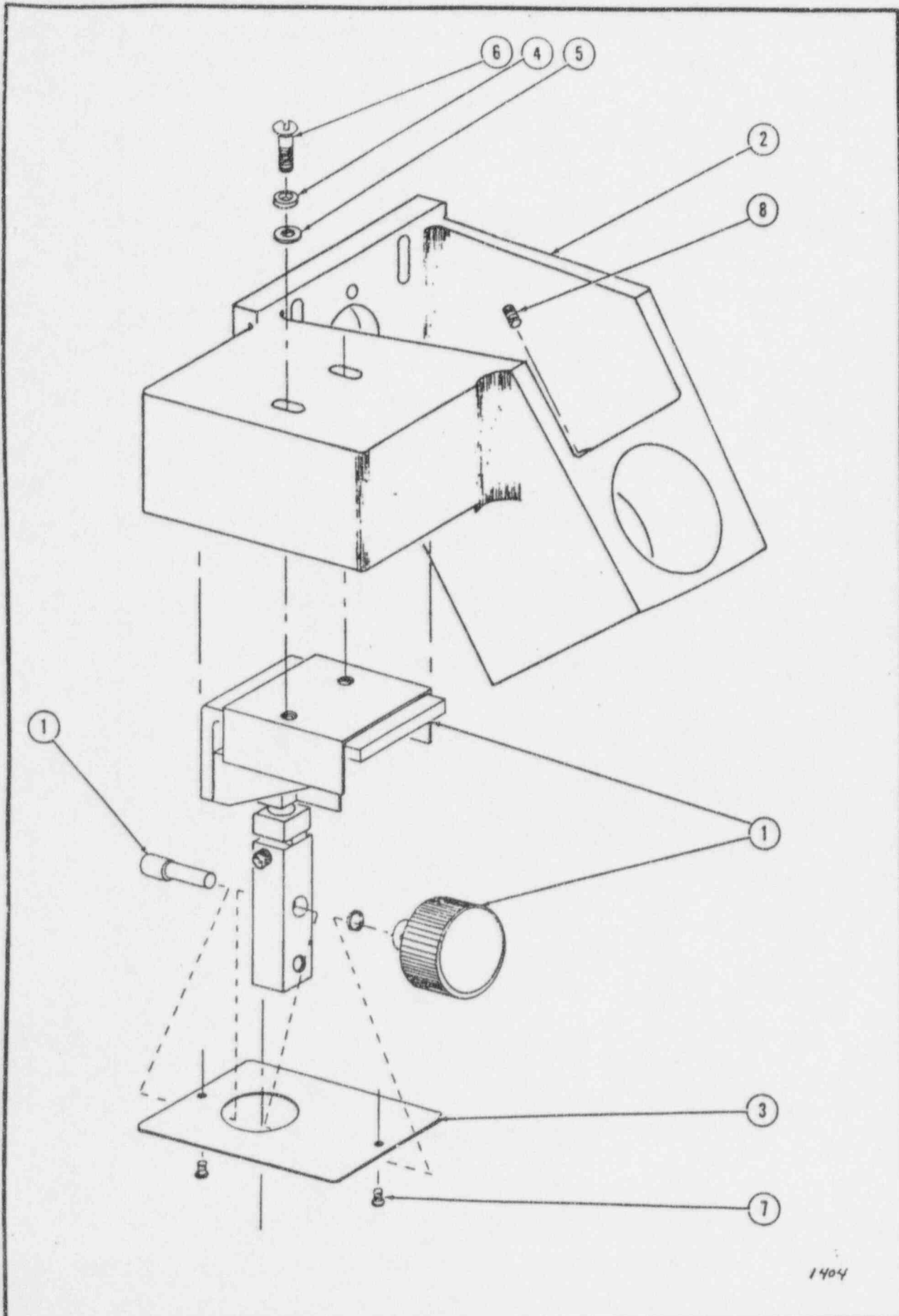
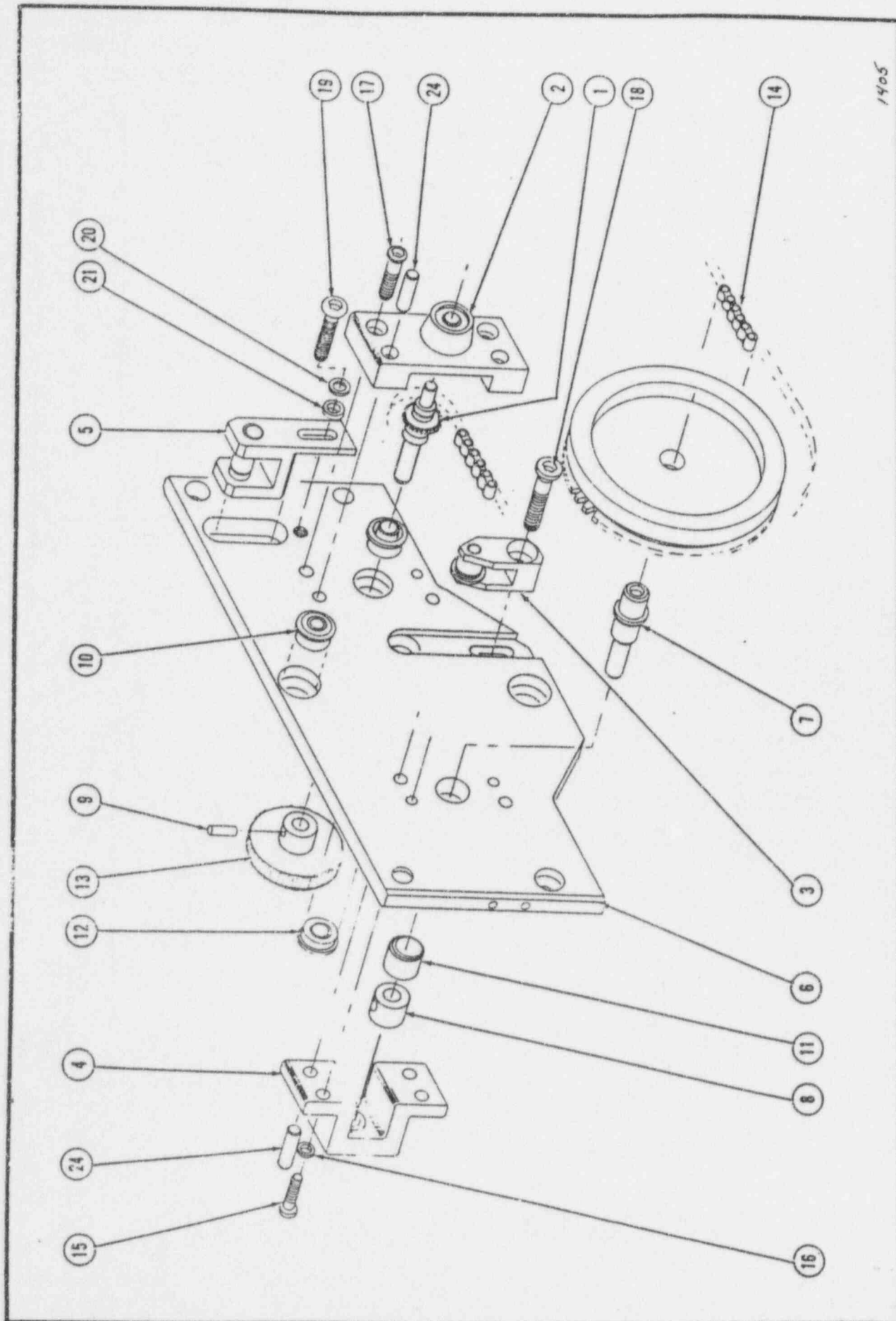


FIG. 8 - LOCALIZER MOUNTING BRACKET - Part No. 182250



FIG. 8 - LOCALIZER MOUNTING BRACKET - Part No. 182250

FIG & ITEM	PART NO.	DESCRIPTION	QTY
8 -	182250	Localizer Mounting Bracket (See Fig. 1, Item 19)	
1	181558	Halo Switch Assembly	1
2	55560A	Localizer (Machine)	1
3	55644	Cover - Localizer	1
4	S93-4	Washer - #10 Shakeproof	REF.
5	S98A-7	Washer - 7/32 I.D. Plain	REF.
6	S5A-91	Screw - 10-32 x 1/2 Round Head Machine	REF.
7	S33-12	Screw - 8-32 x 1/8 Socket Cup Point Set	1
8	S277-25A	Screw - 6-32 x 5/16 Pan Head	2



1405

FIG. 9 - FRONT PLATE ASSEMBLY - Part No. 182276A

FIG. 9 - FRONT PLATE ASSEMBLY - Part No. 182276A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
9 -	182276A		Front Plate Assembly (See Fig. 1, Item 22)	
1	182235		Shaft and Sprocket Assembly	1
2	182135		Bracket - Dial Chain	1
3	182098		Chain Tightener Assembly	1
4	182173		Bracket Bushing Assembly	1
5	182097		Sprocket Assembly	1
6	57437A		Front Plate	1
7	57428		Shaft - Dial	1
8	T10B-580		Collar	1
9	T14A-79		Roll Pin - 1/8 Dia. x 1/2 Lg.	1
10	T12-450		Bearing - 3/8 I.D. x 5/8 O.D.	2
11	T10F-90		Bushing - 1/4 I.D. x 3/8 O.D. x 5/16 Lg.	1
12	T12-464		Bearing - 1/4 Dia. x 1/2 O.D.	2
13	T77-327		Gear	1
14	T26-146		Chain - Dial Drive	1
15	S21A-7		Screw - 8-32 x 3/8 Socket Head	2
16	S93-3		Washer - Shakeproof	2
17	S22A-14		Screw - 10-32 x 1/2 Socket Head	2
18	S22A-17		Screw - 10-32 x 7/8 Socket Head	1
19	S277L-20		Screw - 10-32 x 1/2 Button Head	1
20	S93-4		Washer - #10 Shakeproof	1
21	S96A-14		Washer - 13/64 ID x 15/32 OD x 1/16 Thick	2
22*	S85A-5		Lockwasher - #10 Spring	1
23*	S111A-15		Nut - 10-32 Hex M.S.	1
24	T14D-197		Dowel - 3/16 Dia. x 1/2 Lg.	4
*Not shown.				

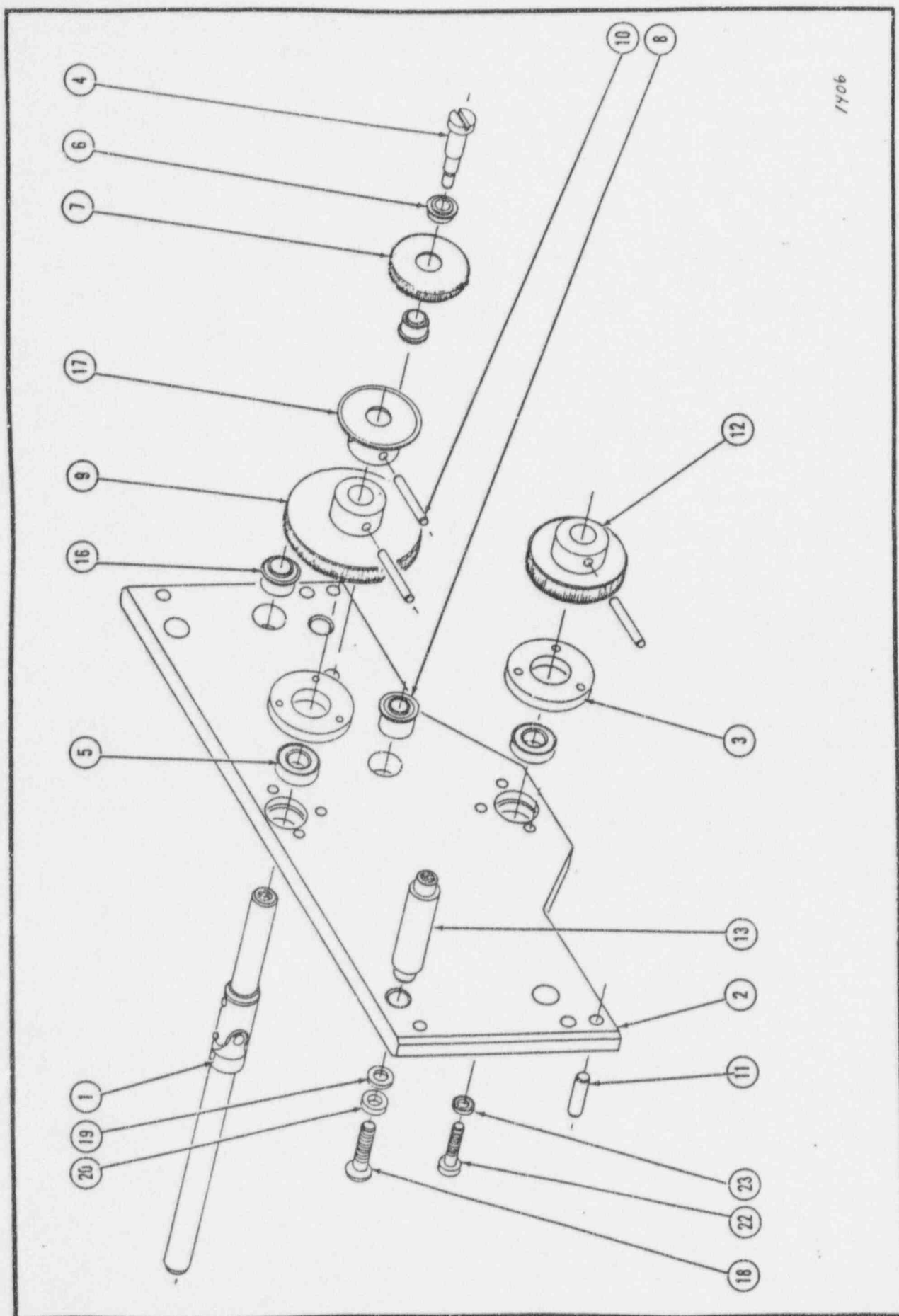
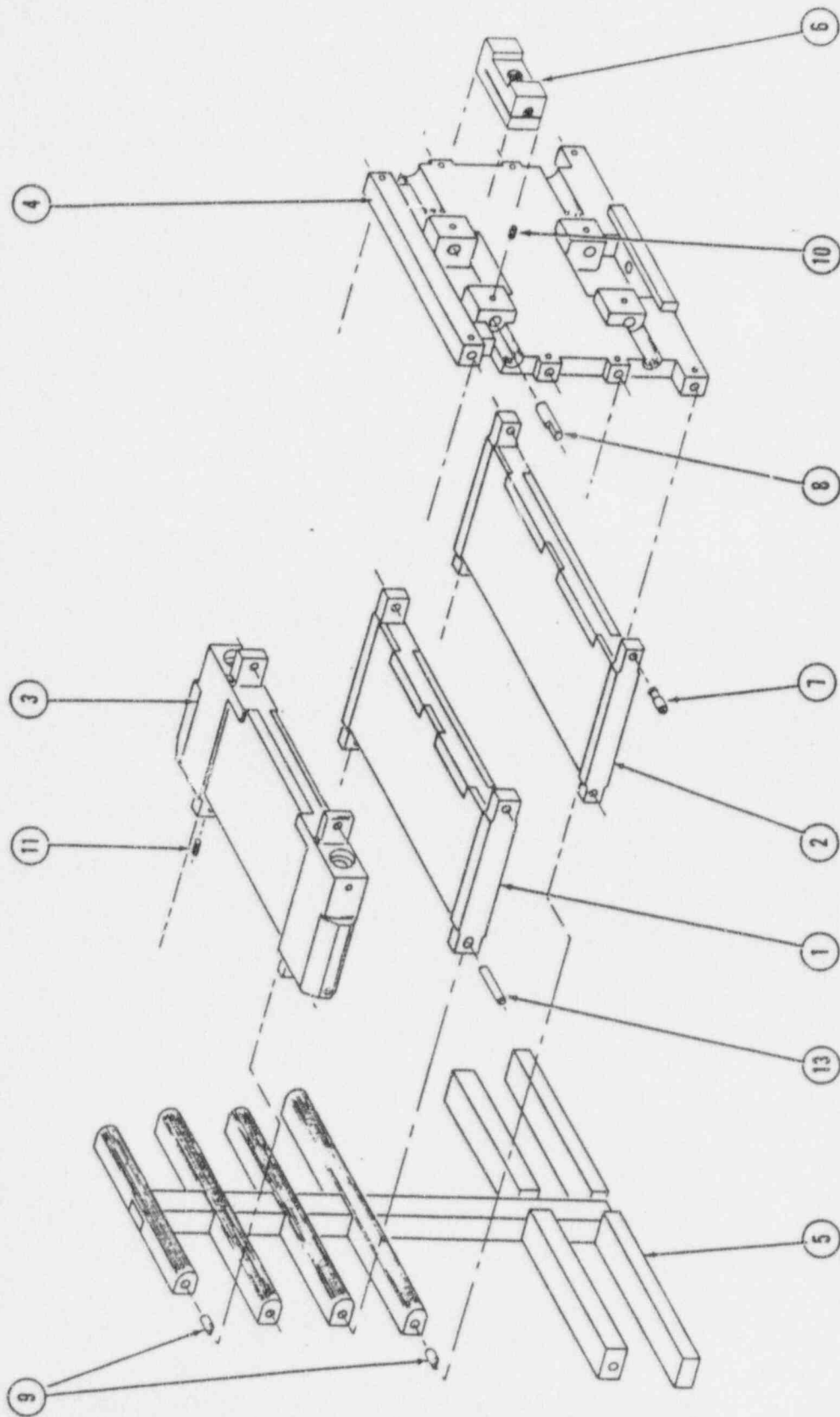


FIG. 10 - REAR PLATE ASSEMBLY - Part No. 182277A

FIG. 10 - REAR PLATE ASSEMBLY - Part No. 182277A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
10 -	182277A		Rear Plate Assembly (See Fig. 1, Item 24)	
1	T82176A		Universal Shaft and Screw Round Head Thread	2
2	57436A		Plate - Rear	1
3	59388		Retainer - Bearing	2
4	57622		Shoulder Screw	1
5	T12-450		Bearing - 3/8 ID x 5/8 OD	2
6	T12-467		Bearing - 1/4 ID x 3/8 OD	2
7	T77-345		Gear - Idler	1
8	T12-464		Bearing - 1/4 ID x 1/2 OD	1
9	T77-366		Gear	1
10	T14A-63		Roll Pin - 1/8 Dia. x 3/4 Lg.	3
11	T14D-197		Dowel - 3/16 Dia. x 1/2 Lg.	2
12	T77-367		Gear	1
13	57639		Post - Gear Box	4
14*	T4A-44		Nut - #6-32	1
15*	S96A-11		Washer - 5/32 x 5/16 x 3/64	1
16	T12-466		Bearing - 5/16 ID x 1/2 OD	1
17	T77E-138		Sprocket - 24T 1.182 OD	1
18	S277A-27		Screw - 10-32 x 1/2 Button Head	4
19	S96A-14		Washer - #10	4
20	S93-4		Shakeproof - #10 Washer	4
21*	S93-2		Washer - #6 Shakeproof	1
22	S21A-2		Screw - 6-32 x 1/2 Socket Head	6
23	S85A-3		Lockwasher - #6 Spring	6
			*Not shown.	



1407

FIG. 11 - VANE ASSEMBLY, "Y" MOTION SIDE, OPPOSITE DIAL - Part No. 183031

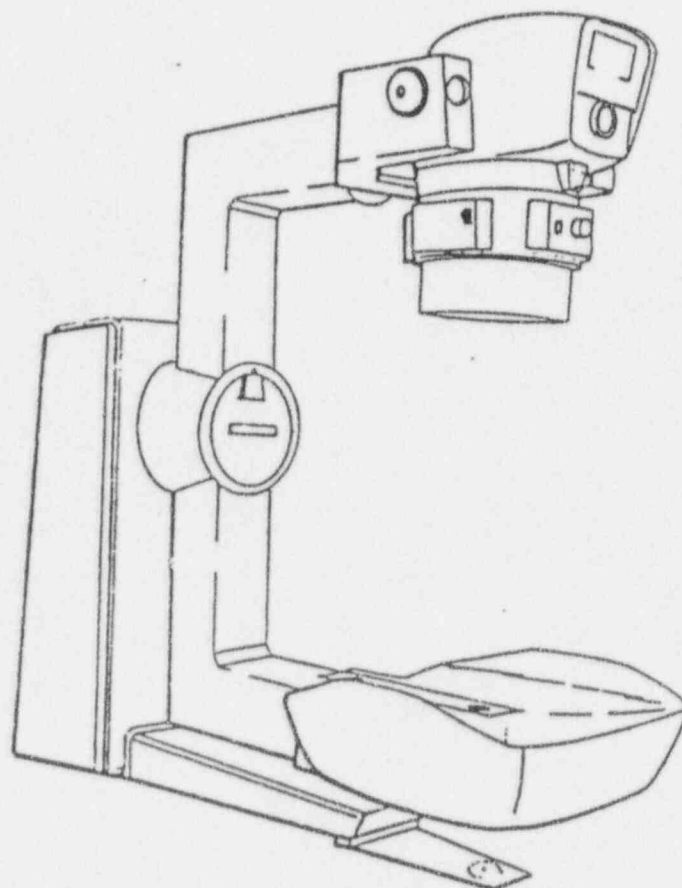


FIG. 11 - VANE ASSEMBLY, "Y" MOTION SIDE, OPPOSITE DIAL - Part No. 183031

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
11 -	183031		Vane Assembly, "Y" Motion Side, Opposite Dial (See Fig. 1, Item 27)	
1	183030		Intermediate Vane	2
2	183029		Bottom Vane	1
3	184019		Vane - Bushing Assembly	1
4	548288		Rear Plate	1
5	59519		Tungsten Tree Machining	1
6	T4-448		Lead Screw Nut (Left Hand)	2
7	T14D-182		Vane Pivot Pin	6
8	T14D-186		Lead Screw - Pivot Pin	4
9	T14D-198		Pin - Pivot Tungsten Tree	4
10	S33-12		Screw - 8-32 x 1/8 Socket Set Cup Point	10
11	S33-99		Screw - 4-40 x 3/16 Socket Set Screw, Cup Point	6
12	S301-97		Loctite - Grade "HV"	A/R
13	T14D-241		Pin - Dowel	4

C/9 MAINTENANCE MANUAL

H57:M, REVISION A  
1 MARCH, 1982



## INTRODUCTION

This MAINTENANCE MANUAL has been compiled to instruct and aid in the general and preventative maintenance of the AMS C/9 unit. The procedures contained herein are not all-inclusive in regard to the total servicing and/or calibration required for the proper function of the equipment.

NOTE

Responsibility for securing the appropriate regulations and guidelines for the maintenance and calibration of radiation therapy equipment belongs to the equipment licensee (user).

Section 1 of this manual begins with a routine maintenance schedule. The schedule provides a suggested frequency for inspecting and servicing components and/or functions of the C/9 unit.

Those procedures with titles accompanied by an asterisk (\*) are intended exclusively for a "qualified expert" in radiation therapy techniques. Also, the following "WARNING" pertains to the devices involved in any such procedure.

QUALIFIED EXPERT: With reference to radiation protection, a person having the knowledge and training to measure ionizing radiation, to evaluate radiation safety techniques, and to advise regarding protection needs. With reference to the calibration of radiation therapy equipment, a person having, in addition to the above qualifications, training and experience of the clinical applications of radiation physics to radiation therapy. (NCRP Rep No. 33)

WARNING (\*)

ANY MAINTENANCE OR REPAIR OPERATIONS ON A TELETERAPY UNIT INVOLVING WORK ON A SOURCE DRAWER, THE SHUTTER, OR OTHER MECHANISM THAT COULD EXPOSE THE SOURCE, OR COMPROMISE THE SAFETY OF THE UNIT AND RESULT IN INCREASED RADIATION LEVELS SHALL BE PERFORMED ONLY BY PERSONS SPECIFICALLY AUTHORIZED BY THE NRC OR AN AGREEMENT STATE TO PERFORM SUCH SERVICES.

Section 2 is an electrical circuits description, composed to assist maintenance personnel in locating any particular electrical problem.

Section 3 contains troubleshooting charts including suggested corrective actions. The areas covered are; electrical troubleshooting, mechanical troubleshooting, and troubleshooting the VG8 unit.

CAUTION

UPON COMPLETION OF ANY INSPECTION OR SERVICING OF THE C/9 UNIT, A THOROUGH CHECK OF THE UNIT SET-UP AND TREATMENT FUNCTIONS IS REQUIRED. RESPONSIBILITY FOR THE VERIFICATION OF PROPER UNIT FUNCTION BELONGS SOLELY TO THE "QUALIFIED EXPERT".

# Section 1

## ROUTINE MAINTENANCE

The following is a schedule of the maintenance required on the C/9 Cobalt-60 Units. Following this chart is an explanation of each item listed and what should be done at the scheduled time. By carefully following these procedures, the risk of injury, maladjustment or prolonged shut-downs for servicing can be minimized.

PART/FUNCTION	PROCEDURE REQUIRED	FREQUENCY	Page
Mode selector switches	Check operation of each	1 week	1.2
Treatment Timer *	Check timer accuracy	"	1.2
Shutter *	Opening and closing time, Position Indicators	"	1.1
Optical distance indicator *	Check accuracy	1 month	1.2
Yoke centering switch *	Check zero-centering and isocentric accuracy	3 months	1.3
Head-Tilt centering switch *	Check zero-centering and isocentric accuracy	"	1.4
C-arm centering switch *	Check zero-centering	"	1.2
Stand	Tighten bolts	6 months	1.5
C-arm and Drive sprocket	Tighten bolts	"	1.5
Head-Trunnion	Tighten bolts	"	1.5
Barrier/counterweight	Tighten bolts	"	1.6
Zonagard *	Check mercury switches, lamps	"	1.6
Shutter V-belt *	Check wear	"	1.6
Drive gear reducer/sprocket	Lubricate, inspect	12 months	1.7
Drive chain	Lube, adjust, inspect	"	1.7
Slip rings	Inspect, service	"	1.7
Skip-Scan switch	Verify function	"	1.8
Speed controls *	Check accuracy	"	1.13,14,15
Yoke drive	Lubricate gear	"	1.9
Tilt drive	Lubricate gear	"	1.11
Yoke limit switches *	Check function	"	1.9
Tilt limit switches *	Check function	"	1.11
Yoke, Head, C-arm centering switches *	Zero-centering, isocentric accuracy	When Required	1.2,3,4
Yoke-rotation brake	Check, adjust	"	1.9,10
Head-tilt brake	Check, adjust	"	1.11,12

\* CAUTION: Service and/or adjustments may be performed only by personnel licensed by the NRC or an Agreement State to service Cobalt Units.

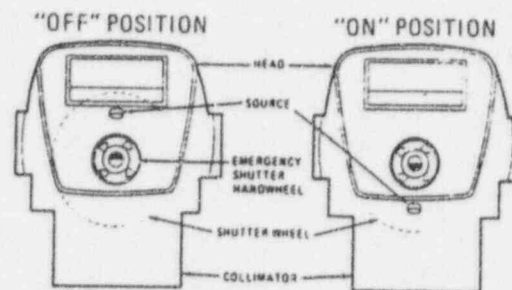
## SHUTTER CLOSING AND OPENING TIME \*

\* CAUTION

WHENEVER CHECKING THE SHUTTER, DRIVE BELT, OR LAMPS, BE SURE YOU READ THE WARNINGS TO SERVICE PERSONNEL IN THE FRONT OF THIS MANUAL. SERVICE/ADJUSTMENTS MAY BE PERFORMED ONLY BY PERSONNEL LICENSED BY THE NRC OR AN AGREEMENT STATE TO SERVICE COBALT UNITS.

WARNING

IF THE SHUTTER OPENING OR CLOSING REQUIRES MORE THAN TWO SECONDS, CONTACT THE FACTORY FOR ASSISTANCE AND NOTIFY THE OPERATOR TO BE ON THE LOOKOUT FOR A SHUTTER FAILURE UNTIL REPAIRS ARE MADE. A STICKY SHUTTER CAN BE VERY DANGEROUS.



SOURCE TRANSFER MECHANISM

A motorized shutter-drive rotates the shutter wheel (and source) to the "ON" position. A V-belt pulley concurrently winds a heavy clock spring until the "ON" position is reached. The motor acts as a counterpoise against the tightly-wound spring. Counter-force is maintained by the stalled motor at low voltage (70-80VAC) as long as electrical power is applied.

Upon completion of the treatment time, or in the event of a power failure, the spring will automatically return the source to the safely-shielded "OFF" position. Note that while the complete source return process requires a 180-degree reversal of the shutter wheel, only during the first 20-degrees of closing is a meaningful amount of radiation emitted.

To make the shutter test, the treatment room doors must be closed, the white Zonegard lamp lit, and the treatment room cleared of all personnel. Set the Treatment Timer for 1 minute. Insert the shutter key in the control and actuate the keyswitch. Hold for approximately two seconds until the green source position indicator extinguishes leaving the red indicator on. Release the key.

The following sequence should occur:

## SOURCE POSITION:

## OCCURENCE:

0° (keyswitch off)

Green source position indicator lit

0° to 142° (keyswitch on, held)

Red and Green position indicators lit.

142°

Elapsed time meter starts.

180° (release keyswitch)

Green source position indicator extinguishes, Red indicator on, Red ZONEGARD lamp ON, TREATMENT TIMER starts, ELAPSED TIMER running.

After one minute, the shutter should close extinguishing the red indicator lamp in the control, leaving the green indicator lit.



## OPTICAL DISTANCE INDICATOR

- Place the C-arm at its 0° position, with the extenders removed.
- Place the alignment fixture paddle at a distance of 35cm (13-29/32 inches) from the bottom edge of the lowest fixed trimmer bar.
- Turn on the collimator field and optical distance indicator lamps.

The etched reticle in the distance indicator contains a graduated scale ranging from 55cm to 100cm. The 80cm mark on the projected localizer scale should fall on the intersection of the collimator cross hairs,  $\pm 2$ mm.

To adjust the distance indicator,

- Loosen the four screws that secure the lamp bracket to the collimator.
- Adjust the three set screws in the bracket until the 80cm graduation falls on the intersection of the cross hairs.
- Check the alignment ( $\pm 2$ mm) at the 60 and 100cm positions. (Assure proper source to image distance.)
- Tighten the four lamp bracket screws.

## TREATMENT TIMER \*

Use an accurate stop watch to check the accuracy of the timer. The timer accuracy should fall within a tolerance of  $\pm 1$  percent. Use a large time period to minimize errors in measurement.

NOTE

THIS PROCEDURE IS NOT APPLICABLE TO "TIMER ERROR" MEASUREMENTS AS REQUIRED BY THE USNRC.

## MODE SELECTOR SWITCHES

All the mode selector switches on the control should be checked for proper function. Refer to the General Description section of the OPERATORS MANUAL ( T55B-28, Rev. A ) for the function of each mode selector.

## C-ARM CENTERING SWITCH \*

The C-arm centering switch (SW32) is located at the rear of the large C-arm drive sprocket. An actuator depresses the centering switch when the C-arm reaches zero degrees. When rotated in the SLOW speed mode with the pendant handswitch, the C-arm must stop at 0° in either the clockwise or counterclockwise direction.

To adjust;

Place a 10-inch (25 cm) level across the upper-most cap screws which secure the main sprocket. Rotate the C-arm a little in both directions until the two cap screws are level. This is the accurate 0° position to set the C-arm centering switch.

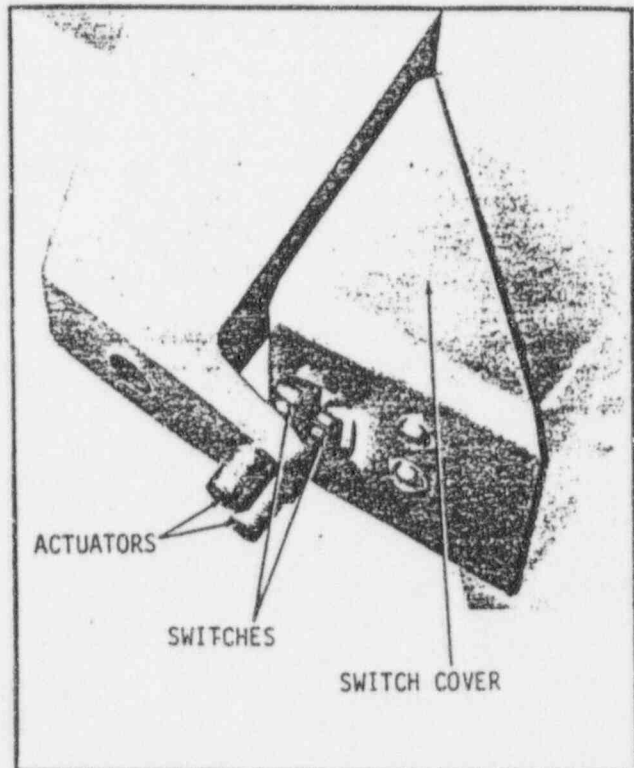
## YOKE CENTERING SWITCHES \*

During yoke rotation, the head must stop at zero degrees and the collimator cross hairs must focus on isocenter  $\pm 2$ mm.

Service/adjustments are to be performed only by personnel licensed by the NRC or an Agreement State to service Cobalt Units.

Yoke centering adjustment:

- Referring to INSTALLATION manual T55-570, Rev.A, use the techniques explained to locate the true isocenter of the unit.
- Place the C-arm to its 0° position and turn on the collimator field lamp. The Field cross-hairs must intersect the alignment paddle cross-hairs,  $\pm 2$ mm, at the true isocentric distance (SAD).
- Remove the covers over the yoke centering switches and actuators, located at the interface of the yoke and C-arm.
- Center the yoke and head for zero-positioning of the cross hairs on the alignment fixture by jogging with the pendant handswitch.
- Position the yoke centering switches so the rollers align with the actuators on the yoke.
- Loosen the lock-set screws in the yoke actuator bracket. Turn the threaded actuators against the switch rollers until a "click" is heard inside the switch. Both switches must be actuated at the same time.

CAUTION

BOTH SETS OF ACTUATORS MUST BE ADJUSTED SO THEY JUST TRIP THE SWITCHES, WITHOUT USING ALL THE OVERTRAVEL BUILT IN.

NOTE

Check actuator points. If a sharp tip is evident, file down to avoid any indentations on the switch roller. Replace switch if damaged.

- Rotate the yoke clockwise, then counterclockwise and observe the cross hair projection on the alignment fixture to verify that centering is consistent from both directions. If not, recenter yoke and readjust the actuator screws.

## YOKE CENTERING (cont'd.)

- If the yoke stops before center consistently from one direction and the actuator screws do not correct this condition, then loosen the switch bracket and slide the switch assembly in the direction of rotation. Readjust the actuator screws.
- Check centering again and, if satisfactory, tighten all mounting screws and the actuator set screws.
- Reinstall covers.

## HEAD-TILT CENTERING SWITCH \*

Service/adjustments are to be performed only by personnel licensed by the NRC or an Agreement State to service Cobalt Units.

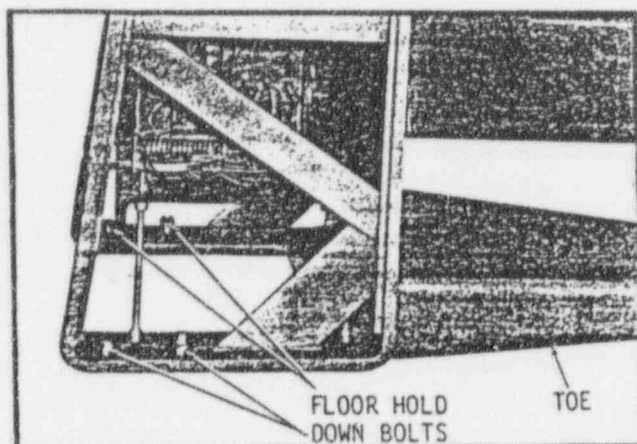
The head-tilt centering switches (SW30 and 47) are located at the front center of the yoke. The actuators are mounted at the rear center of the cobalt head.

To adjust the head-tilt centering device refer to the Yoke Centering procedure. The head is tilted inward and outward, and the actuators and switches are adjusted to stop the head when centered at zero degrees.



## STAND FLOOR BOLTS

Tighten the stand-to-floor mounting bolts/nuts using a large adjustable wrench or a 15/16 open-end wrench.



### C-ARM DRIVE SPROCKET

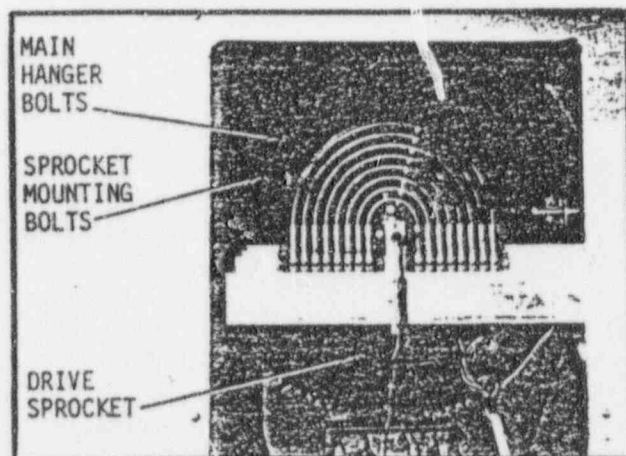
Remove the left-hand shroud from the Stand and note the location of the sprocket mounting bolts. (Ten 5/8 X 18 socket-head screws)

Rotate the C-arm in the SLOW speed mode until a mounting bolt is accessible through the opening above the upper diagonal brace on the left-hand side of the Stand. Mark this screw with a crayon or chalk.

With a 1/2" allen wrench, partially torque the screw. When each of the mounting bolts has been partially torqued, continue the rotation procedure and final-torque each bolt to 240 Ft.-Lbs.(33 Kg-m). (80 Lbs. with a three-foot extension or 120 Lbs. with a two-foot extension.)

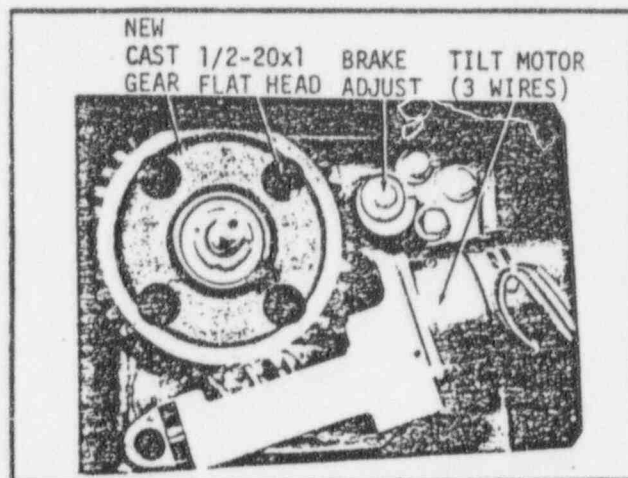
### STAND TO C-ARM BOLTS

These bolts are accessible through the ten holes in the large C-arm drive sprocket. Proceed as above to torque each bolt to 240 Ft.-Lbs. (33Kg-m)



### HEAD TO TRUNNION AND TRUNNION RETAINER BOLTS

Remove both Yoke arm covers. Rotate the C-arm to the 90° position. Using 5/8" allen wrench, torque the four bolts in the lower-most arm to 40 Ft.-Lbs. 11Kg-m). Torque the trunnion bearing retainer bolts in the upper-most Yoke arm to the same specification. (The weight of the Head is pulling the trunnion bearing into its seat.) Rotate the C-arm to the 270° position and repeat the torquing process.





### BARRIER/COUNTERWEIGHT BOLTS

Remove the hanger cover (barrier end) or the counterweight shroud. Using a torque wrench and a 5/8-inch Allen wrench, torque these 3/4-16 bolts to 420 ft.-lbs. (58 Kg-m). Tighten the bottom bolts first. Then, rotate the unit 180° and tighten the remaining bolts. If a torque wrench is not available use a 3-foot extension pipe on the Allen wrench to exert a pressure of 140 pounds or a 2-foot pipe extension to exert 210 pounds pressure.

### ZONEGARD LAMPS \*

One white lamp and two red lamps illuminate the "Zonegard" window. When only the white lamp is on, the shutter is closed. When the red lamps are on, the shutter is open. The tilt switch (SW6) is located in the Yoke, between the head-tilt limit switches SW28 and SW29. When the head tilt is in the center position, SW6 is closed by the actuator arm, energizing the white Zonegard lamp L2. If the key in the control is turned to the "ON" position, the white lamp goes out and the red lamps light, indicating that the shutter is open. For a more detailed description see Section 2.

### ZONEGARD MERCURY SWITCHES \*

Two mercury switches, SW8 and SW9, located in the front part of the left-hand yoke arm, can be adjusted to close the shutter should the angle of yoke-rotation aim the beam toward unshielded areas of the treatment room.

The mercury switches, SW8 and SW9, are connected in series, and the tilt switch SW6, Zonegard Relay (RE22), Collimator limit switches SW23, 34, 35, 37, 38 are all connected in parallel across both SW8 and SW9. Thus, if either the tilt switch is closed or, if both mercury switches are closed, the shutter circuit is complete and the shutter can be opened with the control key. The mercury switches are to be positioned to close when the collimator is pointed at a room wall (or floor) thick enough to shield adjacent areas from the direct radiation beam. Thus, the head can be tilted such that the radiation beam no longer strikes the radiation barrier, and the shutter opened, if the radiation beam is directed at a safe room wall.

The exact adjustment of the mercury switches, SW8 and SW9, must be determined in accordance with the radiation shielding design of the room.

### SHUTTER V-BELT DRIVE \*

As the Cobalt Unit is used, some wear of the V-belt in the shutter drive will occur. It is recommended that the head be vacuum-cleaned whenever the cover is removed, to extract any V-belt residue or dust trapped within.

When installing new V-belts, some adjustment of the idler spring is necessary to equalize the shutter opening and closing times. Belt replacement also necessitates careful checking of the shutter operation several times to see that the belt does not take a quick set and begin to slip.

## DRIVE GEAR REDUCER

- Remove the right-side stand shroud.
- Remove the oil filler plug (on top of the reducer) and check the level of the oil. If the oil is more than 1/2 inch (13mm) below the filler plug, add A.M.S. # S-304-49 Lubricant until the 1/2-inch level is reached.
- A visual inspection should be made of the gear box for any oil leaks. If oil is evident, tighten all the gear box screws and check that the oil drain plug is tight.
- Inspect the sprocket on the gear reducer shaft. Make sure this sprocket is tight on the shaft. If loose, inspect the 1/4-inch (6.35mm) key and, if worn, replace it with an oversized key.

Replacing sprocket key:

- To install the oversized key, raise the motor-mounting channel just enough to remove the drive chain from the drive sprocket.

WARNING

BE SURE THE C-ARM IS PROPERLY BALANCED OR SUPPORTED  
BEFORE REMOVING THE CHAIN. REMOVING THE DRIVE CHAIN  
ALLOWS THE C-ARM TO ROTATE FREELY.

- Remove the four motor-mounting bolts and turn the sprocket and shaft toward you.
- Remove the two sprocket set screws and, with a gear puller, remove the sprocket.
- Remove any burrs from the reducer shaft and the inside surface of the sprocket.
- Place the oversized key in the shaft keyway to assure a positive fit, then remove it.
- Reinstall the sprocket on the shaft with the sprocket and shaft keyways aligned.
- Partially tighten the sprocket set screws, then insert the oversized key.
- Place the sprocket in its original position on the shaft and tighten the set screws.
- Remount the motor/reducer, but do not tighten the mounting bolts.
- Lay a long straight edge (vertically) against the face of the large C-arm sprocket and align the reducer sprocket with the straight edge.
- Tighten the motor-mounting bolts.
- Reinstall the drive chain and lower the motor-mounting channel to tighten the chain. (Refer to Chain Adjust on page 1.8.)



## DRIVE CHAIN CHECK/ADJUST

WARNING

REMOVAL OR FAILURE OF A CHAIN ALLOWS THE UNIT TO ROTATE FREELY AND COULD CAUSE INJURY.

Check over the chain for any worn or defective links. Replace the chain, if required.

Attach a pull scale to the drive chain at a point eight inches above the small reducer sprocket. With a horizontal pull of 10 lbs. (4.5 Kg), the chain deflection should be about 1/8" (3 mm).. If the deflection is greater or less, make the adjustments with the mounting channel adjustment studs. Final check the adjustment by rotating the C-arm in both directions while observing main drive chain deflection. Readjust as required. Be certain to secure any chain adjustment by tightening the adjust nuts against both sides of the motor-mounting channel!

## SKIP-SCAN SWITCH ACTUATION

WARNING

REMOVE THE SHUTTER KEY FROM THE REMOTE CONTROL UNIT DURING THIS CHECK.

Place the C-arm at the 0° position, with all the tabs in the "Tab-out" position. Starting at the 15° tab on the rotational scale, depress four tabs, skip six tabs, then depress four more tabs. Continue in this sequence around the scale.

With the MAIN POWER OFF, remove the C-arm rotational scale pointer, exposing the cam switch, and place the leads of an ohmmeter across the switch terminals.

Energize the unit and, with the pendant handswitch, rotate the C-arm in the "SLOW" speed mode one complete revolution.

The ohmmeter should read zero ohms in the "Tab-in" range, and infinity in the "tab-out" range. If the ohmmeter reads a steady state, the skip/scan switch should be adjusted or replaced.

## SLIP RINGS

The Slip Ring assembly should be visually checked. Over time, the lubricant turns black.

With electrical power off, apply alcohol to a soft cloth and carefully wipe the rings to remove all residue. Apply a small amount of Lubri-Plate to the clean rings to provide better slide action and prevent any squealing noise. (If any dust-producing remodeling is in progress, these rings should be cleaned before the unit is placed into operation.)

## YOKE DRIVE GEAR

Rotate the C-arm to the 90° or 270° position. Rotate the Yoke so as to point the Collimator downward. Turn off all power to the C-9 unit.

Remove the cover from the Yoke drive assembly. Apply some Lubriplate to the Yoke drive gears. Do not get lubricant on the disc brake.

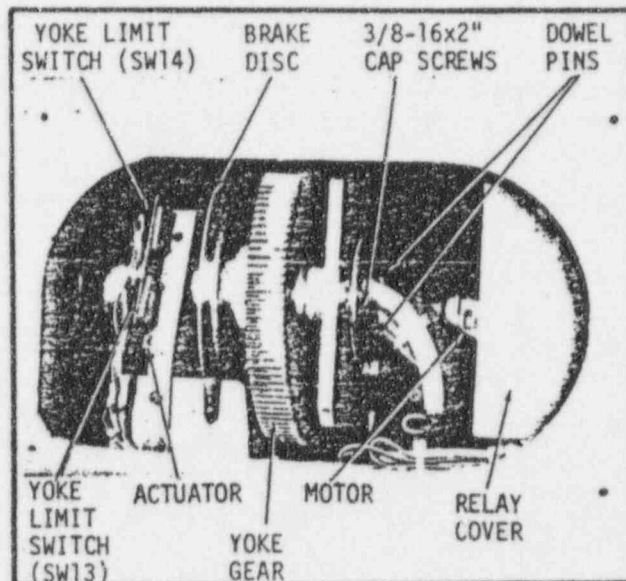
## YOKE LIMIT SWITCHES \*

The Yoke-rotation limit switches are located just forward of the Yoke drive assembly.

Place the Yoke in the 0° position as indicated on the Yoke angulation scale.

Remove the access cover from the Yoke drive assembly.

Rotate the Yoke clockwise with the pendant handswitch. The limit switch (SW-14) should inhibit Yoke rotation at 175° from the 0° position. No override of the switch may be permitted. Repeat the check in the counter-clockwise direction. Limit switch 13 should inhibit rotation without overriding the switch. Should the Yoke travel beyond these limits, loosen and reposition the actuator band to actuate the switches at the correct moment.

CAUTION

TO PREVENT DAMAGING THE CABLE ASSEMBLIES CONTAINED WITHIN THE YOKE, NEVER ROTATE THE YOKE CONTINUOUSLY BEYOND 180° IN ANY ONE DIRECTION.

## YOKE ROTATION BRAKE ADJUSTMENTS

Routine adjustment:

- With a wrench, turn the hex-head brake adjusting screws counter-clockwise until disengaged from the spring.
- Finger-tighten the same adjust screw in the clockwise direction. The screw is now in contact with the compression spring.
- With a wrench, turn each brake adjust screw 3-1/2 turns clockwise.

If the yoke motor is to be replaced, or the surface of the brake pads become glazed causing a squeal, the following adjustment should be made:

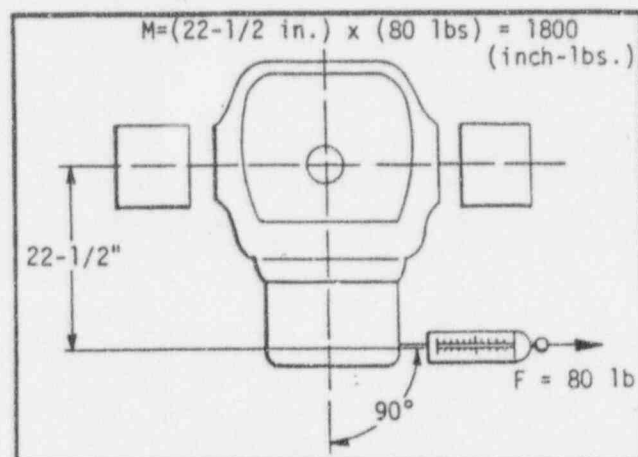
1. Rotate the C-arm to the 90° position, the collimator pointing toward the barrier.
2. Turn off all electrical power to the C/9 unit.
3. Remove the plate covering the yoke rotation assembly.
4. Remove the limit switch bracket, and lay it to one side.
5. Loosen both brake pad adjustment screws until the brake pads clear the brake disc by about 1/8 inch.
6. Remove the brake pad housing.
7. Inspect the brake discs for burrs. Remove any burrs with a flat mill file.
8. Clean brake discs with an alcohol-based solvent.
9. Completely remove the brake pad adjusting screws, tension springs, brake pad holders, and pads from the housing. (Do not attempt to remove the brake pads mounted in the rear of the housing.)
10. Using a flat mill file, remove the glazed surface from the brake pads. Make sure the pad surface remains flat and square. Round-off all sharp edges.
11. Clean pad surfaces with a cloth dipped in an alcohol-based solvent.
12. Apply a thin coat of grease to the brake pad tension spring.
13. Reassemble the brake components. Insert the brake adjusting screws and turn them one revolution.
14. Install the brake housing in the yoke. Position the housing so that the surface of the fixed pads just touch the brake disc. Secure the brake housing to the yoke, replace the four bolts and the dot plugs.
15. Turn the brake adjusting screws clockwise until the brake pads just touch the brake disc, then turn the screws an additional 3-1/2 revolutions.
16. Perform a brake tension test as follows;

Remove the yoke drive motor from its mounting plate.

Place the hook of a 100-pound pull scale under the bottom, right side of the collimator frame.

Adjust brake tension for 80 lbs. (36 Kg) of pull.

Reassemble yoke drive components and the limit switch function (pg.1.9).



## TILT DRIVE GEAR

Rotate the C-arm to the 90° position. Rotate the yoke to the 0° position. Turn off all power to the C/9 unit.

Remove the cover on the right side of yoke, exposing the tilt drive motor and worm gear.

Apply Lubri-Plate to the worm drive.

## HEAD-TILT LIMIT SWITCHES \*

Switch SW28 limits the outward tilt of the head, while SW29 limits the inward tilt. Both switches are located in the left side of the yoke hanger. Remove cover and position the head to the angular tilt limit as defined in accordance with the radiation shielding design of the room. Loosen the screw on the actuator arm and place the actuator directly over SW28, making sure the switch arm is fully-depressed. Tighten the actuator arm.

CAUTION

IN ADJUSTING SWITCH SW29 IN THE FOLLOWING STEP,  
MAKE SURE THE COLLIMATOR DOES NOT STRIKE THE YOKE .

The actuator arm should depress the switch SW29 when the head is positioned 20° inward. Position the actuator accordingly.

## HEAD-TILT BRAKE ADJUSTMENT

Routine adjustment; (See photo, next page)

- Turn the brake adjusting screw counterclockwise until disengaged from the spring.
- Finger-thread the screw clockwise until a slight resistance is felt.
- Turn the screw an additional 3 to 3-1/2 turns.

Special adjustment;

If the tilt motor should need replacing, or the surface of the brake pad becomes glazed (causing a squeal), the following steps are recommended:

1. Rotate the C-arm to the 90° position, with the collimator pointing toward the barrier.

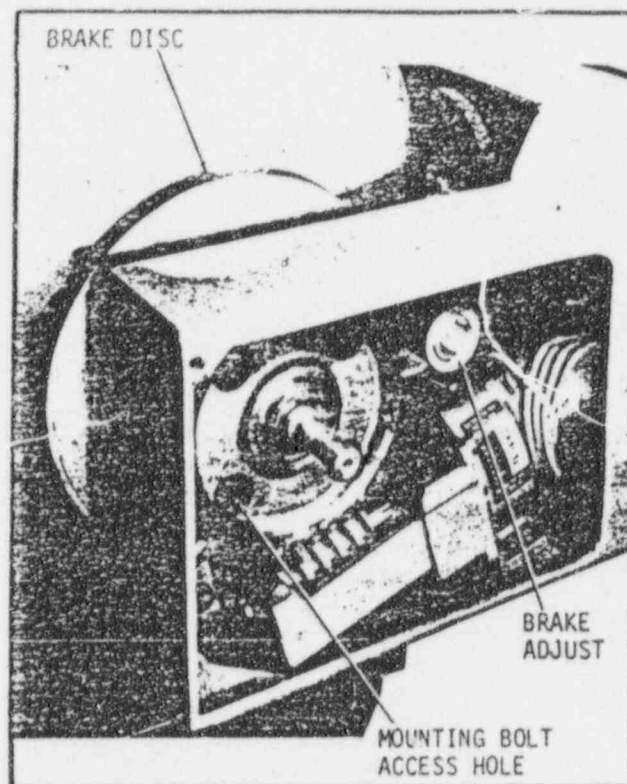
2. Turn off all electrical power to the unit.
3. Remove the dot plug, pointer cover, and pointer from the right side of the yoke.
4. Remove the right side yoke cover.
5. Remove the brake adjusting screw, tension spring, and brake pad holder.
6. Remove the inner brake pad housing and any shims by unscrewing the three bolts which secure them to the yoke.
7. Using a flat mill file, remove the glazed surface from the brake pads. Make sure the pad surface remains flat and square. Round-off all sharp edges.
8. Clean pad surfaces with a cloth dipped in an alcohol-based solvent.
9. Reposition the inner brake pad housing on the yoke. The brake pad must touch the brake disc. If the pad does not touch the disc, remove shims until it does. If the pad does not touch the disc without shims, the pad must be replaced.
10. Secure the inner brake pad housing to the yoke with the three mounting bolts.
11. Rotate the yoke counterclockwise until the collimator points toward the floor.
12. Apply a thin coat of grease to the brake tension spring.
13. Reassemble the brake assembly. Insert the brake adjusting screw and turn clockwise until the pad just touches the brake disc. Then, turn the screw 3-1/2 additional revolutions.
14. Perform a brake tension test as follows;
 

Remove the motor/worm-drive assembly by removing the three mounting screws.

Attach the hook of a 100-pound pull scale to the front, bottom edge of the collimator and pull until head moves.

The reading on the scale should be 55.5 lbs.(25 Kg). (55.5 lbs.x 22.5 in. exerts a momentary force of 1250 inch-pounds.)

Remount the head-tilt motor/drive assembly.
15. Turn on electrical power and check braking action.
16. Check the head centering switch for proper operation. (See page 1.4)





## RATIOTROL C-ARM DRIVE SPEED CONTROL \*

The 1385F Stand incorporates a direct-current 1/4 H.P. C-arm rotational drive control. The RATIOTROL drive is a single-phase, 115 Volt, 50 or 60 Hz, SCR speed control. Detailed circuit descriptions, schematics, etc. are provided in Ratiotrol manuals which are part of the C/9 document package.

Controls

The RATIOTROL has been Factory-tested and adjusted prior to shipment. No adjustment should be necessary at the time of installation.

In some cases, due to a difference in line voltage, some adjustment may be necessary. The only controls that might require a readjustment are the MAX, MIN, and LOW SPEED potentiometers.

CAUTION

DO NOT ATTEMPT TO READJUST THE OTHER POTS. IF COMPONENT FAILURES OCCUR IN ANY OF THE PRINTED CIRCUITS, IT IS RECOMMENDED TO REPLACE THE PRINTED CIRCUIT BOARD.

The degree of accuracy is based upon  $\pm 1\%$  of the maximum degree of rotation per minute. Since  $399^\circ$  is maximum in the stated time, the tolerance should be  $\pm 4^\circ$ . Therefore, at any setting between  $40^\circ$  and  $399^\circ$ , the accuracy should be within  $\pm 4^\circ$ .

NOTE: At speeds below  $40^\circ/\text{Min.}$  the  $\pm 1\%$  regulation cannot be assured.

C-arm: Speed Adjustments \*

To adjust the C-arm rotation, the serviceman must observe the following:

SPECIAL WARNING

THE MACHINE MUST NOT BE TURNED ON IF THERE IS SOMEONE IN THE ROOM, AND NO-ONE SHOULD ENTER THE ROOM UNLESS HE IS ABSOLUTELY SURE THE SHUTTER IS TURNED OFF. THE SURVEY METER SHOULD BE USED AFTER EACH OPERATION OF THE SHUTTER AND BEFORE RE-ENTERING THE TREATMENT ROOM. ALSO, THE SURVEY METER SHOULD BE USED TO CHECK UNKNOWN RADIATION LEVELS BEFORE PERSONNEL WORK IN A GIVEN AREA. EACH TIME THE SERVICEMAN ENTERS THE TREATMENT ROOM, THE SHUTTER KEY MUST BE REMOVED FROM THE CONTROL AND PLACED IN HIS POCKET.

WARNING (\*)

ANY MAINTENANCE OR REPAIR OPERATIONS ON A TELETHERAPY UNIT INVOLVING WORK ON A SOURCE DRAWER, THE SHUTTER, OR OTHER MECHANISM THAT COULD EXPOSE THE SOURCE, OR COMPROMISE THE SAFETY OF THE UNIT AND RESULT IN INCREASED RADIATION LEVELS SHALL BE PERFORMED ONLY BY PERSONS SPECIFICALLY AUTHORIZED BY THE NRC OR AN AGREEMENT STATE TO PERFORM SUCH SERVICES.



Minimum Speed Check \*

To check the minimum speed the following steps are recommended:

1. Turn on the control. The field of the motor is now energized. It is recommended to leave the power on approximately 45 minutes before using the C/9 unit, in order to bring the motor up to the optimum temperature. Place the shutter key in your pocket.
2. Using the pendant switch, rotate the C-arm to zero degrees.
3. Clear the area around the C-arm arc of travel. Leave the room and close the door.
4. Set the speed selector (degrees/minute) on the VG-8 Control to 40-degrees/minute.
5. Set the timer for one minute.

WARNING

THE FOLLOWING STEP CREATES A "SOURCE ON" CONDITION, AND FULL RADIATION WILL BE PRESENT. TAKE ALL NECESSARY SAFETY PRECAUTIONS.

6. Set DIRECTION SELECT to clockwise, turn the Keyswitch and hold until the red source position lamp illuminates. At the instant the red light illuminates, depress the ROTATE Switch.

NOTE

Should the Rotate Switch not be depressed at the instant the red light comes on, a timing error will be induced by the operator and wrongly indicate an out-of-spec. condition.

7. When the C-arm stops rotating after one minute, and making sure the shutter is closed, enter the treatment room and note the angular position of the C-arm rotation scale pointer.
8. If the pointer indicates between 36° and 44°, the rotation speed falls within tolerance.
9. If the rotation speed is greater or less than specified in Step 8, then remove the back panel of the C/9 stand. Open the hinged cover of the RATIOCONTROL and proceed to adjust the MIN Speed Pot according to "FAST SPEED Adjustments," page 1.15.

Maximum Speed Check \*

1. Repeat Steps 1, 2, and 3 under MIN Speed Check.
2. Set the speed selector on the VG-8 Control to 399°/min.
3. Repeat steps 5 through 7, above.
4. If the pointer indicates between 395 and 403 degrees, the rotation speed is acceptable, since it falls within the +/- 4-degree tolerance.
5. If the rotation speed is greater or less than specified in Step 4, open the hinged cover of the Ratiotrol and proceed to adjust the Maximum Speed. (See "Maximum Speed Adjust", page 1.16.)

"LOW SPEED" Adjustment of C-arm \*

The pendant handswitch is used to control the C-arm in this procedure. The C-arm can be adjusted to as slow a speed as desired by the radiologist.

1. To adjust, place the FAST-SLOW switch to the SLOW position.
2. Rotate the C-arm with the pendant handswitch.
3. While the C-arm is rotating, adjust the LOW SPEED potentiometer, located on the cover of the RATIOTROL to the desired speed.

CAUTION

TOO HIGH A SETTING WILL CAUSE AN OVERRIDE CONDITION  
FOR THE C-ARM CENTERING SWITCH.

Circuit Protection

Line protection is provided by a 30 amp circuit breaker (CB-1). The drive motor armature circuit is protected by an electronic load sensing device. Both are contained within the Ratiotrol chassis.

"FAST SPEED" Adjustments:Minimum Speed Adjust:

Should the C-arm be rotating too slow or too fast at the 40°/min. setting, adjust the large MIN SPEED (Fine adjust) potentiometer located in the bottom half of the Ratiotrol. Clockwise adjustments increase the rotation speed. Check the speed after each small adjustment of the potentiometer.

Should the adjustment of the fine MIN. SPEED potentiometer above be inadequate, proceed to make very small adjustments of the Min. Speed pot. (R-1), located on the Input printed circuit board inside the Ratiotrol cover. Note that very minor adjustments of R-1 have very large effects on the rotational speed.

After the minimum speed is set, check the maximum speed. These two controls interact with each other. The maximum speed may now have to be readjusted.

#### Maximum Speed Adjust:

Should the C-arm rotate faster or slower than required at the 399°/Min. setting, the Max. Speed Pot. will have to be adjusted. The pot is located on the lower left portion of the Control Board. CW rotation of the pot will increase the maximum speed as indicated by the arrow on the Control P.C. Board. Very small adjustments of this potentiometer have very large effects on the rotation speed.

After the maximum speed has been set, check the minimum speed function. As these two controls interact with each other, the minimum speed may now have to be readjusted.

#### Speed Setting Problems:

##### NOTE

When initiating rotation of the C-arm, one must turn the Keyswitch and hold it until the red source position lamp illuminates. At the instant the red light illuminates, depress the Rotate Switch. Should the Rotate Switch not be depressed at the instant the red light comes on, a timing error will be induced by the operator and wrongly indicate an out-of-spec. condition.

Due to manufacturing tolerances, aging, or line voltage differences, the proper speeds may not be attainable without further adjustments. Before making any further adjustments, every effort must be made to adjust the speeds using the Max. and Min. Speed Pots.

Refer to the Ratiotrol manual (page 15) before proceeding with an adjustment of the I.R. compensation.

The I.R. Comp. Pot (R9) is located near the Max. Speed Pot. at the bottom of the Control P.C. Board. This pot is factory sealed with red paint and should be adjusted only as a last resort. Turn the pot R9 CW very slightly. When this is done both Min. and Max. Speed Pots. must be readjusted.

Caution must be taken as instability will occur should the I.R. Comp. Pot be turned too far CW. If this occurs, a "hunting" action will be observed as the C-arm is rotated. At this point the I.R. Comp. Pot must be turned CCW to regain stability.

#### Final Checks - IMPORTANT

After all speed settings are complete, check both Max. and Min. speeds in the CW and CCW directions. Speed checks at 100°/Min., 200°/Min., and 300°/Min. should be made to verify linearity. If any of the above do not meet specifications, the adjustments must be repeated. Should repeating these procedures prove inadequate notify Advanced Medical Systems service department.

## SECTION 2 ELECTRICAL CIRCUITS DESCRIPTION

### DEPENDENT CONDITIONS

The following circuit descriptions are applicable when;

- SLOW/FAST switch (SW19) in SLOW position
- C-arm at zero degrees (SW32 closed)
- Yoke rotation at zero degrees (SW31 & 48 closed)
- Head tilt at zero degrees (SW6, 30, & 47 closed)
- Collimator field less than 32X32cm (SW33 & 34 closed)

These conditions shall be assumed to exist unless otherwise noted.

Refer to C/9 schematic diagram E-200070. All relays and switches are detailed in the quiescent state. Note that relays 13, 16, 19, & 23 are latching relays. Any 110 volt pulse will cause a latching relay to change position and mechanically latch in that position until pulsed again.

### POWER ON

The MAIN power switch (SW1) engages the L1 (common) and L2 (hot) lines of a 117-VAC power source. When SW1 is tripped, the MAIN Switch Indicator (lamp 1), the white ZONEGARD lamp (lamp 2), and the Green SOURCE POSITION INDICATOR lamp (lamp 3) are illuminated.

Also, transformers T1 & T7 are energized. T1 supplies 6.3 VDC to the Localizer (Optical Distance Indicator) and Backpointer lamps; L9 & L11 respectively. T7 supplies 24 VDC to the Collimator Vane-positioning Motors. Relay 1 is energized, enabling the shutter circuits.

### HEAD TILT CIRCUITS

These circuits are controlled from the pendant handswitch, only. There are no Head-tilt or Yoke-rotation controls at the Remote Control Console. As such, the two circuits are used only during treatment set-ups.

#### HEAD TILT IN

To actuate TILT-IN, depress the Handswitch Enable (SW49) and the Tilt-In push-buttons on the handswitch to energize the Tilt-In relay (RE17), closing contacts RE17B & RE17C. The Tilt Motor drives the Head toward the Stand until either of the depressed handswitches are released or the Tilt-In Limit Switch (SW29) is engaged.

#### HEAD TILT OUT

Depressing the Handswitch Enable and Tilt-Out pushbuttons energizes the Tilt-Out relay (RE18), closing contacts RE18B & RE18C, and powers the Tilt Motor in the CW direction. The tilt motion continues until either of the depressed handswitches are released or the Tilt-Out Limit Switch (SW28) is engaged.

## HEAD TILT CIRCUITS (cont'd.)

NOTE

Switching capacitor leads from the Black motor lead to the Red motor lead reverses the direction of the armature.

HEAD-TILT CENTERING

Switches 30 & 47 are the Head-Tilt centering switches. When the head-tilt motion approaches zero degrees of tilt from either direction, the centering switches become engaged. The tilt-drive relay contacts RE17A or RE18A enable the tilt-centering relay (RE16) to latch, opening RE16B and inhibiting power to the drive motor. At the same time, RE16A closes to bypass SW30 & 47 and inhibit further operation until either the tilt-in or tilt-out pushbutton has been released.

## YOKE ROTATION CIRCUITS

Yoke rotation is controlled from the pendant handswitch, only. Power to the rotation motor is supplied through the Handswitch Enable and either the HEAD CCW or HEAD CW pushbuttons.

YOKE ROTATION, CW

Depressing the Handswitch Enable (SW49) and the HEAD CW pushbuttons energize the Yoke CW relay (RE21) and closes contacts RE21B & RE21C. This powers the motor until the Yoke CW limit switch (SW14) is engaged or either of the pushbuttons are released.

YOKE ROTATION, CCW

Depressing the Handswitch Enable and HEAD CCW pushbuttons actuate the Yoke CCW relay (RE20), which closes RE20B & RE20C. The Yoke rotates CCW until either of the pushbuttons are released or the Yoke CCW limit switch (SW14) is engaged.

YOKE CENTERING

When the Head approaches zero degrees of Yoke rotation from either direction, the Yoke centering switches (SW31 & 48) close, latching the Yoke Disable relay (RE19). RE19B opens, inhibiting power to the rotation drive motor. At the same time, RE19A closes to complete a bypass about the centering switches. Only when the HEAD CW or CCW pushbutton is released and depressed again (energizing relay 20 or 21) will another pulse energize RE19 to close the drive circuit and open the bypass around the centering switches.



YOKE CENTERING (cont'd.)

The ZONEGARD Control Relay (RE22) is de-energized when the Yoke Centering Switches close and latch RE19A. Other conditions permitting (see ZONEGARD LAMPS), the de-energizing of RE22 will turn on the Zonegard lamp and enable the Shutter Drive circuits.

When the next latching pulse is delivered to RE19 (driving the Yoke off-center), RE22 is energized and contact RE22A opens to disable the Zonegard lamp, other conditions permitting.

Note that the Mercury switches (SW8 & 9) provide a bypass around RE22A. The position of the Mercury switches was determined in accordance with the radiation-shielding characteristics of the treatment room upon installation, and must not be altered.

C-ARM ROTATION CIRCUITSHANDSWITCH CONTROL

Depressing the Handswitch Enable (SW49) and C-ARM CCW or CW pushbuttons energize the C-ARM CCW or CW relays (RE14 & 15, respectively). The relays energize RE6 for CCW rotation and RE7 for CW rotation of the C-arm. Rotation continues until either of the pushbuttons are released or, if in the SLOW speed mode, the C-arm centering switch is engaged.

REMOTE CONTROL

When C-arm rotation is initiated from the Remote Control Console, switch 20A energizes RE6 or RE7 directly. The direction of rotation is indicated at the control panel. Engaging the POSITION REMOTE switch CCW or CW (energizing RE6 or RE7) reverses the voltage polarity of the C-arm drive motor armature.

NOTE

The SPEED-DEG./MIN. control on the control console determines the C-arm rotational speed during therapy. A reference voltage is fed from the control to the Ratiotrol through RE14 & 15 normally-closed contacts.



## C-ARM ROTATION CIRCUITS, (cont'd.)

SLOW/FAST SWITCH

Switch 19, in the SLOW position, enables the C-arm Centering Switch (SW32) and allows rotational speed adjustments by the LOW SPEED potentiometer, located on the cover of the Ratiotrol unit. (Automatic C-arm centering functions only when the unit is operated from the pendant handswitch, in the SLOW mode.)

Isolation Relay (RE24) enables the C-arm centering relay (RE23) for centering in either direction of C-arm rotation. (RE23A must be closed to energize the drive relays.)

(Assume Counterclockwise rotation) When the centering switch is engaged at zero degrees of C-arm rotation, latching relay 23 is energized, opening RE23A. (With the L1 side of relay 14 open, RE6 is de-energized and C-arm rotation stops.) At the same time, RE25 is energized, switching RE25A. Should the CCW pushbutton be depressed again, RE23 receives another pulse, latching RE23A for rotation. Relay 25 is also energized, switching RE25A. Thus, the automatic centering circuit is reset for actuation in the clockwise direction. Should the CW pushbutton be depressed (C-arm reached center in CCW direction), RE24 is energized, causing relays 23 & 25 to energize. RE23A closes, completing the drive circuit, while RE23B & 25A are reset for the next centering pulse. The C-arm will rotate until the pushbutton is released or the centering switch is engaged.

In the FAST mode, SW19 shorts the normally-closed contact 23A to inhibit the action of RE23. SW19 also directs the speed reference voltage to VCC buss for MAX SPEED.

DYNAMIC BRAKING

The dynamic braking function occurs when both the CCW relay (RE6) and the CW relay (RE7) are de-energized through the dynamic braking resistor (R6). Braking should occur when either of the C-arm (CCW or CW) pushbuttons are released.

RELAY 28

Relay 28 directs a D.C. voltage from the Ratiotrol control bridge to the internal Ratiotrol logic circuits.

HALO CONTROL RELAY

The Halo switch control relay (RE8) has been disabled at the factory and is shown for reference only with earlier C/9 units.

## SHUTTER DRIVE CIRCUIT

SHUTTER ENABLE CIRCUITS

The following interlocks must be closed to enable the Shutter Drive motor.

- A) Door interlock switch
- B) Zonegard Mercury switches (SW8 & 9)
- C) Halo Control relay (energized - Do not alter.)

OR

- A) Door interlock switch
  - B) Halo Control relay (energized)
  - C) Head-Tilt at 0° on tilt scale (SW6)
  - D) Yoke at 0° on Yoke rotation scale (RE22)
  - E) Collimator field size less than 32X32cm (SW33 or 34)
- OR
- Collimator rotated to 0°, 90°CW, or 90°CCW on Collimator rotation scale (SW35, SW27, or SW38)

SHUTTER OPERATION

The above conditions being met, the Shutter Control relay (RE2) energizes when the Treatment Timer (SW4) is set and the Shutter Keyswitch is actuated.

When RE2A closes, power is supplied to the Shutter Drive motor through resistor R2. At 142° of shutter rotation, the Shutter-Open switch (SW39) is actuated to lock in the Control relay R2. R2 may also be locked in when the SKIP-SCAN relay (RE27) is energized. Once the Control relay is locked in, the Shutter Drive motor will remain under power until either the treatment time elapses, or a SKIP condition occurs in the SKIP-SCAN mode of operation.

The Shutter-Open condition may also be inhibited by opening the treatment-room door or by depressing the EMERGENCY bar on the remote control console.

The EMERGENCY bar, when momentarily depressed, de-energizes RE2, turning off the Shutter motor. Gravity and a tightly-coiled spring return the Shutter to the source-off position. Should the Shutter stick, the EMERGENCY bar may be held depressed to reverse-power the drive motor. The Shutter is then motor-driven to the source-off position.

CAUTION

POWERING THE SHUTTER TO THE SOURCE-OFF POSITION BY HOLDING THE EMERGENCY BAR DEPRESSED SUBMITS THE SHUTTER MECHANISM TO SEVERE STRESSES AND MAY DAMAGE IT. HOLD THE BAR DEPRESSED ONLY IF THE SHUTTER SHOULD FAIL TO RETURN WITH THE POWER OFF.

## TIMER CIRCUITS

ELAPSED TIME METER

This timer is energized by switch 10 in the Head, which is mechanically-actuated at 142° of Shutter rotation.

The meter counts up from zero in .1-minute increments. The timer is incremented by a timing cam which actuates SW25 every .1 minutes. The cam is driven by a 50 or 60Hz timing motor with an output shaft speed of 10 RPM.

The ELAPSED TIME METER is reset to zero upon actuation of the SHUTTER KEYSWITCH.

TREATMENT TIMER

The Treatment Timer is a line frequency pulse counter. The counter is preset for a particular time span by the C/9 operator. Upon being energized, the timer will count down the preset treatment time in minutes and hundredths.

The counter may be reset to the original preset value by depressing the actuator, just below the read-out dial face. Resetting the timer in this manner will also reset SW4 to the normally-closed position.

The Timer Driver is located on a subchassis in the Remote Control. It is a line frequency counter and is thereby only as accurate as the main power line frequency regulation.

The timer has two power supplies: a 24VDC unregulated power supply to operate the counter, and a 15VDC regulated source for the integrated circuits.

Transformer T1 feeds a 50 or 60Hz signal into the timer board which is half-wave rectified by diode CR1. The half-wave pulse train is fed into a Schmidt Trigger wave-shaping circuit in IC-1 (367A1). The output of IC-1 is a square-wave pulse train at the specific line frequency. These square-wave pulses are fed into a divide-by-5 or 6 counter (IC-2) which generates a .1 second clock pulse to trigger two J-K flip-flops in IC-3. There are two jumpers required on the board to determine the proper output frequency. This configuration requires that the line pulses through diode CR2 be in-sync with the counter clock pulses. The enable pulse is fed into IC-1 from normally-open contacts on relay K1. The Schmidt trigger output is fed in IC-4 to enable a NAND gate and buffer. The final output pulse from the buffer (IC-4) fires transistor Q4. Transistor Q4 masters the Darlington transistor Q5 (MJE700). Each Q5 pulse fires the counter index one unit. Diode CR6 and the RC network across the counter coil are used for transient protection of the Darlington Q5 transistor.

The Treatment Timer functions when the Timer Start Relay (K1) is energized by the closing of the Shutter-Open Limit Switch (SW39). When the frequency counter counts down to zero, the normally-closed counter contacts open, breaking the seal on the Shutter Control Relay (RE-2). As RE-2 drops out, the Shutter Rotor will close.

## LAMP CIRCUITS

ZONEGARD LAMPS

The ZONEGARD lamp is illuminated WHITE when the C/9 unit is energized, but in the SOURCE-OFF condition, and ONLY when the Collimator central axis is aimed at an area of the treatment room which is safely shielded. The limits of the safe areas are defined by branch circuits including the Mercury switches (SW8 & 9), the Tilt switch (SW6), RE22A, and the parallel combination of collimator switches SW33, 34, 35, 37, and 38.

As the Shutter begins to rotate, the Shutter Home switch (SW11) opens, turning off the WHITE ZONEGARD lamp and turning on the RED ZONEGARD lamps.

The GREEN SOURCE POSITION INDICATOR functions in tandem with the WHITE ZONEGARD lamp.

RED SOURCE POSITION INDICATORS are illuminated when the Shutter rotates from the Home position. The indicators are located on the C/9 head (ZONEGARD RED), in the treatment room entryway, and on the Remote Control Console (RED SOURCE POSITION INDICATOR).

FIELD ILLUMINATION

The Field lamp receives 20VAC from the T7 transformer, through the 10 amp lamp fuse F7. This lamp is extinguished when the Main power is off, treatment is initiated, or when the Field Lamp switch (SW15) is in the OFF position. The lamp function is mastered through the Field Illumination Relay RE29.

BACKPOINTER/LOCALIZER LAMPS

These lamps receive 6.3VAC from transformer T1. Circuit protection is supplied by line fuse F6.

The Backpointer lamp switch (SW36) is located on the radiation barrier, just behind the lamp port.

The Localizer lamp switch (SW40) is located on the Collimator shroud, along side of the Collimator Field Lamp switch.

MAIN POWER INDICATOR

The MAIN neon indicator (L1) is wired across the main power feed to the Remote Control Console, and is illuminated whenever the MAIN switch (SW1) is closed and fuse F1 is good.

## REMOTE CONTROL UNIT FUNCTIONS

### TREATMENT MODE SET-UP

The FAST/SLOW switch (SW19) is placed in the FAST mode in all moving-beam treatment modes. (The automatic centering circuit is locked out.) The Digi-Pot (R9) speed control (SPEED-DEG/MIN) is used to set the C-arm rotational speed at the Remote Control Console.

### POSITION REMOTE SWITCH

The POSITION REMOTE switch (SW20) is a double-pole, double-throw type which changes the direction of C-arm rotation by directly energizing RE6 or RE7. The B side of the switch illuminates the CW lamp (L19) or the CCW lamp (L18) above the position remote switch.

### DIRECTION SELECT SWITCH

Switch 14 is actuated to select the initial direction of C-arm rotation in the Skip/Scan treatment mode or, when depressed in conjunction with the POSITION REMOTE switch, to rotate the C-arm to the next treatment port in the Index mode.

Actuating the switch changes the position of the Gantry Direction Select Latching Relay (RE13). The CW lamp (L17) and the CCW lamp (L16) above the DIRECTION SELECT switch are controlled through RE13 to indicate the actual direction of rotation.

### FIXED TREATMENT MODE

The conditions necessary to allow the shutter drive circuit to energize are;

#### L1 Side:

- 1a. Either collimator vane set at less than 32cm
- b. Yoke at 0° on the Yoke rotation scale
- c. Head Tilt at 0° on the head-tilt scale

#### OR 2a. Collimator rotated to 0°, 90°, or 270° on rotation scale

- b. Yoke at 0° on Yoke rotation scale
- c. Head Tilt at 0° on head-tilt scale

#### OR 3. Zonegard Mercury switches 8 & 9 closed

#### L2 Side:

1. Treatment Timer set to a time
2. Shutter Keyswitch turned and held



## REMOTE CONTROL UNIT FUNCTIONS (cont'd.)

When the keyswitch (SW3) is actuated, relay 2 energizes, closing RE2B and driving the shutter motor to open the shutter. (See Shutter Drive section)

Switches 10, 11, and 39 are mechanically-actuated by the shutter rotor assembly.

Switch 11 opens when the shutter begins to open, extinguishing the white Zonegard lamp (on the head) and lighting the red source position lamps on the head, in the treatment room entryway, and at the remote control console.

Switch 10 actuates at 142° of shutter rotation, turning off the collimator field lamp (if on) by de-energizing relay 29 to open RE29B, and extinguishes the Green source position indicators. Also, the Counter Pulse Motor is energized, causing the elapsed time meter to increment.

Switch 39 actuates when the shutter is fully-open, extinguishing the green source position lamps on the remote control (L3) and in the treatment room entryway (L4), energizing Relay 26 and the exposure timer. The energizing of RE26 completes a seal around the keyswitch, allowing the operator to release the switch while maintaining a source-on condition. Until RE26 is energized, releasing the key-switch will cause the shutter to return, mechanically, to the source-off position.

Treatment will continue until the treatment timer times-out, opening the drive circuit.

ROTATE MODE

Switch 21 enables the Rotate mode and disables the Oscillate and Skip/Scan modes.

The DIRECTION SELECT switch (SW24) is actuated to preset the circuit for the desired direction of C-arm rotation during treatment. Lamps L16 and 17 indicate the CW or CCW direction selected.

To initiate treatment, the ROTATE switch is depressed while the shutter keyswitch is actuated.

The shutter-opening sequence is as described in the FIXED TREATMENT MODE description. The closing of RE2B provides power thru SW27 (4-5 contacts) and depressed SW21 to energize Rotation relay RE9. The ROTATE lamp (L13) is also lighted.

The Rotation Relay (RE-9) seals in and inhibits the Gantry Direction Select Relay (RE-13). Power is supplied thru relay RE6 or 7 to the C-arm Drive Motor. These relays are in-turn controlled by RE13, RE9, and Index Switch (SW-17).

NOTE

Though all push-tabs should be in the Tab-Out position when treating in the ROTATE mode, if Cam switch 23 should be closed when the ROTATE and SHUTTER switches are actuated, the switching of RE2C will send a pulse thru relay 13 before relay 9 can energize to open RE9C. The unintended pulsing of relay 13 will cause the C-arm to rotate opposite to the desired direction.



## REMOTE CONTROL UNIT FUNCTIONS (cont'd.)

OSCILLATE MODE

The DIRECTION SELECT switch (SW24) must be momentarily actuated. Index tabs on the C-arm must be depressed for the degree of arc to be covered, with one tab out at each end of the arc to provide the reversing signal to the C-arm drive. The OSCILLATE switch (SW22) on the Control must be held depressed while the keyswitch is actuated.

Depressing the OSCILLATE switch and shutter keyswitch inhibits both the Skip/Scan and Rotate modes, while energizing the Oscillation Relay (RE10). The Oscillate mode is locked in when RE10 energizes.

Relay contact 10B closes applying power to the common of contact RE13A. Depending upon the state of RE13A, the C-arm will rotate CW or CCW.

Rotation will continue until the end of the preset arc, when the closing of the Cam switch (SW23) will energize the Gantry Direction Select latching relay (RE13).

As previously described, relay 13A contacts are in series with the power drive relay 6 or 7 and will cause one to drop out and the other to energize, reversing the direction of C-arm rotation. This sequence will continue until terminated by the treatment timer. (The Treatment Timer is represented as SW4 on the schematic.)

SKIP/SCAN MODE

When the Skip/Scan switch (SW27) is closed, relays RE27 (Skip/Scan Auxiliary) and RE11 (Skip/Scan Control relay) are enabled. The Rotate and Oscillate modes are disabled.

As the Cam switch (SW23) is actuated by the depressed tabs, the source will go to the off position. In the "TAB OUT" areas, the source will be on. Several combinations may be selected around the periphery of the C-arm ring.

Skip/Scan switch 27 must be held depressed while the keyswitch is actuated. Relay 2 energizes as described under the "FIXED TREATMENT MODE" description. Power is provided thru relay 2C contacts to the Skip/Scan switch 27 plus relays 11 and 27.

The Skip/Scan Control relay (RE11) is sealed thru contact 11A. Relay contacts 11B close, energizing CW or CCW rotation as selected with the Direction Select switch (SW24).

Relay 2B contacts have opened the shutter at the start of the cycle, providing that the C-arm cycle was started at a tab-out position (SW23 open). As the C-arm rotates and trips switch 23, relay 12 is energized. Relay 12A is in series with the power drive to the shutter motor. As the shutter closes, switch 10 in the Head opens, stopping the exposure timer motor and de-energizing relay 26. Relay 27 normally-open contacts however are parallel to relay 26 contacts, maintaining the lock in circuit to relay 2. As the C-arm continues to rotate, it moves off the cam, allowing switch 23 to open, reopening the shutter for the next scan area. This Skip/Scan cycle will continue until the Treatment Timer terminates treatment.

## REMOTE CONTROL UNIT FUNCTIONS (cont'd.)

INDEX MODE

The FAST/SLOW switch is in the FAST position for all moving-beam treatment modes. Thereby, the DIGI-POT (R-9) speed control is used to set the C-arm rotational speed at the control console, which inhibits the automatic C-arm centering circuit.

The choice of rotational direction is made with the POSITION REMOTE switch on the control console. The C-arm is positioned by depressing both the INDEX and POSITION REMOTE switches at the same time. The C-arm will rotate to the first Depressed-Tab position. The INDEX and POSITION REMOTE switches are released and treatment is initiated by actuating the shutter keyswitch. (The source is off during C-arm rotation.)

When depressing POSITION REMOTE and INDEX simultaneously, the C-arm rotates until a depressed-tab condition interrupts the drive circuit. Power is supplied to the Skip/Scan relay (RE11) via normally-closed contact RE2C when the INDEX switch (SW17B) is actuated. This enables the Skip/Scan Shutter-control relay (RE12). The C-arm rotates in the direction indicated by the Position Select Switch (SW20).

When the CW or CCW relay is powered thru normally-closed contacts RE12B and RE8C, the C-arm will continue to rotate until the INDEX switch is released or a depressed tab is encountered. When this happens, the Skip/Scan Control relay (RE-12) is energized. As RE12 actuates, contact RE12B opens, inhibiting RE6 or 7 by interrupting the SW17, RE12B, RE8C, and Position Remote Switch (SW20) circuit. As the Cam switch (SW23) is actuated, the INDEX lamp (L15) lights to indicate that the desired position has been reached.

EMERGENCY BAR

The EMERGENCY bar (SW2) will interrupt and inhibit any and all operating functions. If the bar is momentarily depressed, the Shutter-Drive motor is de-energized and allows the Source to return to the home position by means of gravity and a tightly-wound coil spring. Should the rotor stick, the source may be powered to the home position by holding the Emergency Bar depressed.

CAUTION

Structural damage to the head may result should the rotor be powered to the home position. ONLY IN EMERGENCY SITUATIONS SHOULD THE EMERGENCY STOP BAR BE HELD DEPRESSED.

COLLIMATOR VANE DRIVE MOTOR

24 VAC is supplied by transformer T-7, through fuse F8 to diode bridge CR. The 24 VDC is applied via dropping resistor R-11 to the common poles of the Long Vane Switch (SW-42) and the Short Vane Switch (SW-41). The reversing of these permanent magnet motors is accomplished by reversing polarity to the motor armature. The travel is limited by microswitches located in the collimator. Should an open-limit switch be actuated, the vane still may be powered in the opposite direction.

### Section 3 TROUBLESHOOTING

#### ELECTRICAL TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
1. No power.	F1, CB-1, or line phase reversed.	Replace fuse/reset CB-1. Connect L1 to ground.
	Main power switch (SW1) in control defective.	Replace switch.
	No input power.	Check power to disconnect switch.
2. C-ARM CW, C-ARM CCW pushbuttons do not function.	Circuit Breaker on Ratiotrol.	Reset Circuit Breaker
	Motor defective.	Replace motor.
3. C-ARM CCW pushbutton inoperative.	Relay 6 defective.	Check for 120V AC across coil.
	C-ARM CCW switch defective.	Replace switch.
4. C-ARM CW pushbutton inoperative.	Relay 7 defective.	Check for 120V AC across coil.
	C-ARM CW switch defective.	Replace switch.
5. C-arm rotates in Fast speed only with handswitch.	Ratiotrol defective.	Check for proper speed settings.
	SLOW/FAST switch defective.	Replace switch.
6. C-arm will not rotate clockwise from control console (source off).	Relay contacts RE9B, 10B, 11B, or 8C not closed.	Replace relay.
	Switches SW17 or SW20 defective.	Replace if defective.
	Relay RE6 or RE7 defective	Replace relay.

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
7. HEAD CW & HEAD CCW pushbuttons do not function.	Yoke motor defective.	Replace motor.
	Capacitor C7 defective.	Check capacitor C7.
	Defective contacts of RE21A, RE20C, RE19A.	Check contacts.
	Above relay coils open.	Check relay coil continuity.
	Pendant Enable switch (SW-49) defective.	Check SW-49 closure.
8. HEAD CW pushbutton inoperative.	Defective HEAD CW switch.	Check switch.
	Yoke limit switch (14) open.	Check switch (SW14).
	Relay 21 coil open.	Make continuity check of coil.
9. TILT IN & TILT OUT pushbuttons do not function.	Switch 17 not closed.	Check SW-17 contacts.
	Tilt motor defective.	Replace motor.
	Pendant Enable switch (SW-49) defective.	Check SW-49 closure.
10. TILT OUT pushbutton inoperative.	Relay 18 defective.	Replace relay.
	Switch (SW28) open.	Check switch (SW28).
	TILT OUT switch defective.	Replace hand tilt switch.
	Switch SW30 and SW47 contacts fused together.	Check switch SW30 or 47.
11. TILT IN pushbutton inoperative.	Relay 17 defective.	Check relay.
	Switch (SW29) open.	Check switch.
	TILT IN switch defective.	Replace switch.
	Switch SW30 and SW47 contacts fused together.	Check switches.

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
12. Shutter does not open.	Keyswitch (SW3) defective.	Replace switch.
	Relay 2 not operating.	Check voltage across relay coil.
	Door switch (SW5) open.	Check door switch.
	Relay 1 inoperative.	Check relay coil and contacts.
	C1 defective.	Check capacitor.
	R2 open.	Check resistance of R2.
	Shutter motor defective.	Replace motor.
	Head positioned beyond room shielding specs.	Reposition head.
	Relay 12 open.	Check coil and contacts.
13. Shutter does not open in Skip/Scan mode. (source on)	Defective Treatment Timer.	Check SW1 open contacts.
	Cam Switch (SW23) not actuated.	Reposition switch.
	Switch SW27 open.	Check switch.
	Relay 11 coil open.	Check relay coil.
	Relay contact RE2C defective.	Clean contacts; replace relay if required.
	RE27 malfunctioning.	Check relay coil and contacts.
14. Field Illumination Lamp (L10), Back Pointer Lamp (L11), and Localizer (L9) will not light.	SW21 or 22 switches open.	Check for continuity.
	Check collimator switch SW-15 and RE-29.	
	Transformer T7 open (L10). Transformer T1 open (L9, 11).	Check for 120V AC across primary and correct secondary voltages.
	Fuses F7, F8 blown.	Replace if defective.
	Ground connection open.	Check terminal 20 on yoke TB-4 for ground.



TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
15. Timer and counter do not operate (shutter open).	Switch (SW10) not actuated when shutter starts to open.	Replace if defective. Check switch actuator.
16. Routine check of emergency switch failed to close shutter.	Defective switch 2.	Replace if defective.
	Poor contact on slip ring.	Make continuity check across yoke terminals TB4-4 and TB4-9 with SW2 depressed. Circuit should be closed.
<u>CAUTION</u> CLOSE SHUTTER MANUALLY WITH SHUTTER WHEEL BEFORE CHECKING.		
17. Elapse Time Counter	"Close" motor winding of shutter motor open.	Check continuity of motor winding across terminals TB4-2 and 4-9.
	Defective SW10 *	Replace Switch
	Defective Timer motor	Replace motor
	Defective cam switch SW-25	Replace Switch
18. Treatment Timer	Defective Counter	Replace Counter
	Defective fuse F1 (inside VG3 timer control chassis).	Replace fuse.
	Defective diode bridge CR1	Replace Bridge
	Defective Power Regulator board.	Replace P.C. board 200018
	Defective Timer Start Relay	Replace K1
	Defective Timer Driver Board	Replace P.C. board 200041,A
	Defective Counter	Replace Counter

NOTE: Should the Timer Driver Board be found defective check diode CR-6 and PC suppression circuit located on the back of the counter.

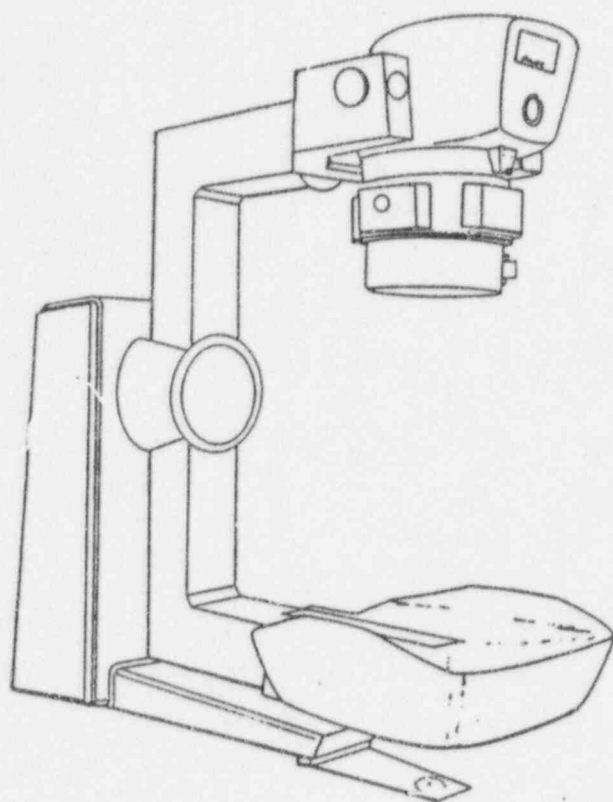


## MECHANICAL TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
1. Squeal present during C-arm rotation.	Slip rings dirty; no lubrication.	Clean with alcohol on soft cloth; apply Lubri-Plate.
2. Squeal present when yoke or head rotates.	Surface of brake pads glazed.	File with flat mill file to remove glaze and clean pads with alcohol.
3. Head or yoke drifts at centerline.	Brakes not adjusted properly.	Adjust brakes (refer to Routine Service).
4. Isocentric alignment varies at various positions of C-arm.	Trunnion mounting bolts require tightening.	Tighten bolts (refer to Routine Service).
	Yoke-to-drive gear bolts require tightening.	Tighten yoke-to-drive bolts.
5. Shutter opening and closing time increased.	Low shutter motor voltage.	Check voltage.
	Damaged gear teeth.	Replace worn gears.
	Excessive friction in motor drive or drive bearings.	Check belt tension; replace defective drive bearings.
6. Backpointer light out of alignment by more than 2mm.	Barrier mounting bolts loose.	Tighten barrier mounting bolts. (Refer to Routine Maintenance).
	Backpointer mirror not adjusted.	Readjust three Phillips head screws on top of backpointer assembly.
7. Optical Distance Indicator inaccurate.	Needs adjustment.	Adjust three set screws in lamp bracket (refer to T55-570 (Rev.A.)).
8. Yoke or tilt motor groans.	Brake tight.	Back off 1/2-turn on brake adjust screw.

## TROUBLESHOOTING GUIDE FOR RATIOTROL

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
1. Line fuse blows.	Defective interconnection.	Check all wiring and connections between line, control, and motor.
	Shorted motor field. Defective suppressor. Shorted field diode. Shorted power diode. Shorted SCR. Improper connection of control panel or magnetic contactor package.	Repair or replace motor. Replace suppressor. Replace all field diodes. Replace all power diodes. Replace all SCR's. Check wiring.
2. Loss of armature current.	Overload.	Remove cause of overload or resize drive HP.
	Defective control-to-motor wiring.  Open field diode. Short circuit in motor. Improper connections of control panel or magnetic contactor package.	Check all cables and connections between control and motor. Replace all field diodes. Repair or replace motor. Check wiring.
3. Armature current OK, Motor does not run.	Open AC line.	Check branch disconnect switch and AC power source.
	Improper wiring.  Defective motor. Defective control board. Defective IR board. Open power diode(s).	Check all AC-to-control wiring and connections. Repair or replace motor. Replace control board. Replace IR board. Replace all power diodes.
4. Motor runs at top speed only.	Defective control board. Defective speed pot. Open field diode(s). Improper connection of control panel or magnetic contactor package.	Replace control board. Replace PCB. Replace all field diodes. Check wiring.
5. Control cannot be set at zero speed.	Minimum speed pot set too high.	Adjust minimum speed pot. (Refer to Procedure).



**C9 COBALT<sup>60</sup> THERAPY UNIT**

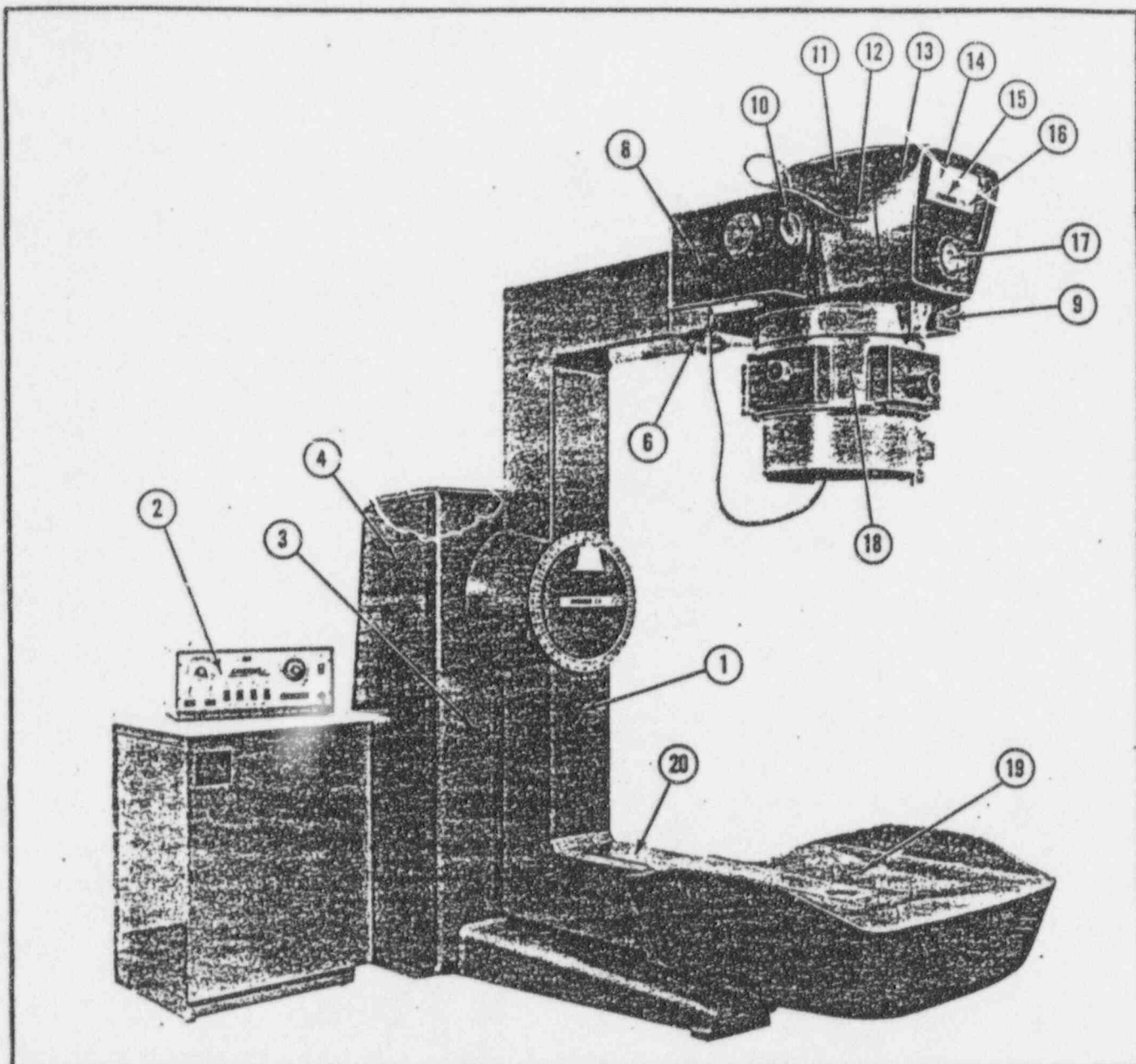
**H57:P**

# PARTS LIST

Cat. 6296 Cobalt<sup>60</sup> Unit

## CONTENTS

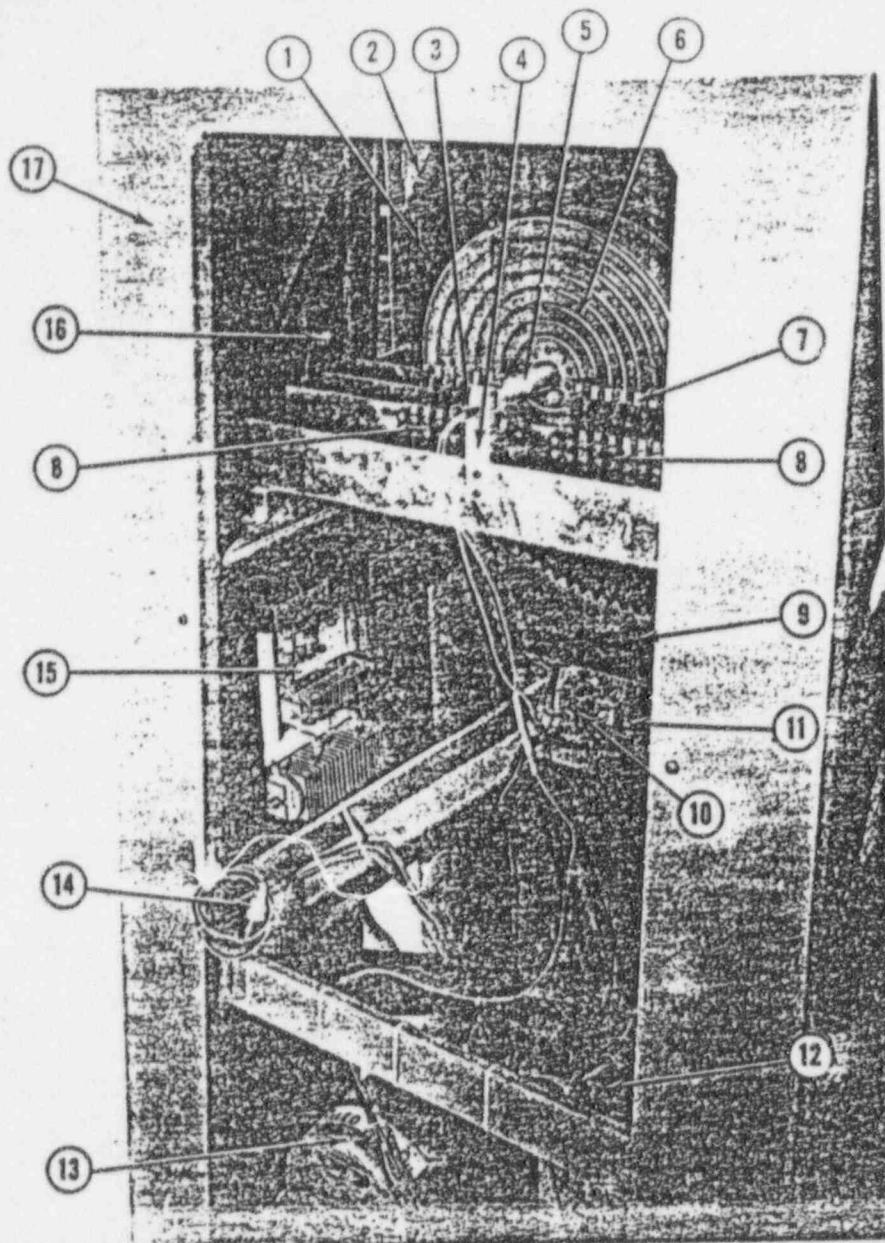
- ① C9 CO<sup>60</sup> UNIT & ASSEMBLIES
- ② CAT. 1385D STAND
- ② STAND (Rear View)
- ③ CHASSIS ASSEMBLY
- ④ DC POWER SUPPLY (Main Motor)
- ⑤ SLIP RING ASSEMBLY - FIGURE 1
- ⑥ OSCILLATING SWITCH ASSY. - FIGURE 2
- ⑦ YOKE ROTATION ASSEMBLY
- ⑧ YOKE ROTATION CONTROL
- ⑨ YOKE (Left Side) 1
- ⑩ L.H. TRUNNION ASSY. - FIGURE 3
- ⑪ YOKE (Right Side)
- ⑫ WORM DRIVE ASSEMBLY
- ⑬ R.H. TRUNNION ASSY. - FIGURE 4
- ⑭ HAND SWITCH ASSEMBLY
- ⑮ COBALT<sup>60</sup> HEAD
- ⑯ BARRIER ASSEMBLY - FIGURE 5
- ⑰ CONTROL, COBALT<sup>60</sup>
- ⑱ CONTROL, COBALT<sup>60</sup> (Rear View)



ITEM	DESCRIPTION	PART NO.
1	C9 CO <sup>60</sup> UNIT & ASSEMBLIES	6296
2	Weldment, C-Arm	46677-C
3	CO <sup>60</sup> Control	VG8-B
4	Stand Assembly	1385-D
5*	Shroud, Left Hand	46657-A
6	Shroud, Right Hand	46657
7*	Scale, Yoke Tilt	54150-A
	Pointer, Yoke Tilt	54151
*	Not Shown	
†	Parts List Not Available at this printing.	

ITEM	DESCRIPTION	PART NO.
8	Cover, Yoke Arm, L.H.	54015-A
9	Cover, Yoke Arm, R.H.	54015
10	Scale, Angulation	13823-E
11	CO <sup>60</sup> Head	590-E
12	Cable, Head to Yoke	BL1824-C
13	Front Cover, Head	46672
14	Window	46717
15	Nameplate	T92-193
16	Insert, Nameplate	T92-199
17	Shutter Handwheel	40378-B
18†	Collimator	3706-A
19	Barrier Assembly	16484-B
20	Cover, Hanger	46851

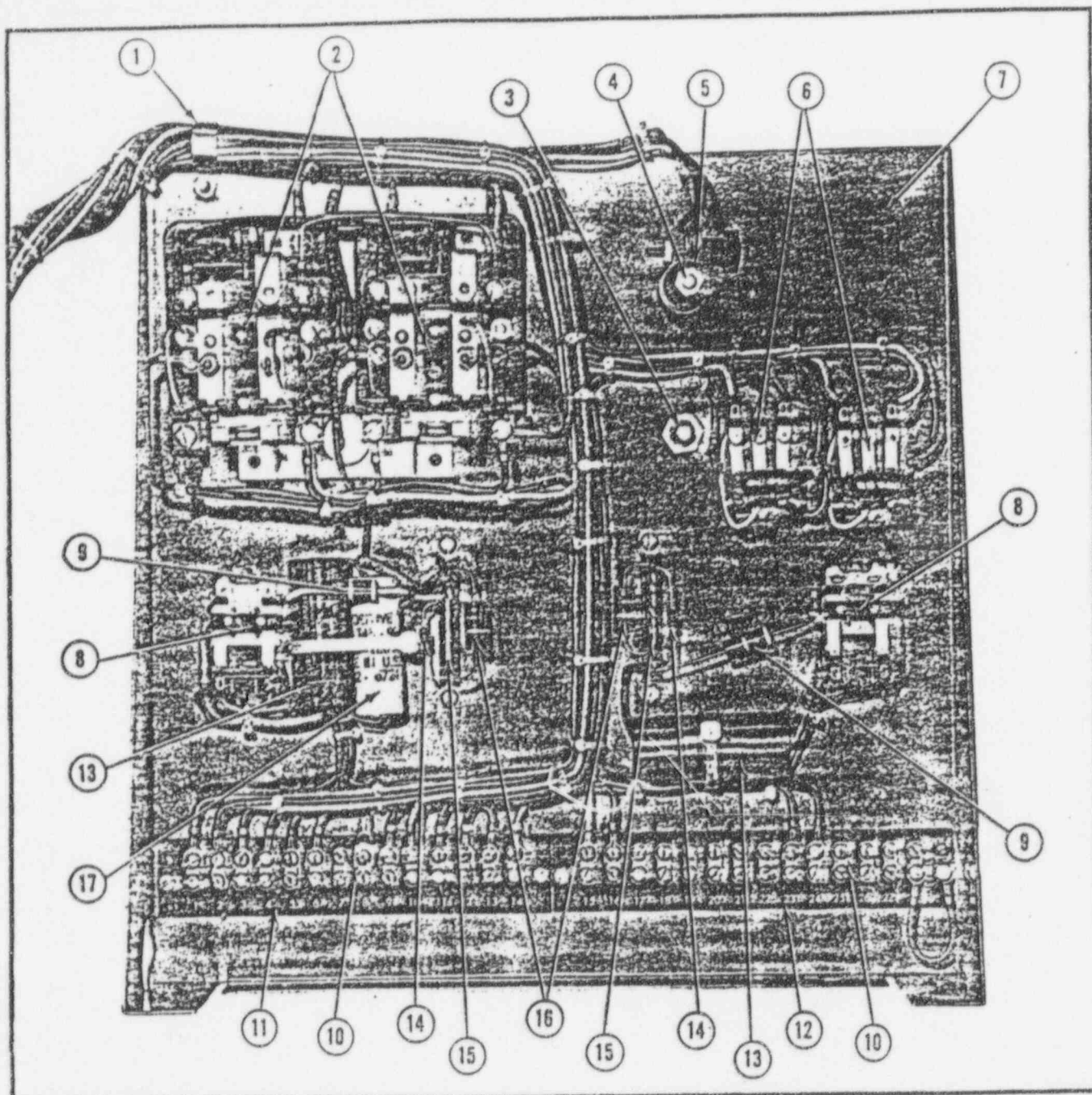




ITEM	DESCRIPTION	PART NO.
	STAND (REAR VIEW)	1385-0
1	Sprocket	T77E-72
2	Chain	T26-102
3	Mounting Bracket, Rotation	
	Scale Pointer	16441-A
4	Clamp, Fixed Tube	46603
5	Shaft Assembly,	
	Slip Ring	15741-A
6	Slip Ring	46452
7	Brush Finger	15742-A

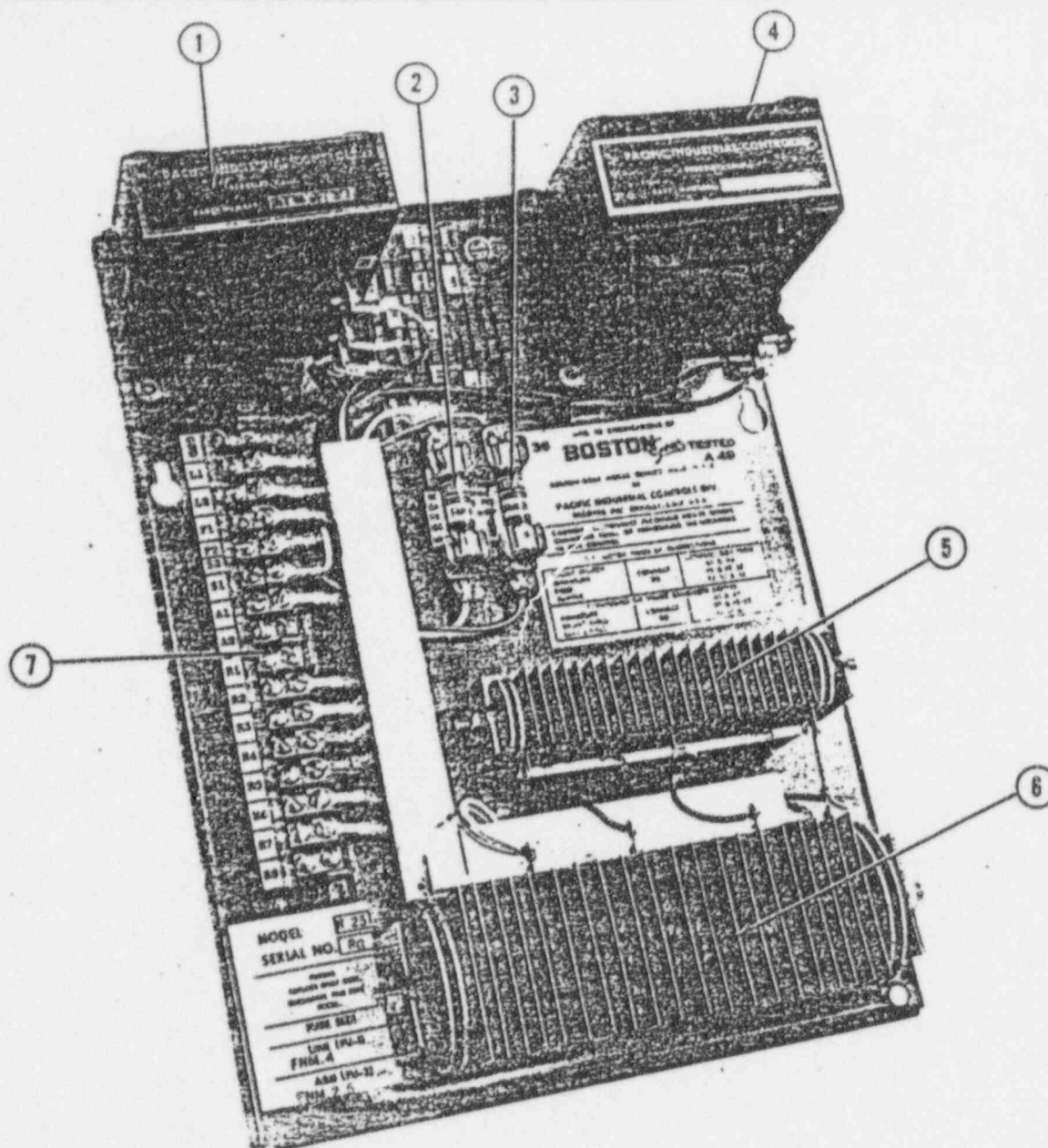
ITEM	DESCRIPTION	PART NO.
8	Terminal Strip	T81B-33
9	Switch (SW-32)	T29A-51
10	Relay, SPST (RE-24, 25)	T19A-27
11	Relay, DPDT (RE-23)	T19A-130
12	Chassis Assembly	16478
13	Motor, C-Arm Rotation	T93D-11
14	Switch, N.O. Pushbutton	T29-82
15	Power Supply, Motor	46666
16	Switch, Slow-Fast	T29-50
17	Stand, Weldment	46658





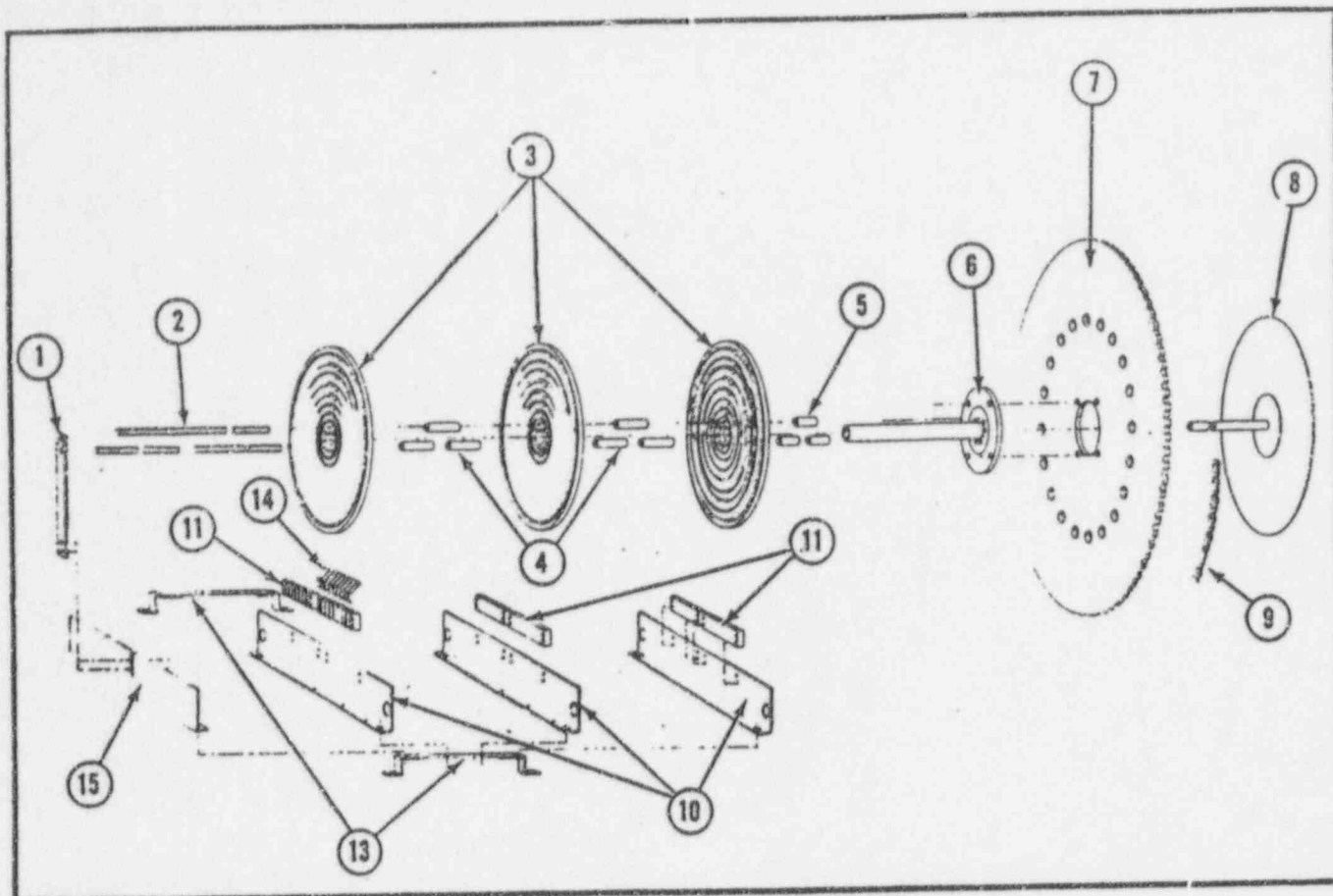
ITEM	DESCRIPTION	PART NO.
	CHASSIS ASSEMBLY	16478
1	Clamp, Cable	T66A-10
2	Relay, DPDT (RE-6,7)	T19A-53
3	Rheostat, 50 $\Omega$ , 100W (R-3)	T6B-6
4	Resistor, 300 $\Omega$ , 50W (R-6)	T6-39
5	Washer, Bakelite	T11F-9
6	Relay, 3PDT (RE-14,15)	T19A-150
7	Chassis Panel	46656
8	Relay, DPDT (RE-1)	T19A-105
9	Resistor, 3K $\Omega$ , 2W (R-7,9)	T6E-39
*	Not Shown	

ITEM	DESCRIPTION	PART NO.
10	Terminal Strip	T81A-4
11	Marker, Terminal Strip (1-14)	T81B-4
12	Marker, Terminal Strip (15-28)	T81B-21
13	Capacitor, 100mFd (C-1,3)	T45-225
14	Diode (CR-4,5)	T80-43
15	Terminal Strip	T81A-20
16	Resistor, 20 $\Omega$ , 2W (R-5,8)	T6E-16
17	Capacitor, 30mFd (C-2)	T45-99
18*	Cable, Base to Toe	BL1891-C
19*	Toe Socket Assembly	16832



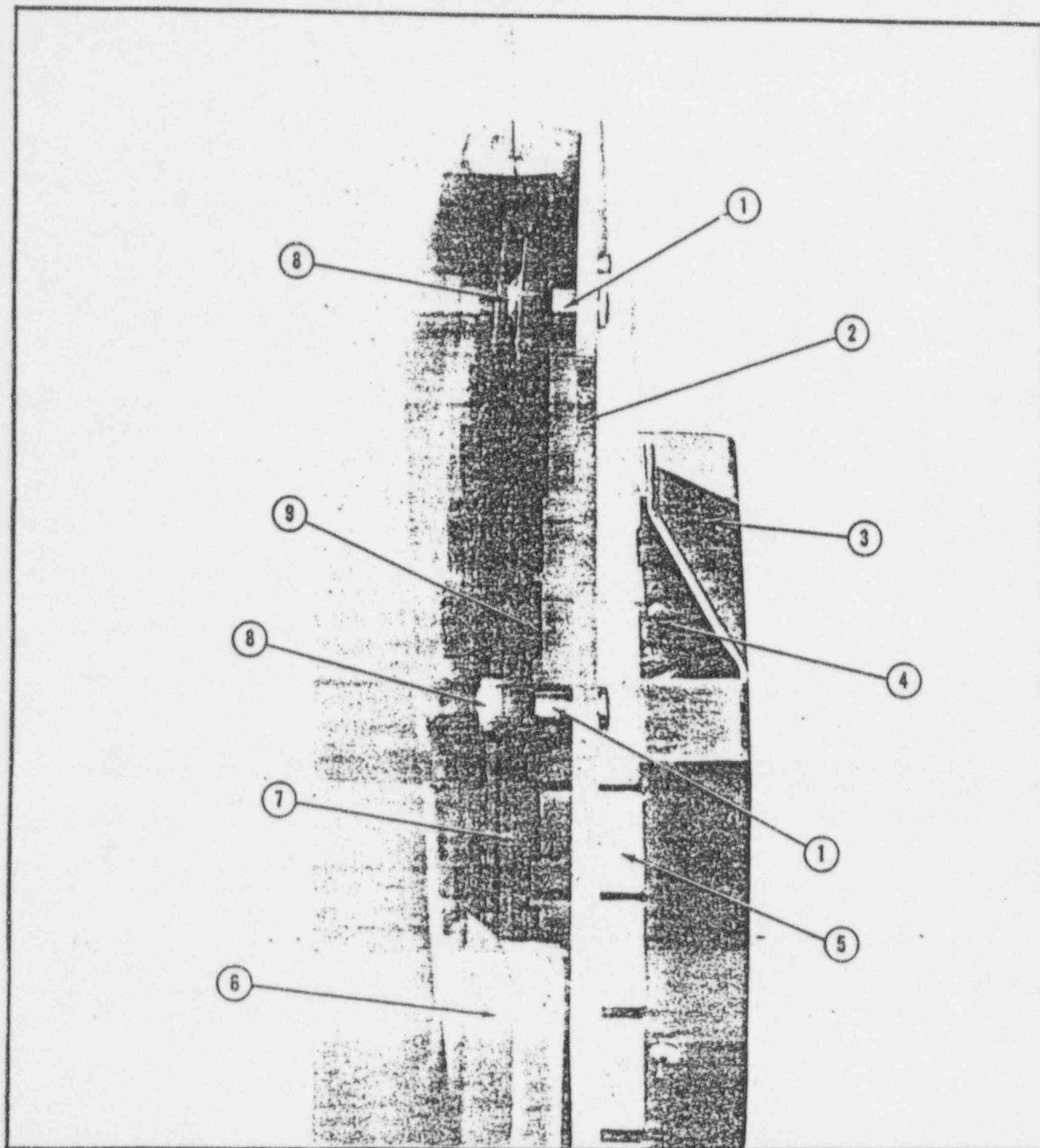
ITEM	DESCRIPTION	PART NO.
	DC POWER SUPPLY(MAIN MOTOR)	46666
*	Order these parts direct from:  Boston Gear Works Quincy, Mass.	

ITEM	DESCRIPTION	PART NO.
1*	Transformer (T-1)	x16S20F
2*	Fuse, 4 Amp. (F-3)	xFNM-4
3*	Fuse, 2-1/2 Amp. (F-4)	xFNM-2½
4*	Choke (L-1)	x16S13
5*	Bridge Rectifier (REC-1)	x61-7757-1
6*	Bridge Rectifier (REC-2)	x61-7636-1
7*	Terminal Strip (TBA)	x440-16



ITEM	DESCRIPTION	PART NO.
1	SLIP RING ASSEMBLY	Figure 1
2	Clamp, Fixed Tube	46603
3	Stud	T13-304
4	Slip Ring	46452
5	Stand Off	T10K-29
6	Spacer	T10K-28
7	Shaft Assembly, Slip Ring	15741-B
	Sprocket	T77E-72
*	Not Shown	

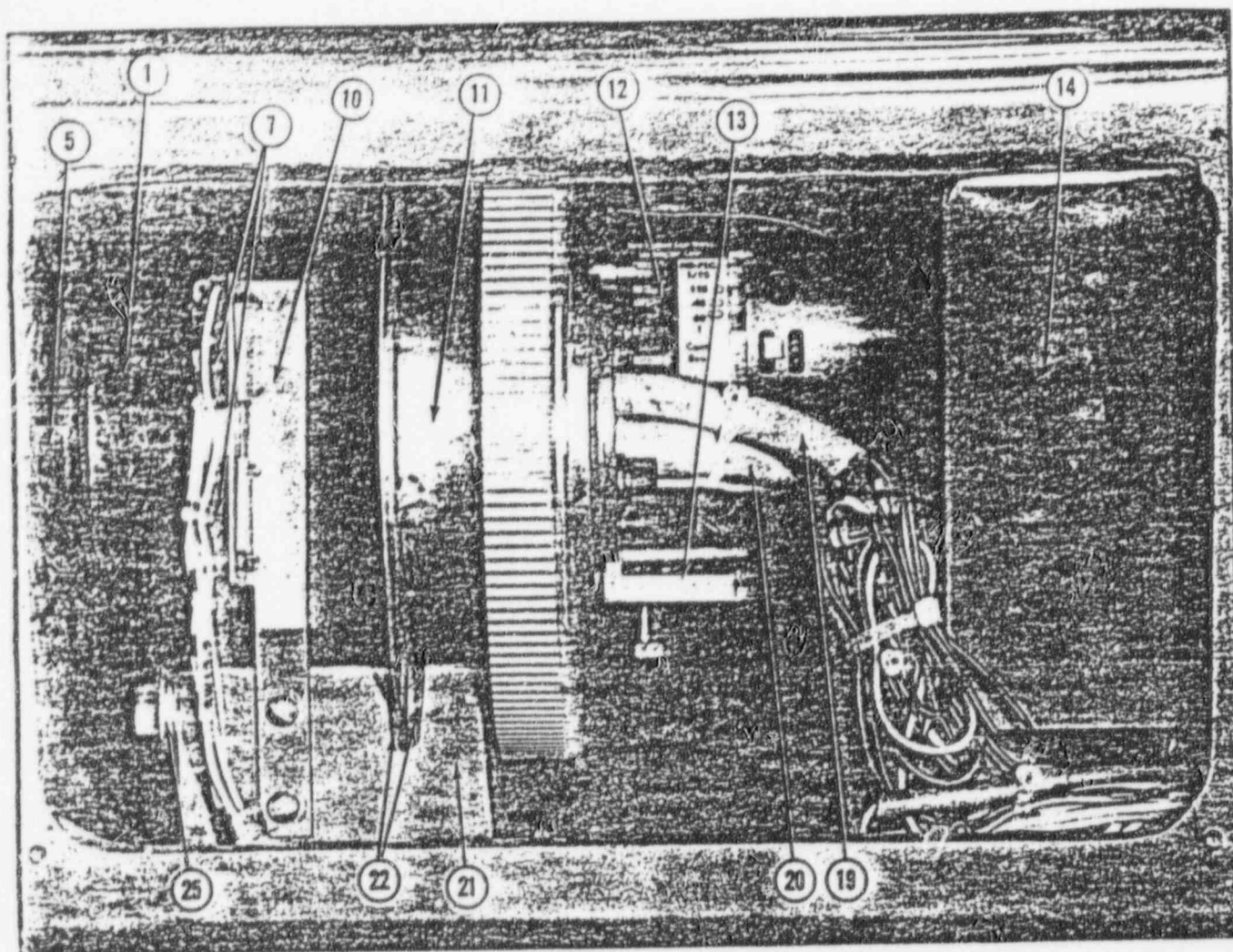
ITEM	DESCRIPTION	PART NO.
8	Mounting Bracket, Rotation	16441-A
9	Scale Pointer	T26-102
10	Chain	43873-A
11	Angle Bracket	T81A-33
12*	Terminal Strip	T81B-33
13*	Maker, Terminal Strip	46604
14	Bracket	15742-A
15	Brush Finger	46605
16*	Angle Bracket	46659
17*	Rear Shield (Main Bearing)	T12-325
	Bearing (Main)	



ITEM	DESCRIPTION	PART NO.
1	OSCILLATING SWITCH ASSY.	Figure 2
2	Spacer	T10C-376
3	Scale	54445
4	Pointer Cover	46712
5	Cam Switch, SPST (SW-23)	T29A-37

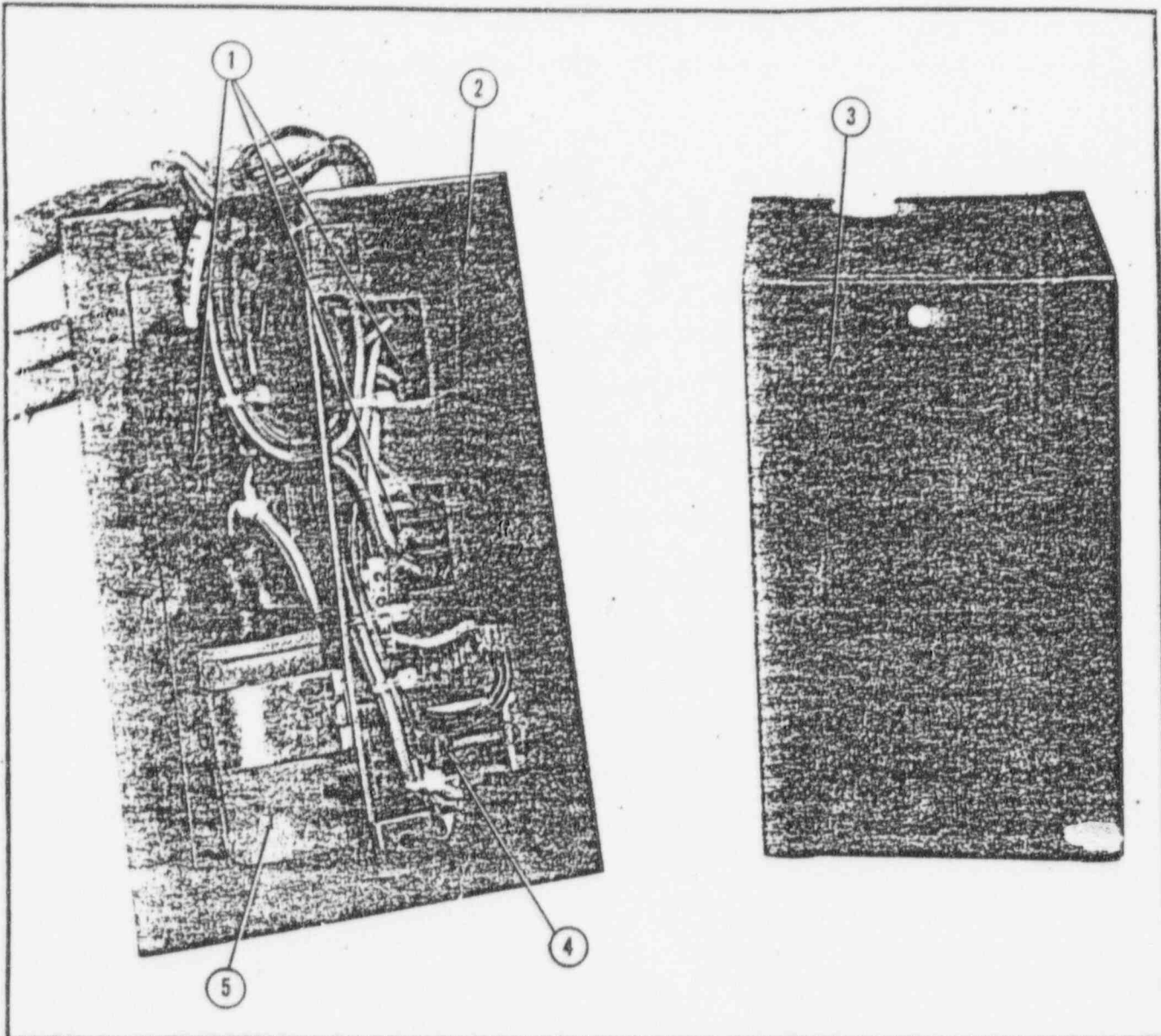
ITEM	DESCRIPTION	PART NO.
5	Cam Wedge	44231
6	Weldment (C-Arm Hanger)	46677-C
7	Plate, Cam Finger Spacer	46705
8	Spacer	T10C-115
9	Cam Finger Assembly	15842





ITEM	DESCRIPTION	PART NO.
1	YOKE ROTATION ASSEMBLY	16833
2*	Yoke Assembly	180997
3*	Dust Cover, Front Bearing	54135
4*	Roller Bearing, Front	T12-424
5*	Roller Bearing, Rear	T12-228
6*	Locknut, Rear Bearing	T4-224
7*	Band, Actuator	54133
8*	Microswitch, Yoke Limit (SW-13, 14)	T29A-16
9*	Actuator, Microswitch	34952
10*	Insulator, Microswitch	T9-74
11	Bracket, Limit Switch	54143
	Gear and Brake Assembly	181007
*	Not Shown	

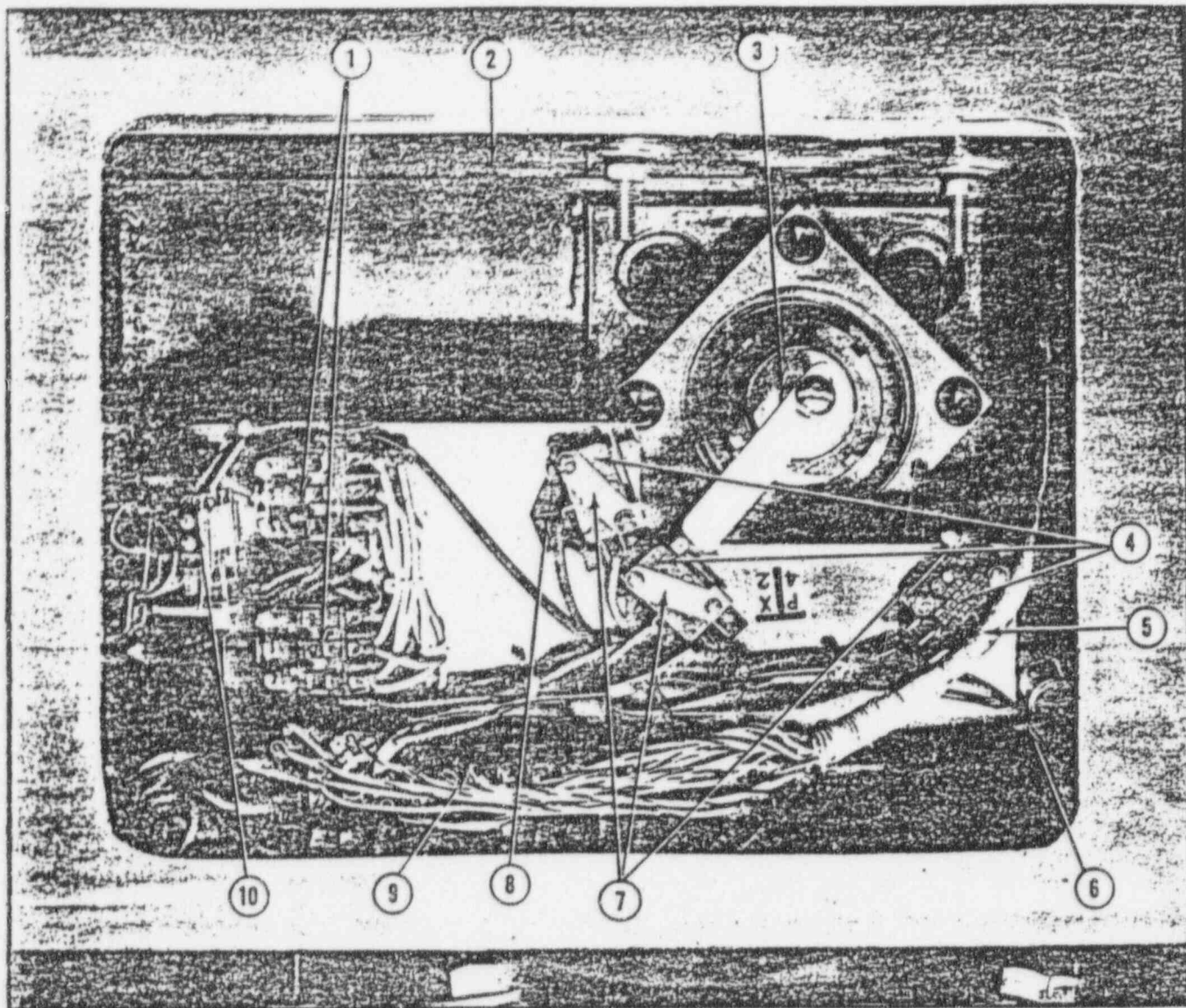
ITEM	DESCRIPTION	PART NO.
12	Motor, Yoke Rotation	T93G-16
13	Mounting Plate, Motor	55431
14	Yoke Rotation Control	181003
15*	Panel, Mounting	181004
16*	Relay, DPDT (RE-19)	T19A-130
17*	Relay, 3PDT (RE-20, 21, 22)	T19A-150
18*	Capacitor, 4mFd (C-7)	T45-464
19	Cable	BL2347-B
20	Cable	T48-96
21	Brake Housing	54155
22	Pad, Brake	53623
23*	Plunger, Brake Spring	54152
24*	Spring, Brake	T5A-256
25	Plug, Spring Retaining	181006
26*	Cover, Yoke Rotation Assy.	54140



PARTS LIST		
1	YOKE ROTATION CONTROL Relay, 3PDT (RE20, 21, 22)	181003 T19A-150
2	Panel Assembly	181004

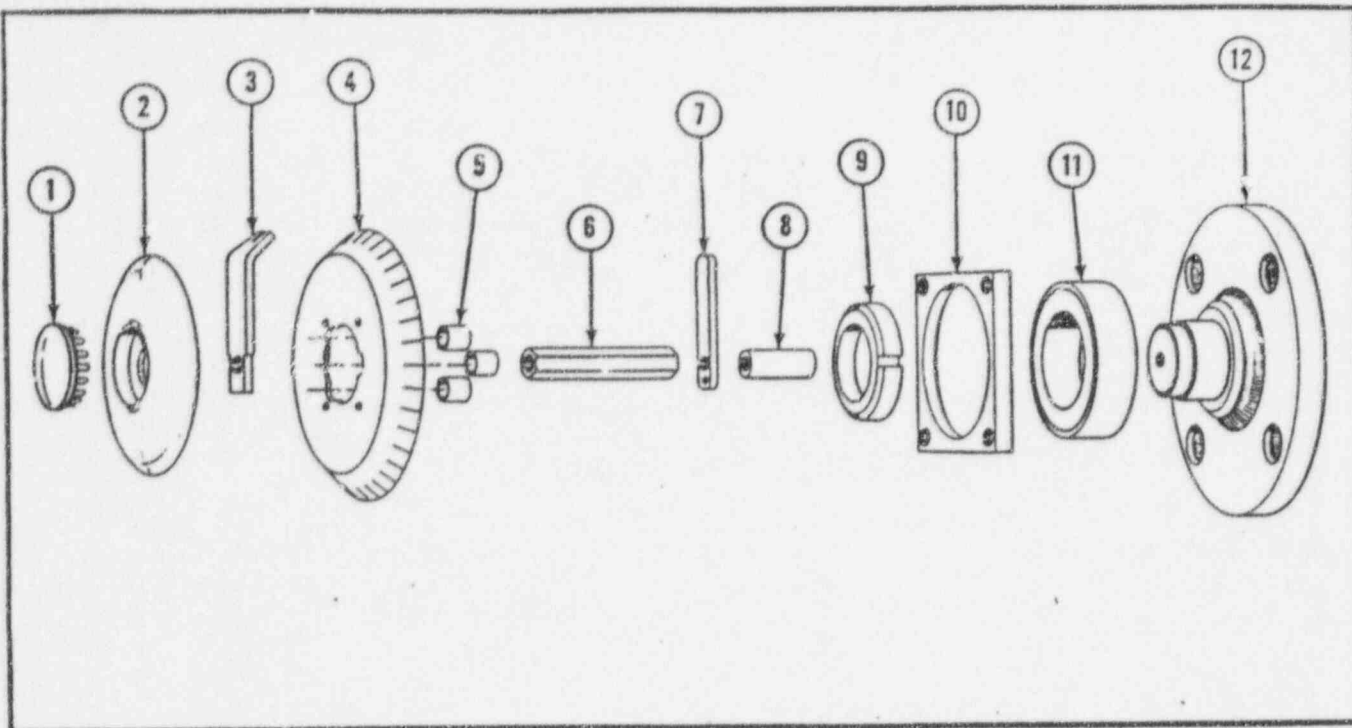
PARTS LIST		
3	Cover, Relay	54142
4	Relay, DPDT (RE-19)	T19A-130
5	Capacitor (C-7)	T45-464





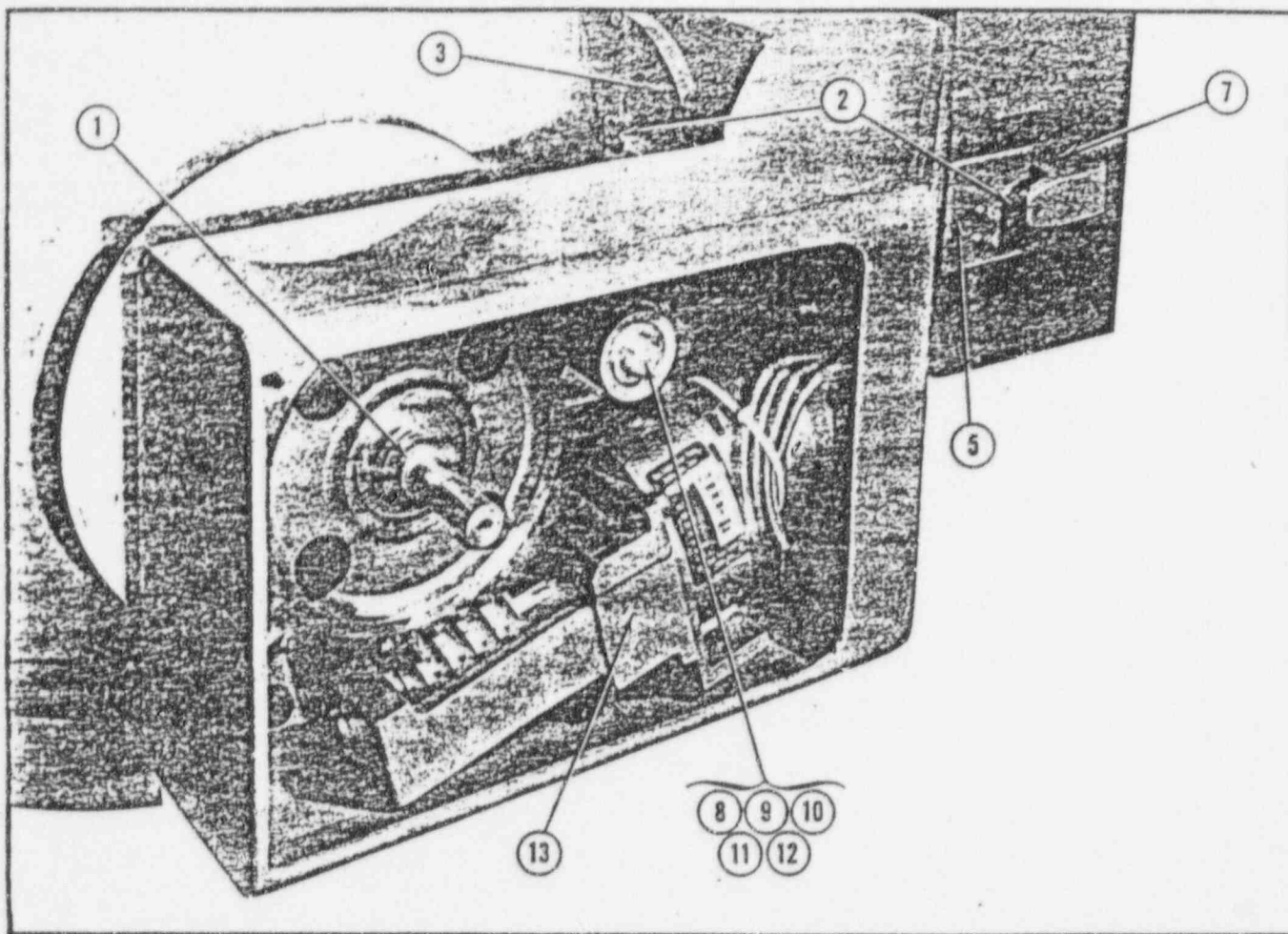
ITEM	DESCRIPTION	PART NO.
1	YOKE (LEFT SIDE)	16833
2	Relay, 3PDT (RE-17, 18)	T19A-150
3	Balance Weight	38688
4	L.H. Trunnion Assembly	Figure 3
	Microswitch (SW-6, 28, 29)	T29A-16
*	Not Shown	

ITEM	DESCRIPTION	PART NO.
5	Cable (Head to Yoke)	BL1824-C
6	Switch, Mercury (SW-8, 9)	T29-98
7	Actuator, Microswitch	35088
8	Spacer, Microswitch	T9-74
9	Terminal Strip	T81A-65
10	Relay, DPST (RE-13)	T19A-130
11*	Capacitor (C-6)	T45-464



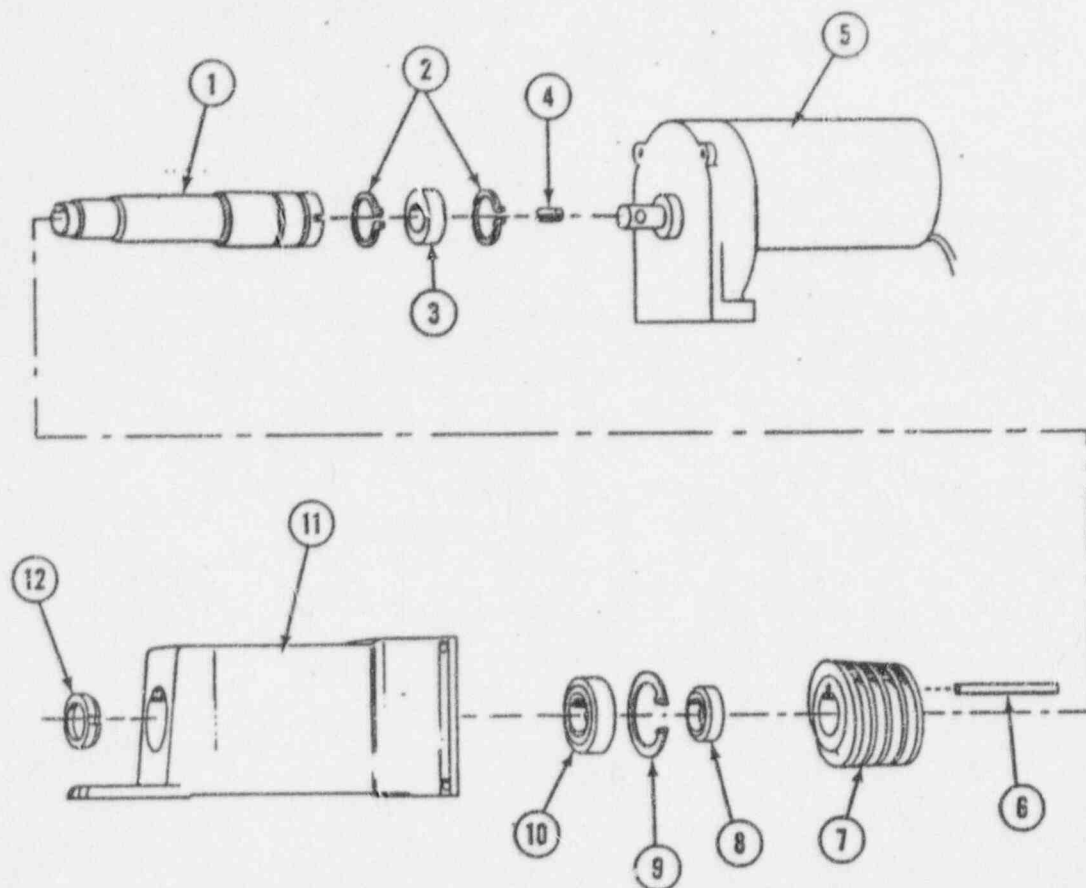
ITEM	DESCRIPTION	PART NO.
	L.H. TRUNNION ASSEMBLY	Figure 3
1	Dot-Plug	T30-53
2	Cover, Angulation Scale	13471-C
3	Pointer	45020
4	Scale, Angulation	35829-A
5	Spacer	T10C-126
6	Spacer	55182

ITEM	DESCRIPTION	PART NO.
7	Actuator	53677
8	Spacer	T10C-538
9	Locknut, Bearing	T4-408
10	Retainer, Trunnion Bearing	54131
11	Bearing, Trunnion	T12-260
12	Trunnion, L.H.	180968



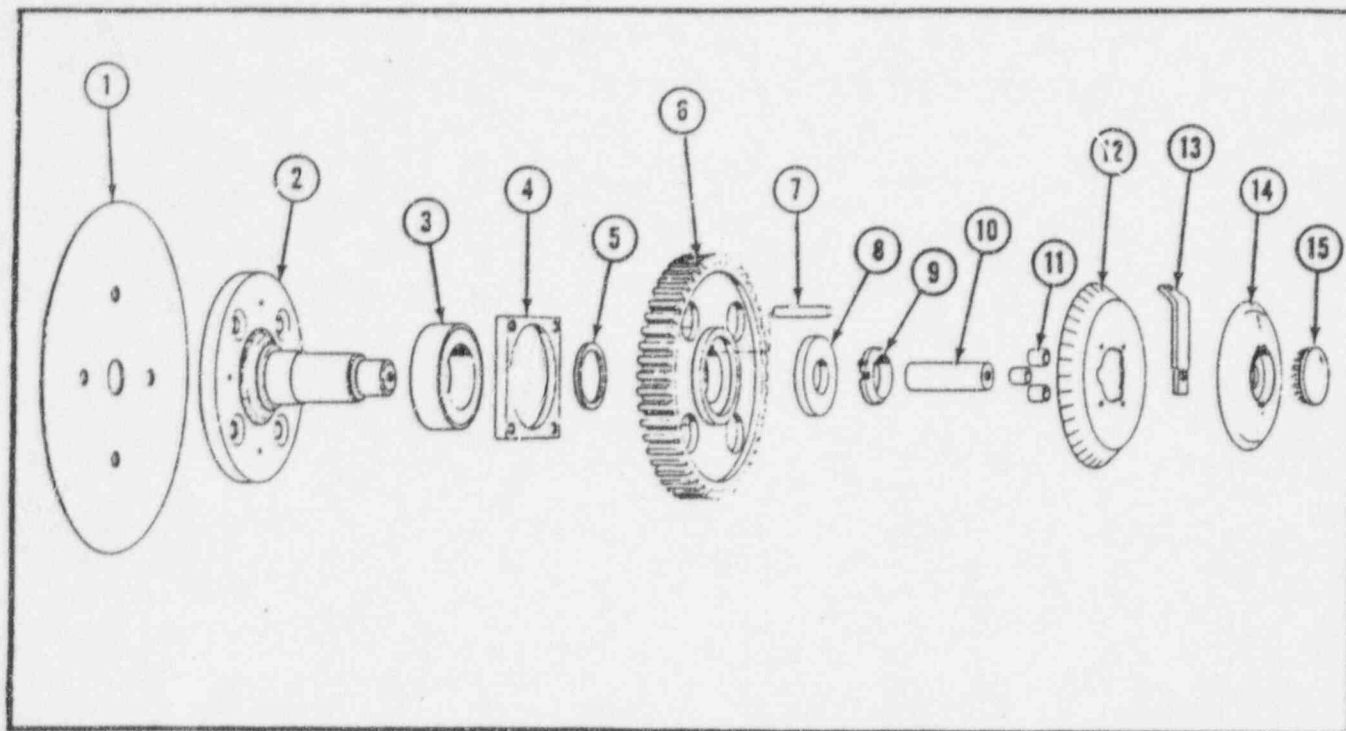
ITEM	DESCRIPTION	PART NO.
	YOKE (RIGHT SIDE)	16833
1	R.H. Trunnion Assembly	Figure 1
2	Cam Switch (SW-23)	T29A-37
3	Yoke Center Cover	54154
4*	Bracket, Mounting (Microswitch)	54153
5	Cover, Yoke Centering Switch	54134
*	Not Shown	

ITEM	DESCRIPTION	PART NO.
6*	Bracket, Mounting (Microswitch)	54136
7	Bracket, Mounting	54492
8	Plug, Spring Retaining	181006
9	Spring Brake	T5A-256
10	Plunger, Brake	
	Spring	53621
11	Pad, Brake	55996
12	Housing, Brake Pad	53843-A
13	Worm Drive Assembly	180999



ITEM	DESCRIPTION	PART NO.
1	WORM DRIVE ASSEMBLY	180999
1	Driveshaft	T14C-52
2	Retaining Ring	T22-52
3	Bearing, Rear	T12-156
4	Pin, Roll	T14A-62
5	Motor	T93G-15
6	Key, Worm Gear	T31-43

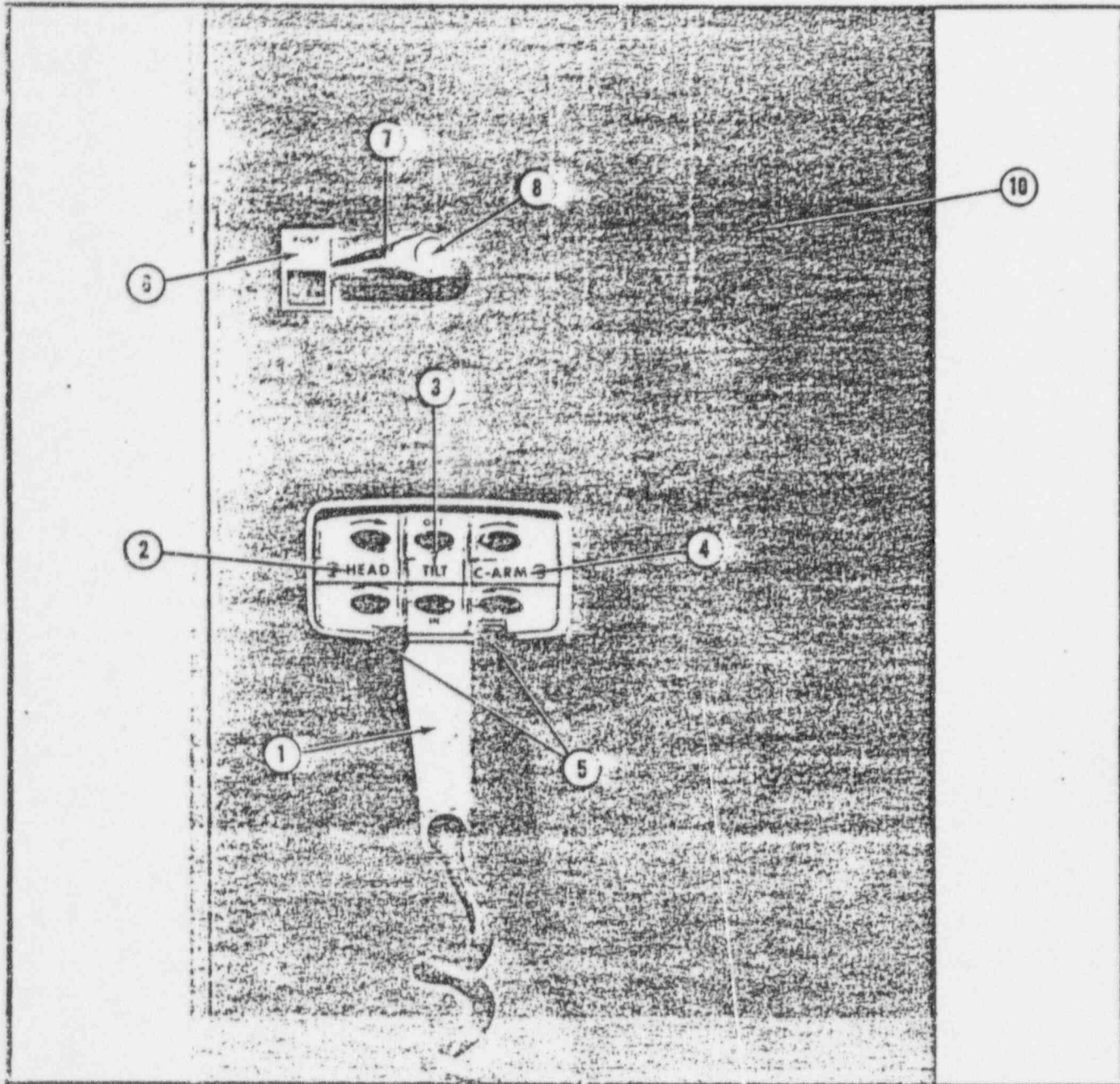
ITEM	DESCRIPTION	PART NO.
7	Gear, Worm	T77B-24
8	Spacer	54144
9	Retaining Ring	T22-144
10	Bearing, Front	T12-245
11	Housing, Gear and Bearing	53844
12	Nut, Bearing Lock	T4-146



ITEM	DESCRIPTION	PART NO.
1	R.H. TRUNNION ASSEMBLY	Figure 4
2	Brake Disc	53628-A
3	Trunnion, R.H.	180967
4	Bearing	T12-260
5	Retainer, Trunnion Bearing	54131
6	Washer, Shim	T11-257
7	Gear, Worm	T77C-33
	Key, Worm Gear	T31-44

ITEM	DESCRIPTION	PART NO.
8	Washer, Shim	T11-258
9	Locknut, bearing	T4-211
10	Spacer	T108-557
11	Spacer	T10C-126
12	Scale, Angulation	35829-A
13	Pointer	45020
14	Cover, Angulation Scale	13471-C
15	Dot Plug	T30-53



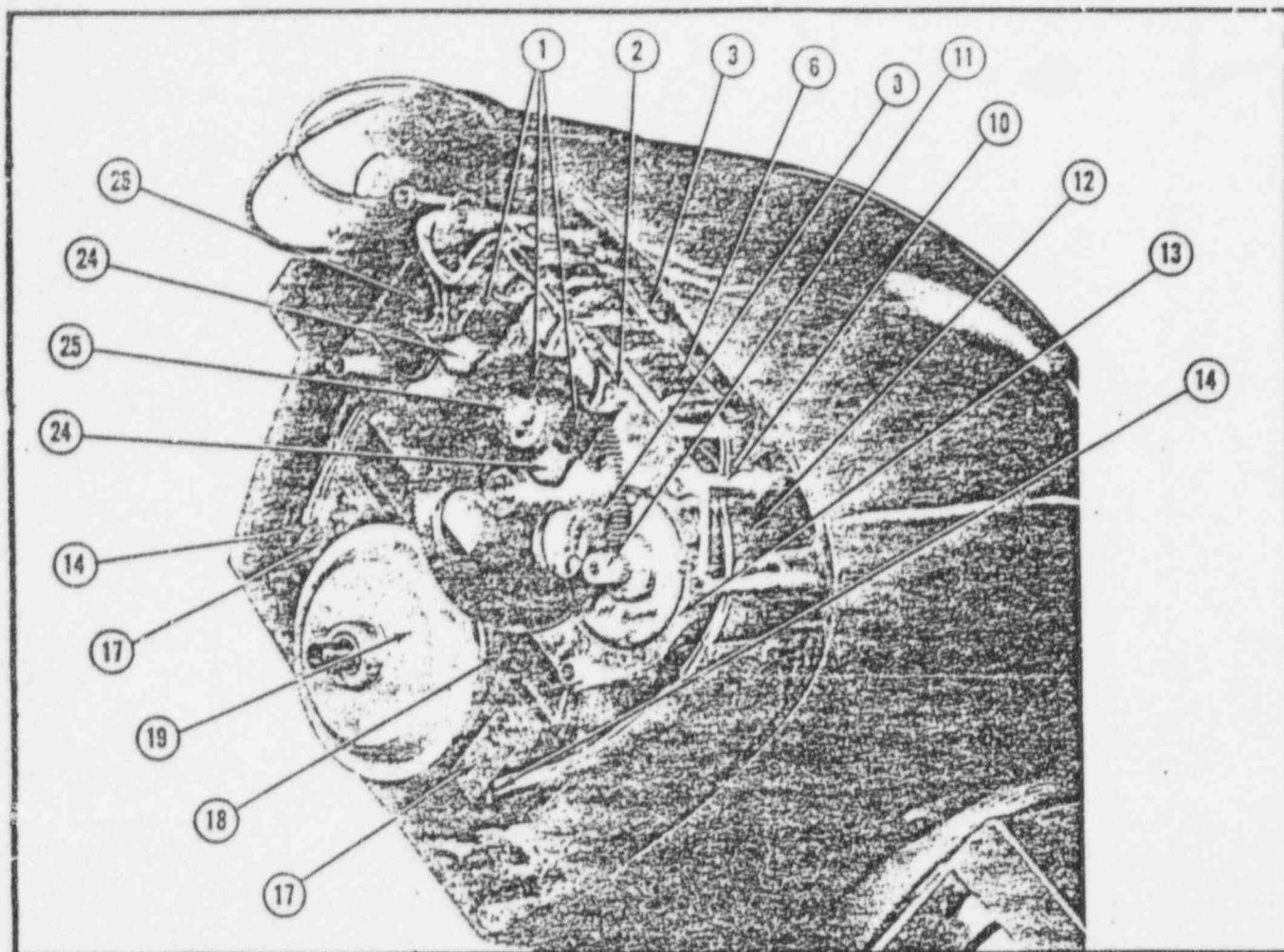


ITEM	DESCRIPTION	PART No.
1	HAND SWITCH ASSEMBLY	16567
2	Switch Assembly	46841
3	Decal, Head	T92-286
4	Decal, Tilt	T92-287
*	Not Shown	

ITEM	DESCRIPTION	PART No.
5	Decal, C-Arm	T92-288
6	Hook, Hand Switch	16566
7	Nameplate, Slow-Fast	T92-204
8	Knob, Speed Switch	T3-102
9	Insert, Knob	36864-B
10	Switch, Slow-Fast	T29-50
	Shroud, R.H.	46657

## HAND SWITCH ASSEMBLY

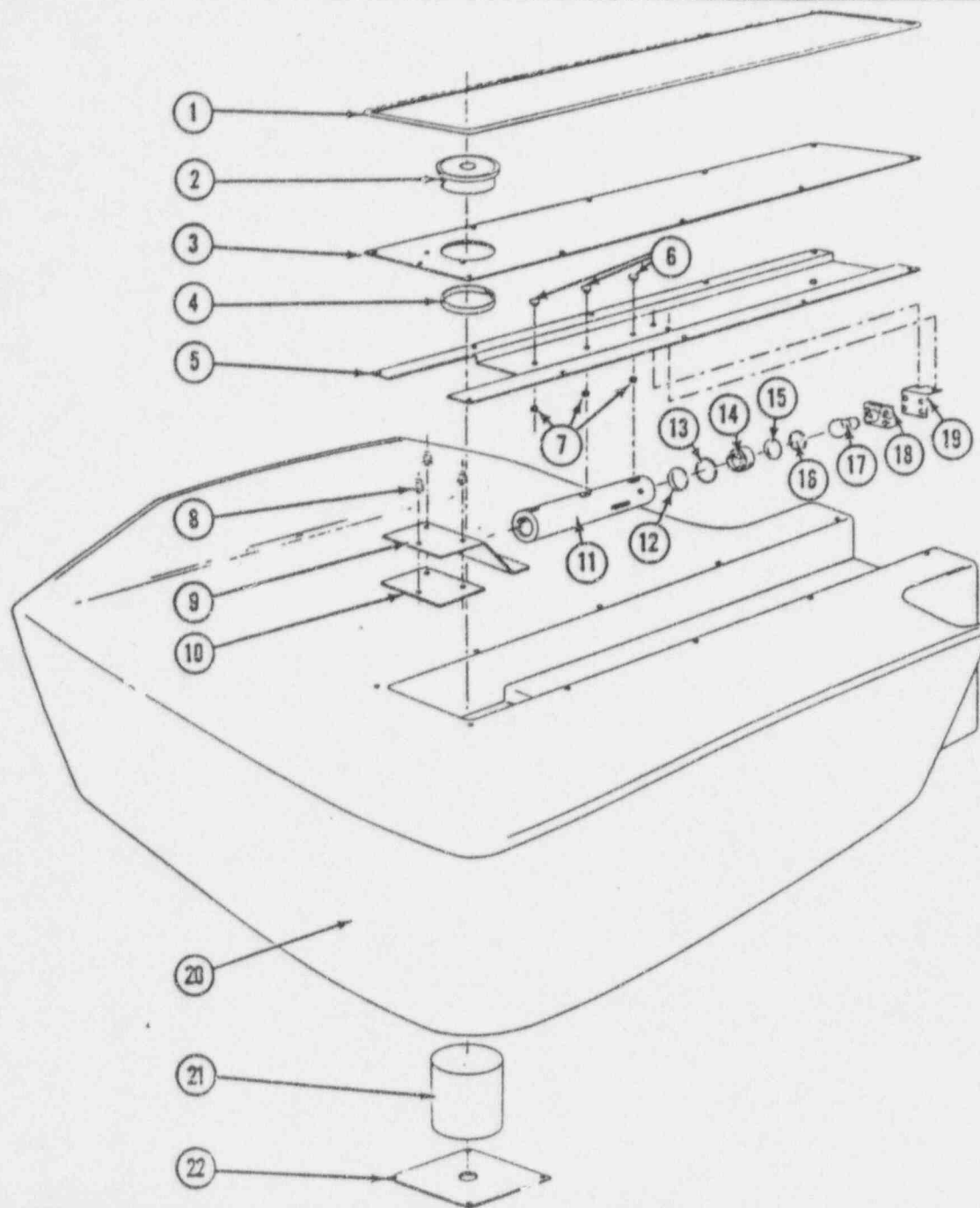
PROPERTY OF PICKER X-RAY  
January 1970



15

ITEM	DESCRIPTION	PART NO.
1	COBALT <sup>60</sup> HEAD	590-E
	Socket, Lamp (Screw Type)	37169-A
	Socket, Lamp (Bayonet Type)	56148
2	Spacer, Lamp Socket	T10C-117
3	Resistor, 150Ω, 100W (R-2)	T6-20
4*	Spacer, Resistor	T11F-21
5*	Stud, Resistor	T13A-117
6	Terminal Strip (TB-5)	T81A-4
7*	Marker, Terminal Strip	T81B-4
8	Gear, Shutter Idler	T77-162
9*	Needle Bearing	T12-337
10	Spacer	T10C-117
11	Gear, Shutter Drive	T77-130
12	Motor, Shutter (B-1)	T93C-10
13	Casting, Shutter Drive	43153-A
14	Microswitch (SW-10, 11)	T29A-16
15*	Actuator, Microswitch	35088
16*	Barrier, Microswitch	T9-74
*	Not Shown	

ITEM	DESCRIPTION	PART NO.
17	Mounting Plate, Micro-switch	56326
18	V-Belt	T26A-11
19	Pulley, V-Belt	T84-21
20*	Cover, Shutter Spring (Outer)	37138
21*	Spring, Shutter Power	37137-A
22*	Collar, Shutter Spring	37144
23*	Cover, Shutter Spring (Inner)	37138-A
24	Lamp, Red, 110V (Screw Type)	T72-45
	Lamp, Red, 110V (Bayonet Type)	T72-112
25	Lamp, White, 110V (Screw Type)	T72-8
	Lamp, White, 110V (Bayonet Type)	T72-110
26	Filament Transformer (T-1)	T86B-8
27*	Capacitor, 4μFd, 600V(C-1)	T45-22

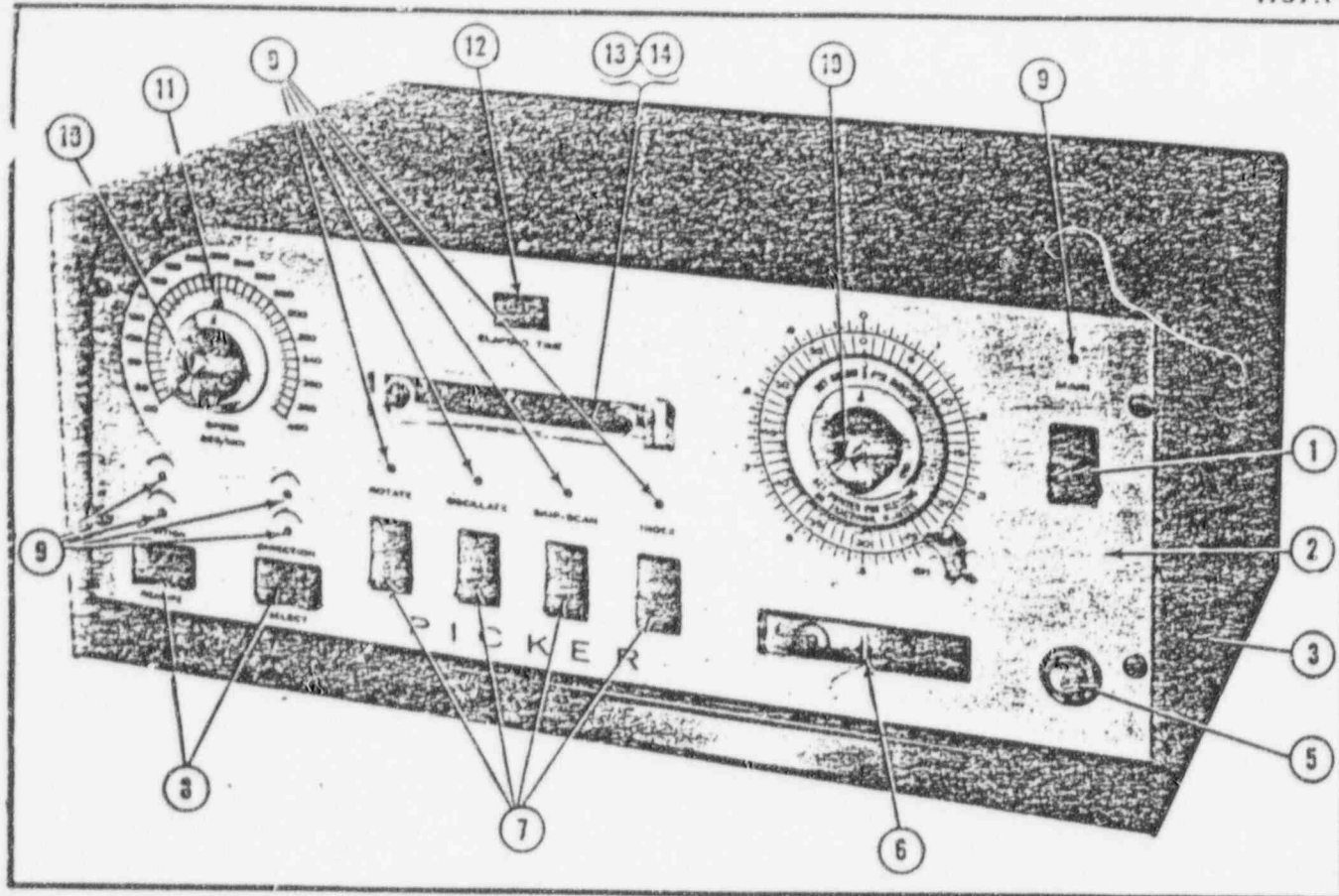


ITEM	DESCRIPTION	PART NO.
1	BARRIER ASSEMBLY	16484-B
2	Trim, Plastic Panel	42429-J
3	Window Assembly	16422
4	Cover, Blackpointer	46428
5	Ring, Rubber	T54-40
6	Bracket, Lamp Housing	46427
7	Rivet, Tubular	T15D-20
8	Washer, 0.195" I.D. x 7/16" O.D.	T11E-5
9	Spring	T5A-161
10	Mirror	46425
11	Nut Plate (Mirror)	46424
12	Housing	46426

ITEM	DESCRIPTION	PART NO.
12	Lens	38266
13	Spring	T5-435
14	Bushing	37945
15	Lens	38267
16	Spring, Condenser	
17	Lens	T5-434
18	Lamp	T27-36
19	Socket, Lamp	31414
20	Bracket, Lamp Mounting	38269
21	Radiation Barrier	54475
22	Barrier Plug	54805
23	Cover, Barrier Plug	54806

## BARRIER ASSEMBLY

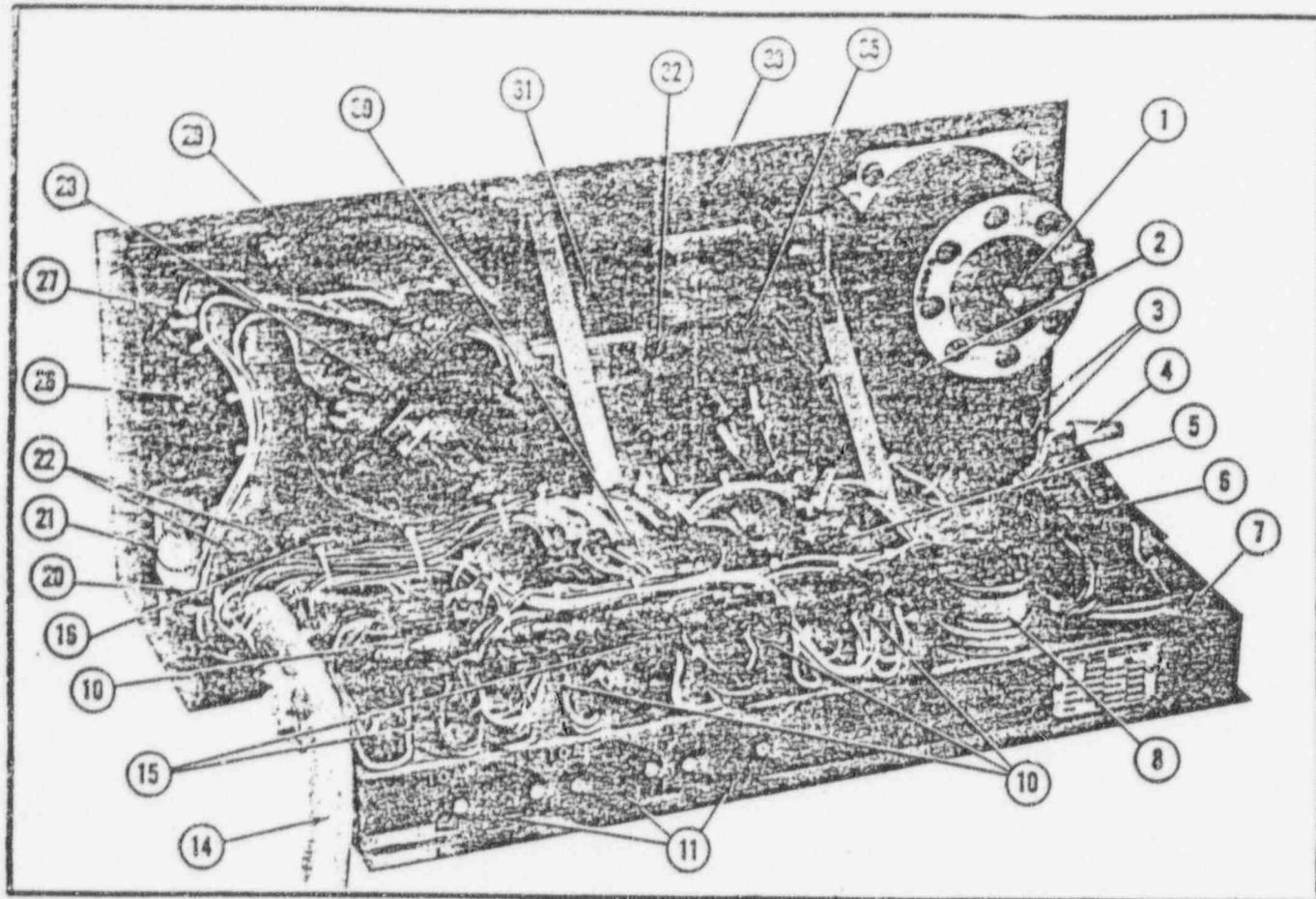
PROPERTY OF PICKER X-RAY  
January 1970



ITEM NO.	DESCRIPTION	PART NO.
1	CONTROL, COBALT <sup>60</sup>	VG8-B
2	Switch, Main, DPDT (SW-1)	T29-147
3	Nameplate	46744
3	Cabinet	160030
4*	Feet, Rubber	T21-140
5	Lock and Keys	36759
6	Window, Shutter Indicating	38759
*	Not Shown	

ITEM NO.	DESCRIPTION	PART NO.
7	Switch, DP MOM (SW-17, 21, 22, 27)	T29-157
8	Switch, DPDT (SW-20, 24)	T29-152
9	Lamp, Indicator	T72-78
10	Knob	T3A-85
11	Pointer, Rotation Speed	50050
12	Counter	34482
13	Exposure Bar	38975
14	Emergency Insert	40099
15*	Spacer	T108-194
16*	Spring	T5A-185





ITEM NO.	DESCRIPTION	PART NO.
	CONTROL, CO <sup>60</sup> (REAR VIEW)	VG8-B
1	Power Stat (Speed Control)	T86F-26
2	Bracket, Lamp	55839
3	Wire Nut (Small)	32423
4	Wire Nut (Large)	36976
5	Panel, Terminal	T76-6
6	Relay, Latching (RE-13)	T19A-130
7	Chassis Assembly	16463
8	Motor, Synchronous	T938-59
9*	Cam	46560
10	Relay, DPDT (RE-2, 8, 9, 11)	T19A-107
11	Fuse Holder	36836
12*	Fuse, 5 Amp (F-5)	T27A-32
13*	Fuse, 10 Amp (F-1, 2)	T27A-24
14	Cable, Control	BL1823-A
15	Relay, DPDT (RE-10, 12)	T19A-108
16	Lamp Bracket	14547
17*	Spacer, 3/8"ODx5/8"L	T10C-159
18*	Socket, Lamp	37169
*	Not Shown	

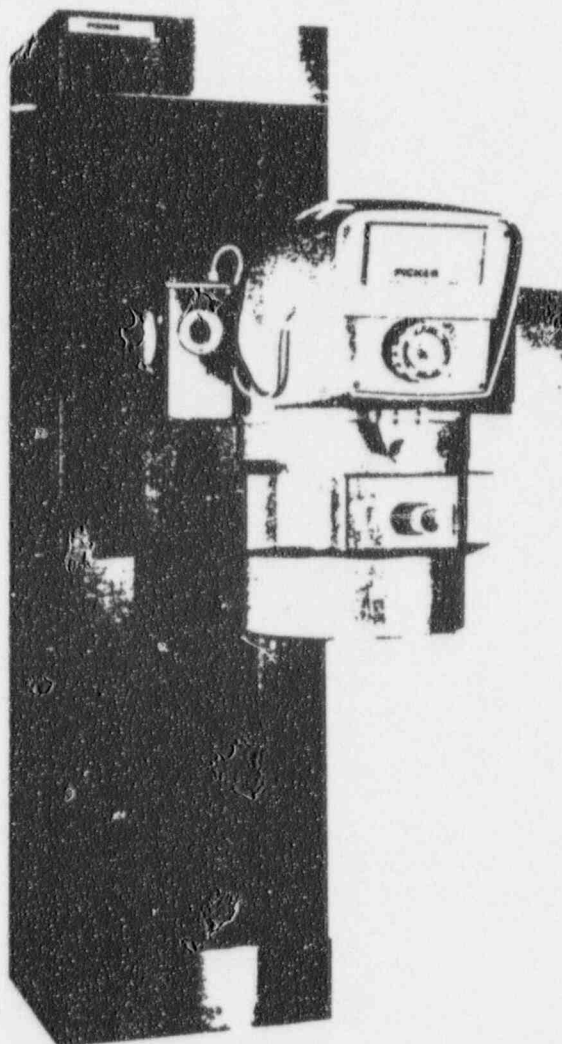
ITEM NO.	DESCRIPTION	PART NO.
19*	Lamp, 6W, 115 VAC	T72-8
20	Bracket, Key Switch	46536
21	Spring, Key Switch	T5-433
22	Switch, Micro (SW-3, 26)	T29A-16
23*	Spacer, Microswitch	T9-74
24*	Actuator, Microswitch (Flat)	34952
25*	Actuator, Microswitch (Roller)	35088
26	Switch, Main, DPDT (SW-1)	T29-147
27	Bracket, Lamp	55837
28	Timer	945-A
29	Bracket, Timer	46562
30	Terminal Strip	T81A-27
31	Cross Strap	38976
32	Bracket, Lamp	55837
33	Counter	34482
34*	Switch, Micro (SW-2)	T29A-15
35	Insulator, Switch	31358
36*	Grommet, Plastic	T21A-70

CONTROL (Rear View)



# **V9 COBALT TELETHERAPY UNIT**

**CAT. NO. 6268  
INSTALLATION INSTRUCTION  
PH59:12 (T55-571)**



**PICKER CORPORATION**  
MEDICAL PRODUCTS DIVISION  
MINER ROAD, CLEVELAND, OHIO 44143

Printed in U.S.A.

## WARNING TO SERVICE PERSONNEL

### FOR RADIATION HAZARDS DURING INSTALLATION OF COBALT 60 TELETHERAPY UNITS

EACH PERSON INSTALLING A COBALT UNIT SHOULD AT LEAST WEAR A 0 - 200 MR DIRECT READING POCKET DOSIMETER, AND PREFERABLY ALSO, A 0 - 5 R CHAMBER AS WELL. A PORTABLE SURVEY METER (G-M OR ION-CHAMBER TYPE) SHOULD BE AVAILABLE, PERHAPS BORROWED FOR THE DURATION OF THE INSTALLATION.

WEAR THE DOSIMETERS ON THE WAIST, CHECK THEM FREQUENTLY FOR INDICATION OF EXCESS RADIATION AND RECORD THE INITIAL AND FINAL READINGS. IN THE EVENT AN OVERDOSAGE IS SUSPECTED, READ THE DOSIMETERS IMMEDIATELY.

THE SURVEY METER *MUST* BE USED TO CHECK THE SHIPMENT AS SOON AS IT ARRIVES. AT 39-INCHES (1 METER) FROM THE CENTER OF THE HEAD(SOURCE) THE AVERAGE DOSE RATE SHOULD NOT BE HIGHER THAN 2 MR/HOUR. LOCALIZED SPOTS AROUND THE HEAD, WHERE RADIATION IS HIGHER, MAY OR MAY NOT BE NOTICEABLE DEPENDING ON THE TYPE OF METER USED AND THE CARE EXPENDED IN SEARCHING FOR THEM. THESE SPOTS SHOULD BE BELOW 10 MR/HOUR AT 39-INCHES FROM THE SOURCE.

THE AVERAGE DOSAGE AT THE SURFACE OF THE HEAD WILL BE ABOUT 35 MR/HOUR. IF THE DOSAGE RATES ARE HIGHER THAN STATED, THE WHOLE INSTALLATION *MUST* BE APPROACHED WITH CONSIDERABLE CAUTION.

IF EVERYTHING IS NORMAL AT THIS STAGE, THE WORK CAN PROCEED IN A REGULAR FASHION, BUT THE SHUTTER LOCKING BAR AND ITS WARNING TAG *MUST NOT* BE REMOVED UNTIL THE MACHINE IS COMPLETELY ASSEMBLED AND READY TO TURN OVER TO THE LICENSEE. THEN, AND ONLY THEN, SHOULD THE SHUTTER BE OPERATED, AND ONLY IF THE PROTECTIVE ROOM WINDOW IS IN PLACE AND THE DOOR SWITCH IS OPERATIVE.

### SPECIAL WARNING

THE MACHINE *MUST NOT* BE TURNED ON IF THERE IS SOMEONE IN THE ROOM, AND *NO ONE* SHOULD ENTER THE ROOM UNLESS HE IS SURE THE SHUTTER IS TURNED OFF. THE SURVEY METER SHOULD BE USED AFTER EACH OPERATION OF THE SHUTTER BEFORE RE-ENTERING THE TREATMENT ROOM. ALSO THE SURVEY METER SHOULD BE USED TO CHECK UNKNOWN RADIATION LEVELS BEFORE PERSONNEL WORK IN A GIVEN AREA.

THE FIRST TIME THE SHUTTER IS OPERATED, USE A SURVEY METER TO BE SURE THAT THE CONNECTIONS TO THE WARNING LIGHTS HAVE NOT BEEN REVERSED. THE ABILITY OF THE SHUTTER TO TURN OFF WITH POWER FAILURE *MUST BE CHECKED* BY CUTTING THE POWER TO THE MACHINE AND USING THE SURVEY METER TO SEE THAT THE SHUTTER TURNS OFF.

THE SHUTTER *MUST* BE CHECKED FOR OPERATION WITHIN ALLOWABLE ROOM PROTECTION BY SETTING THE HEAD IN VARIOUS POSITIONS (45-DEGREES APART) AND MOMENTARILY TURNING THE SHUTTER ON (OPERATE BY SWITCH) THEN ONE SECOND LATER, DEPRESS "OFF" BUTTON ON TIMER. *SHUTTER MUST ALWAYS CLOSE.*

FINALLY, THE OPERATION OF THE DOOR INTERLOCK SWITCH AND THE ABILITY OF THE TIMER TO SHUT OFF THE BEAM *MUST* BE CHECKED. THE RADIOLOGIST MIGHT THEN WISH THE SHUTTER LOCKING BAR REPLACED UNTIL HE IS READY TO USE THE MACHINE. IT CAN READILY BE REMOVED WHEN NECESSARY.

## RADIATION WARNING

X-Rays and Gamma-Rays are dangerous to both patient and operator unless established safe exposure procedures are strictly observed.

The useful beam can produce serious or fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in the National Council on Radiation Protection and Measurements (NCRP) "Medical X-Ray and Gamma-Ray Protection for Energies up to 10 Mev — Equipment Design and Use" NCRP Report #33 as revised or replaced in the future.

Those responsible for the planning of X-Ray and Gamma-Ray equipment installations must be thoroughly familiar and comply completely with the structural shielding requirements outlined in NCRP #34 as revised or replaced in the future.

Failure to observe these warnings may cause serious or fatal bodily injuries to the operator, patient or those in attendance.

# CONTENTS

<b>1</b>	section 1
	EQUIPMENT DESCRIPTION
<b>1</b>	major assemblies and parts
<b>4</b>	cobalt head and control exposure light sequence
<b>5</b>	section 2
	INSTALLATION
<b>5</b>	anchoring equipment
<b>5</b>	radiation protection
<b>6</b>	unpacking
<b>7</b>	installation
<b>12</b>	collimator installation
<b>12</b>	installation of 3706A collimator
<b>18</b>	mounting the background shades
<b>19</b>	optional devices (installation)
<b>20</b>	pin-and-arc (3500C)
<b>21</b>	collimator mounted beam-shaping assembly (3022)
<b>23</b>	therapy table (3702A)
<b>23</b>	dual light source (3593C)
<b>25</b>	section 3
	CHECKOUT AND ADJUSTMENT
<b>25</b>	"V" belt and cam followers
<b>27</b>	collimator film check
<b>31</b>	brake adjustment
<b>31</b>	replacing collimator lamp
<b>31</b>	replacing optical distance indicator lamp
<b>31</b>	section 4
	REFERENCE DATA

iii

## Section 1

### EQUIPMENT DESCRIPTION

Giving the radiologists the advantages of supervoltage radiation without the need for a high voltage generator, the Picker Model V9 Teletherapy Unit precisely controls and directs the gamma radiation of Cobalt<sup>60</sup> contained in a sealed capsule within a 21-inch, spherical head of shielding lead, tungsten, and uranium.

The exact beam direction and field localization provided by the Model V9 makes this advanced equipment highly flexible in application. The radiation beam is turned "on" by rotating the radioactive source from the center of the protective sphere to an aperture at the bottom and turned "off" by returning it to the center.

A specially designed Collimator precisely defines the size and shape of the beam. To permit flexible directing of the beam for various therapeutic treatments, the entire Head and Collimator assembly is mounted on a Stand capable of moving and rotating the Head. Before installing the Model V9, you will want to become more familiar with the details of its operation.

#### MAJOR ASSEMBLIES AND PARTS

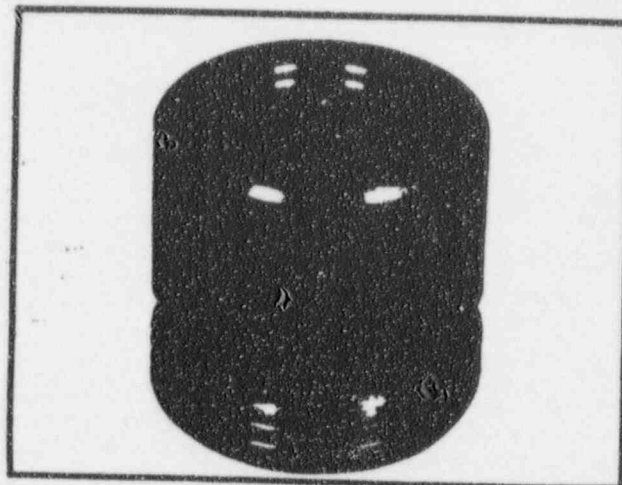
##### Source

The Cobalt<sup>60</sup> radiation Source, usually 1.5 to 2.5cm in diameter, is contained in a double-walled metal cylinder which is housed in the Isotope Container. (Refer to ED-775 and ED-776.)

The Source has been made radioactive by being bombarded by neutrons in a nuclear reactor. The Source, usually made up of a number of thin wafers or closely packed pellets, is carefully sealed within a thick-walled cylinder of tungsten with thin stainless steel caps on the ends. The container does four things:

1. Prevents escape of radioactive matter within the cylinder.
2. The tungsten wall contributes to radiation protection.
3. The thin end windows stop beta radiation yet readily transmit the gamma radiation.
4. The external threads hold the source securely in the Head.

The Source is surrounded by a protective shield called the Head.



ISOTOPE CONTAINER



The Head, mostly solid lead, has within it a Shutter Wheel made of lead, tungsten, depleted uranium, and stainless steel. The Shutter Wheel axle is located off center of the Head so that by rotation it can move the Source from the center of the Head ("off" position to the bottom "on" position).

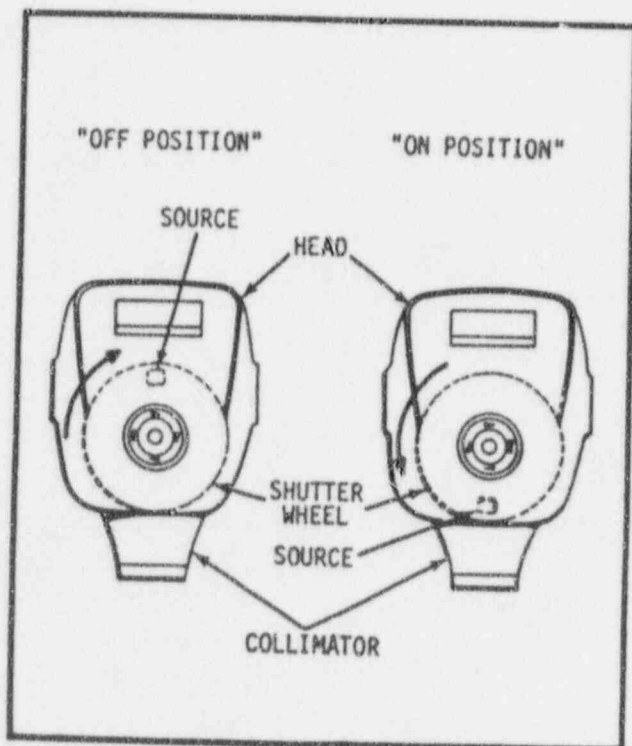
## Shutter

The Shutter Wheel is mounted in the Head with its shaft extending out into the Shutter Drive Housing at the front of the Head. The shaft of the wheel is below center in the Head; i.e., it is nearer the Collimator side of the Head than it is to the top of the Head. When the radiation beam is turned "off," the wheel is rotated until the Source is brought to the exact center of the Head

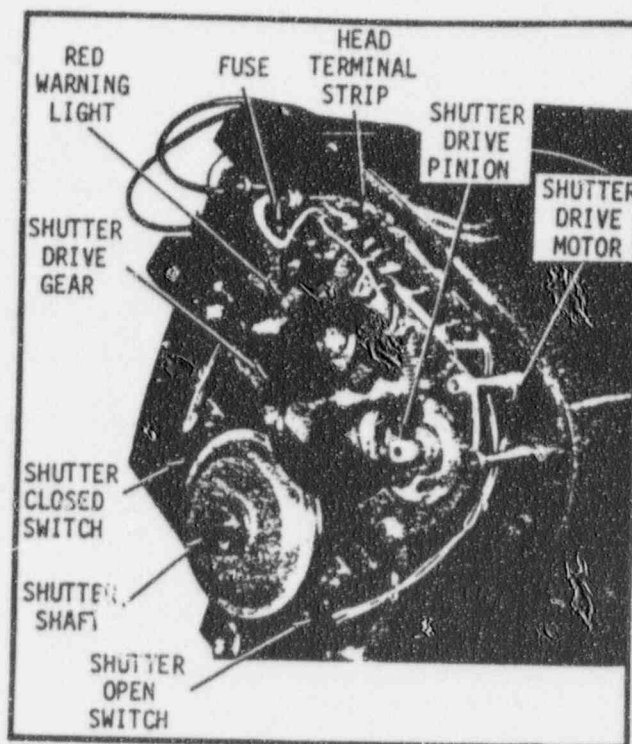
where it is completely surrounded by lead and tungsten, except in the direction of the aperture. In this direction the radiation is blocked by a solid, depleted uranium rod which is a part of the Shutter Wheel. To turn the radiation "on," the wheel is rotated 180-degrees from its "off" position bringing the Source adjacent to the aperture in the bottom of the Head. The radiation is then free to pass through this opening out into the Collimator.



HEAD



SHUTTER WHEEL OPERATION



SHUTTER DRIVE MECHANISM

The Shutter Wheel is turned by a geared motor shutter drive, through a "V" belt, from the "off" to the "on" position. As it turns it winds up a heavy clock spring. In the "on" position, the motor stalls while pulling against the force of the coiled-up clock spring. If electrical power is interrupted or turned off from the control, the motor ceases to exert force, and the spring returns the Wheel to the "off" position.

Return to "off" position requires the wheel to turn 180-degrees, but only during the first twenty degrees is a significant amount of radiation emitted. Thus the sum of the effective shutter opening and closing times is only a fraction of a second. If the shutter should fail to close, the hand wheel on the Head cover can be used to close it, or the shutter can be electrically driven to the "off" position if the operator depresses an "EMERGENCY BAR" on the control.

## Beam Collimator (3706A)

The Collimator is constructed of four sets of flat interleaved lead and tungsten vanes that move with a planar motion to provide variable field sizes. The planar motion of the vanes is necessary to avoid distortion of the edges of the treatment field. The inner defining edges of the collimator vanes are angulated to follow the divergence of the beam for each field size. It is possible at any time to set the collimator vanes for a specific source diameter so that a minimum penumbra will be maintained if an original source is replaced by one of a different diameter.



INSIDE VIEW OF COLLIMATOR

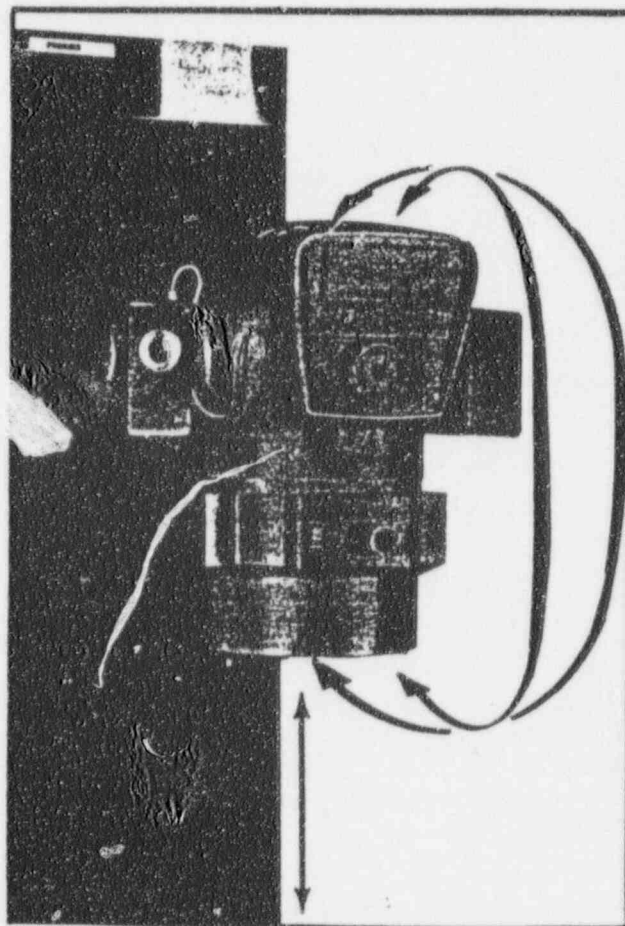
### Positioning Mechanism

The Head is mounted on a Stand which makes possible the following motions:

1. The main support can be raised and lowered through 53-1/2 inches of travel via a safe friction drive.
2. The Yoke can be rotated in either direction, within the same rotational plane, about 175-degrees from its middle position on one horizontal axis; and the Head can be tilted a total of 110-degrees normal to the Yoke's rotational plane. Electrical limit switches and mechanical stops prevent further rotation.
3. Because of the built-in brake, the Head and Yoke rotation positions are automatically locked when the respective switch or handle is released. The Collimator is locked and unlocked with the Collimator Locking Knob.

The Collimator provides continuously variable field sizes from 3 x 3cm to 35 x 35cm at a distance of 80cm from the source. It includes retractable penumbra trimmers so that the source-to-final collimation distance can be varied from 45cm to 65cm. (The minimum field size is 4 x 4cm if the trimmers are retracted.)

The Collimator contains a beam defining light that defines the radiation field at the geometric field size. Field size is defined by lines drawn from the center of the face of the source, past the edges of the outermost beam defining vanes to the skin. An optical distance indicator is provided that projects the source-to-skin distance (SSD) onto the skin of the patient. The Collimator can be rotated about the beam axis through 170-degrees to the left and 170-degrees to the right. A scale is provided to give the angular settings of 90-degrees to the right.



STAND AND YOKE

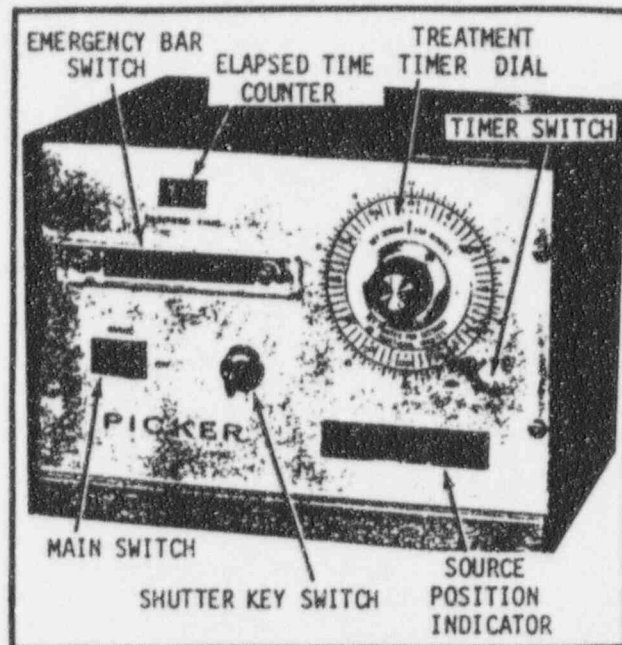
## "Zonegard"

The source head includes an automatic safety system (Zonegard) which prevents an exposure when the head is so angulated that the beam would be directed toward areas of the treatment room that are not adequately shielded. A white indicator light on the top front of the head illuminates the head cover window when the head is pointed within the limits determined by the switches as a reminder to the operator of the Cobalt unit when setting up for treatment. If the light is off, no beam radiation can be programmed indicating that the head is pointed to a part of the treatment room not properly shielded.

## Control Unit (VG-8D)

The Control Unit, containing all the elements necessary to control and monitor the radiation, consists of:

1. "MAIN" SWITCH (Rocker Type): Controls all electrical power to the equipment. Providing undervoltage protection, if the line voltage drops to a dangerously low value or is interrupted, the main power relay contacts will open and remain open after normal line voltage is restored until the "ON" push-button is again pressed.
2. SHUTTER SWITCH WITH KEY LOCK: Lock is a momentary contact switch which opens the shutter when operated (providing the time switch has been turned "on").
3. EXPOSURE "EMERGENCY" BAR: Pushing this bar switch closes the shutter in emergencies where it is desired to stop the exposure before the preset time has expired. It reverses power to the Shutter.



VG-8D CONTROL UNIT

## NOTE

This bar should only be used in an emergency and not to stop the treatment during normal operation.

4. PRECISION TIMER: Permits selection of treatment times in 0.01-minute increments up to 55-minutes, and terminates the exposure at the end of the preset time. Timer is calibrated in minutes and decimal minutes, instead of minutes and seconds, to eliminate treatment time conversions.
5. SHUTTER INDICATOR LIGHTS: Symbolically show position of Shutter Wheel. When the Source is in the safe or "off" position, the green "shutter closed" light is on. When the key switch is operated, both the green "shutter closed" and the red "shutter open" lamps light as the Shutter Wheel begins to turn. At the end of about two seconds the Shutter is fully open and the green lamp goes out. If, for any reason, the Shutter should stick in a partially open position, both indicator lights remain on. This would indicate a malfunction in the unit thus preventing overexposure or an incomplete exposure to the patient.
6. ELAPSED TIME: Records total time for each treatment. Use of the elapsed time counter and proper records facilitates estimation of the radiation exposure should the treatment timer fail to function properly, or should the operator set the timer incorrectly.

## COBALT HEAD AND CONTROL EXPOSURE LIGHT SEQUENCE

A microswitch (SW39) has been added to the Cobalt head to delay the turn-off of the green light in the control. The existing switch SW10 is repositioned to allow the time and counter to be started before the shutter is opened, which is at 142-degrees of rotation. The shutter locking bar is also redesigned to compensate for the above change.

The green lamp is extinguished when the shutter is fully opened, leaving only the red exposure lamp on.

If the shutter did not open fully, the red and green lamps would be on indicating a malfunction in the unit. This prevents an overexposure or an incomplete exposure to the patient.

## Section 2 INSTALLATION

Be sure to read the "WARNING TO SERVICE PERSONNEL" in the front of this manual *BEFORE* proceeding.

READ THIS SECTION OVER THOROUGHLY BEFORE STARTING, PARTICULARLY THE NEW COLLIMATOR REVISED INSTALLATION INSTRUCTIONS.

### ANCHORING EQUIPMENT

The unit must be anchored to the wall and floor to keep it upright. Since it weighs almost four tons, the wall and floor strength should be checked by the building architect for sufficient load strength. The total weight is much greater than for most X-ray equipment, so care must be exercised in selecting a site. Consideration must also be given to the problem of moving large, heavy equipment into the building and to the installation site. (Refer to D-T64-382.)

### RADIATION PROTECTION

Cast concrete or solid concrete block is recommended for radiation protection. While it is usually impractical to use lead as a protective barrier for the direct beam, since the thickness required would be many inches, it is often useful for adding protection against scattered radiation. Protection requirements vary with each installation, and wall thicknesses should be specified by the physicist or radiologist in charge. In addition the registered physicist in the employ of the customer must specify safe head rotation limits before they are reset by the Picker installer to satisfy AEC regulation. The Factory cannot be responsible for the radiation safety of an installation.

The view window should provide protection equivalent to the wall in which it is placed. Various types of high-density glass are available, though ordinary plate glass may be used if of sufficient thickness. Mirror viewing systems can be installed as well as closed-circuit television systems.

A maze entrance, or radiation trap, to the treatment room is strongly recommended over lead doors. Unless the radiation reaching them has been scattered more than once, doors with sufficient lead are very heavy and quite expensive.

National Bureau of Standards Handbook #73 gives recommendations for room shielding design.



## PARTS CHECKLIST

DESCRIPTION	V9
Control Unit, including controls, indicators, and timer. (This unit has an interconnecting cable for connection to a junction box which is part of the conduit system for the complete unit.)	VG-8D*
Therapy Head, including shutter and shutter-drive mechanism and bronze encased lead protection for the Cobalt <sup>60</sup> Source. (Head usually shipped from the Factory with the Source already installed.)	590E
Stand, including columns, drive, hanger, counterweighting, and head support.	1373D
Beam Collimator, including localizer lights, and calibrated field dials.	3706A

\*VG-8D is for 60-cycle power; the VG-8E replaces it for 50-cycle power.

### UNPACKING

Arrangements are usually made with the customer to ship the Cobalt<sup>60</sup> Source from the supplier to the installation site inside the Head of the Model V9 Teletherapy Unit. If this is the case, the Head will arrive sealed.

### WARNING

DO NOT REMOVE ANY BOLTS WHICH ARE SEALED UNTIL TIME TO TEST SHUTTER OPERATION.

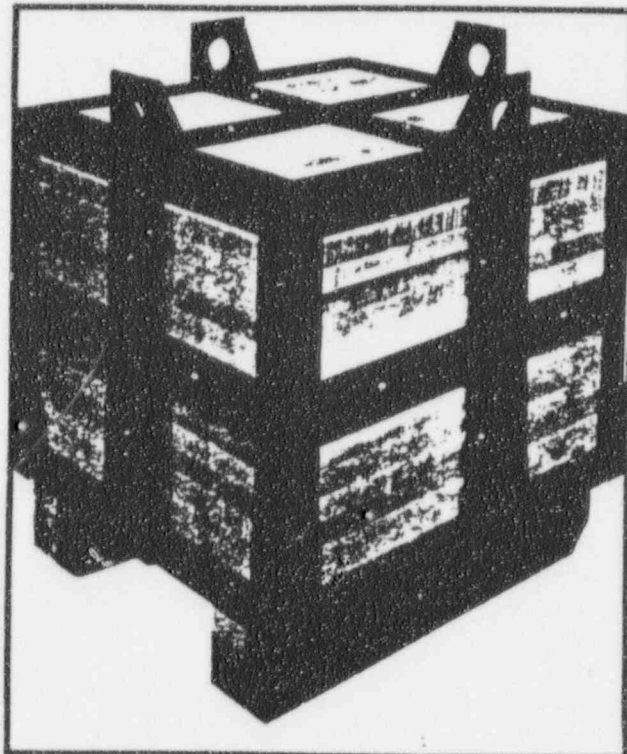
6

When a new source is to be exchanged for an old decayed source, the Source will arrive in a sealed container, which is not to be opened. Factory personnel will ordinarily make the exchange, providing that the seals have not been broken.

When shipped by railroad, the crating is as specified in the table following. For van shipments the packing cases are omitted, but parts are grouped similarly, with cartons being used to keep miscellaneous parts together. Weights and dimensions are for crated and uncrated equipment.

Check the material carefully against the Packing List to make sure that nothing has been omitted. The Collimator and the Control should be handled particularly carefully. It is best to leave the Collimator crated temporarily and open only enough of the Control crate to remove the instructions and wiring diagrams.

The other crates can be opened if moving the cases into the installation site is a problem. However, do not remove the skids and braces from them because they will be needed for assembly.



COBALT HEAD SHIPPING BOX



# SHIPPING BOXES AND CONTENTS

CONTENTS	DIMENSIONS	GROSS WEIGHT	NET WEIGHT
Columns and Motor Drive on skid (Uncrated)	106L x 29W x 30H (99 x 28 x 24)	3420 lbs. (3230)	3030 lbs. (3030)
Collimator and Bearing Ring (Uncrated with skid)	With Box (19-1/2 x 19-1/2 x 11)	525 (450)	* 310 *(310)
Treatment Head with Cobalt Source, skid, and in shipping box	38 x 35 x 39	3200	
Carriage and Hanger with skid (Uncrated)	80 x 30 x 68	1300 (1000)	824 (824)
Sheet Metal Covers and Trim Strips (Uncrated)		335 (115)	115 (115)
Control, Instructions, Wiring Diagrams, Miscellaneous Parts (Uncrated)	26 x 20 x 22 (20 x 11 x 10)	115 (63)	63 (63)
Counterweighting (50 lb. sacks)		350	300

\*Without Skid.

## INSTALLATION

Professional riggers should be employed to move the equipment into the building and to assist in the erection and assembly. It may be possible to rent a lift truck or use a chain hoist, jacks, and rollers, thus avoiding the need for riggers, a suitable alternative if personnel are available with some experience in handling heavy equipment.

The skids and installation accessories, listed next, are the property of Picker X-ray Manufacturing. They must be returned by rail or truck freight to Picker X-Ray Manufacturing, Cleveland, Ohio 44143, as soon as possible to avoid being billed to you. Assemble them compactly, including the hardware, and lash them together for efficient handling.

## FACTORY OWNED EQUIPMENT

ITEM	DIMENSIONS*	PART NO.	WEIGHT
Head Shipping Box	38 x 35 x 39	D-181375	1000 lbs.
Carriage and Hanger Skid	79 x 29 x 12	D-15255	130 lbs.
Column Skid	106 x 29 x 12	C-13878A	110 lbs.
Wall-Eye	20 x 4 x 4	D-13910	20 lbs.

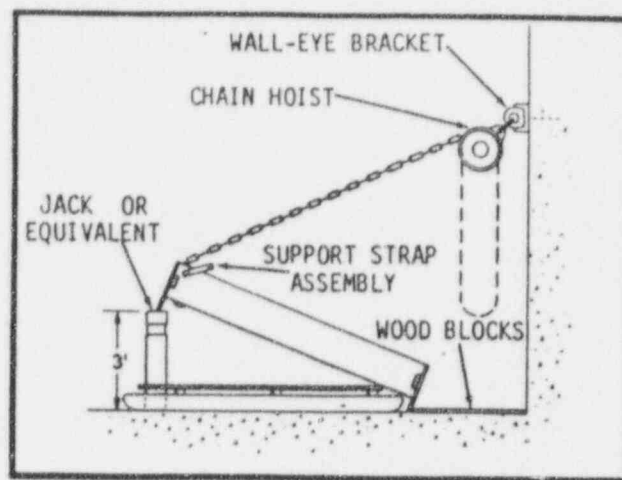
\*L x W x H in inches.

## Erecting the Stand

The following procedures are recommended for installing the Stand:

1. Locate the wall mounting holes or bolts as shown for the Stand assembly in the layout drawing D-T64-318.
2. Drill floor mounting holes and install the required bolt anchors.

3. Attach the Wall-Eye Assembly to the wall using the wall mounting bolt-anchors or through-bolts described in the drawing.
4. Move the Column-Skid Assembly into position and remove banding from the skid.
5. Rig a hand winch or "pull-lift" chain hoist between the Wall-Eye and the square hole in the top mounting plate of the Stand. Be sure the Wall-Eye and the rigging lie along the center-line of the Stand so that it will not sway to the side when tension is applied.



STAND ERECTION

6. Jack the top end of the Stand up three feet before putting the full weight of the stand on the winch or "pull-lift." Complete the job with the winch. *When the columns are almost upright, the Stand will tend to topple towards the wall. A snubbing rope should be used to ease the Stand back slowly.* The Stand should be far enough from the mounting wall to allow the Support Strap Assembly to be raised square to the wall, approximately in line with the wall mounting holes.
7. Remove the Wall-Eye and the winch. Use a pinch-bar or equivalent to remove the two blocks of wood under the floor plate.

#### NOTE

In corner installations where the bolting surface of the support strap assembly is closer than 31-inches from the corner, it will be necessary to assemble the Carriage and Hanger to the Stand before it is bolted into position. This can be done by carefully shifting the upright Stand forward or twisting it nearly parallel with one wall to allow the rear Roller Support Shaft to be assembled. The upright Stand can then be moved back into its final position.

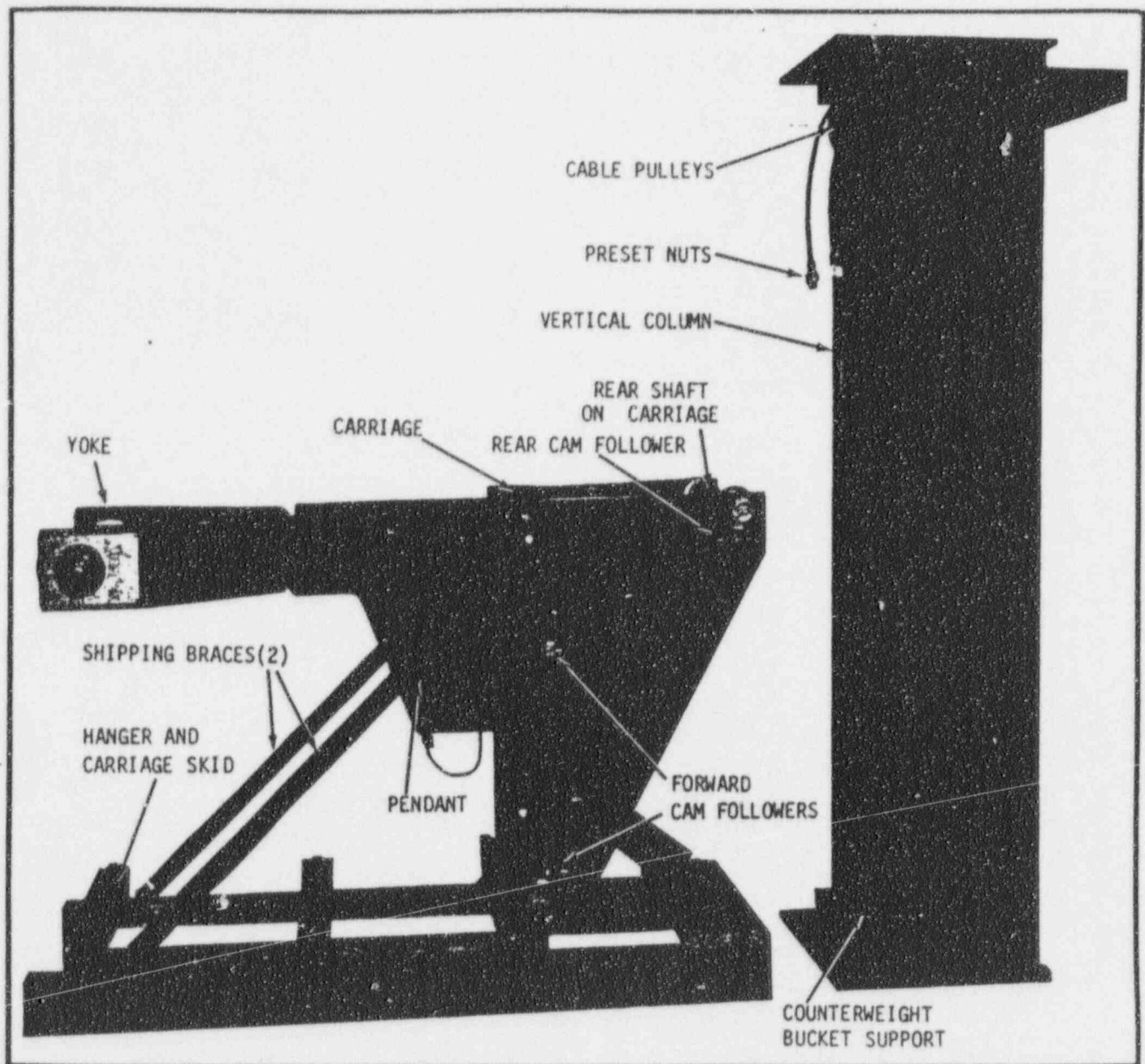
8. Walk Stand toward wall so that the floor mounting bolt anchors are in line with the holes in the Floor Mounting Plate.
9. Install the four wall mounting bolts and washers and the two floor hold-down bolts and washers as shown in layout drawing D-T64-382. Use a straight-edge to check the columns for alignment and to make sure that they have not shifted during shipment or erection. Use a good spirit level to plumb the stand. *The stand should lean backwards about one-half bubble on the spirit level.* Shim if required. Secure the wall and floor mounting bolts.
10. Remove stand skid from area.

#### CAUTION

DO NOT REMOVE THE 4 x 4 SUPPORTS UNDER THE COUNTERWEIGHT BUCKET UNTIL THE CARRIAGE AND HANGER ARE PROPERLY ATTACHED. (SEE PHOTO.)

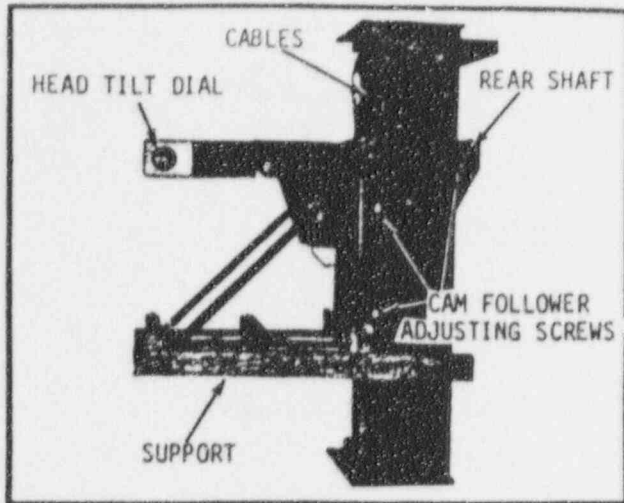
To assemble the Carriage and Hanger Assembly to the Stand, follow these procedures:

1. Use a lift truck or large diameter wood rollers to bring the shipping skid with Hanger into room for assembly to columns.

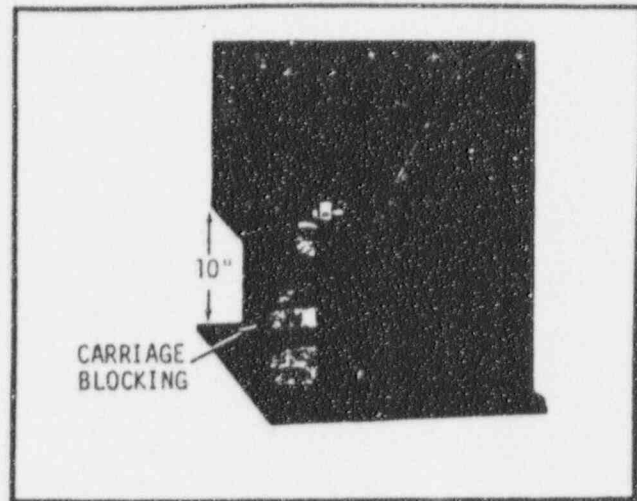


CARRIAGE AND HANGER ASSEMBLY

2. Remove the 2 x 4 from the Carriage end of the shipping skid. Also remove the two 1/2-inch hex screws that hold the angles to rear inside of Carriage to free the angles from the rear of the Carriage.
3. Raise and position the skid approximately 24-inches from the floor and in line with the columns.
4. Remove the masking tape from the 1/2-inch diameter wire cable and snake the cable through the 7/8-inch diameter hole in the left-hand side of the Carriage.
5. Remove the rear shaft and guide rollers.
6. Ease the skid into the column so that the front cam followers nest around the right-hand channel.
7. Assemble the rear Cam Follower Bracket to the rear of the Carriage and assemble the Main Roller Support Shaft to the rear of the Carriage.
8. Remove the banding from the four-wire rope cables secured to the Stand.



ASSEMBLY IN POSITION



CARRIAGE SUPPORT BLOCKS

9. Remove only the lower 5/8-inch nuts and washers from the cables and drape the cables over the top pulleys as shown in the photo of the roll shade. Slip the ends into the outboard two holes in the Carriage.
10. Secure cables with 5/8-inch diameter washers and nuts. (The taped nuts are preset at the Factory.) With the Carriage in the present position, lower the Carriage via the lift truck making sure that the cables are properly seated in the outboard two grooves of the main pulley sheaves and that the "V" belt is between the two wire-ropes.
11. Place wood supports under the Carriage Assembly to prevent its lowering to more than ten inches from the floor. (Refer to photo.)
12. Jack up the Counterweight Bucket to bring the Carriage down against the wood supports and remove the 4 x 4 supports underneath the Counterweight Bucket.
13. Remove the remaining 1/2-inch hex head screws from the front of the Carriage that clamp the angles to the shipping skid.
14. Remove the skid.

#### The Head

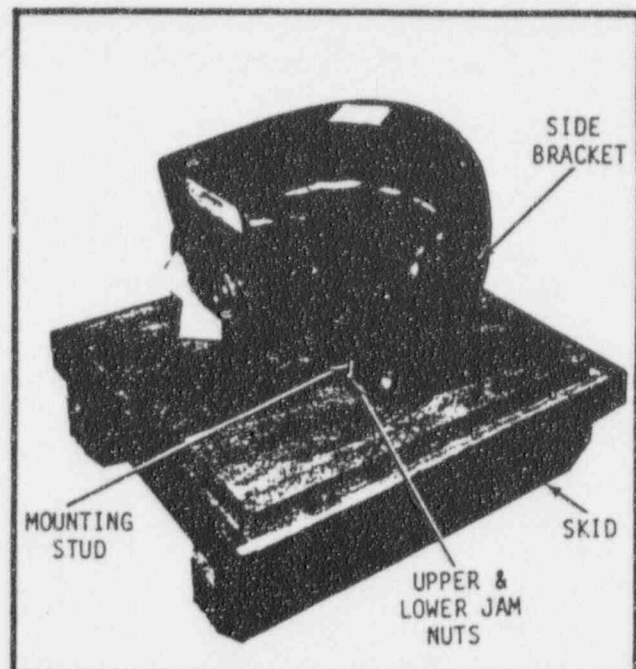
The Head is shipped from PKM with the Co-balt<sup>60</sup> Source already installed and with the shutter locked in the "off" position with a bar bearing a red warning tag—

#### WARNING

DO NOT REMOVE THIS BAR—  
RADIATION HAZARD.

Check the Head with the survey meter for the possibility of radiation leakage above 40 mr/hour at the surface (except bottom and top where it may approach 100 mr/hour at the surface). Also check for obvious shipping damage before proceeding. Follow the next set of instructions very carefully.

1. Place the Head bolting trunnions in position for mating of the Head and Stand by manually rotating the Hanger Yoke to the position shown.



HEAD MOUNTED TO SKID



### CAUTION

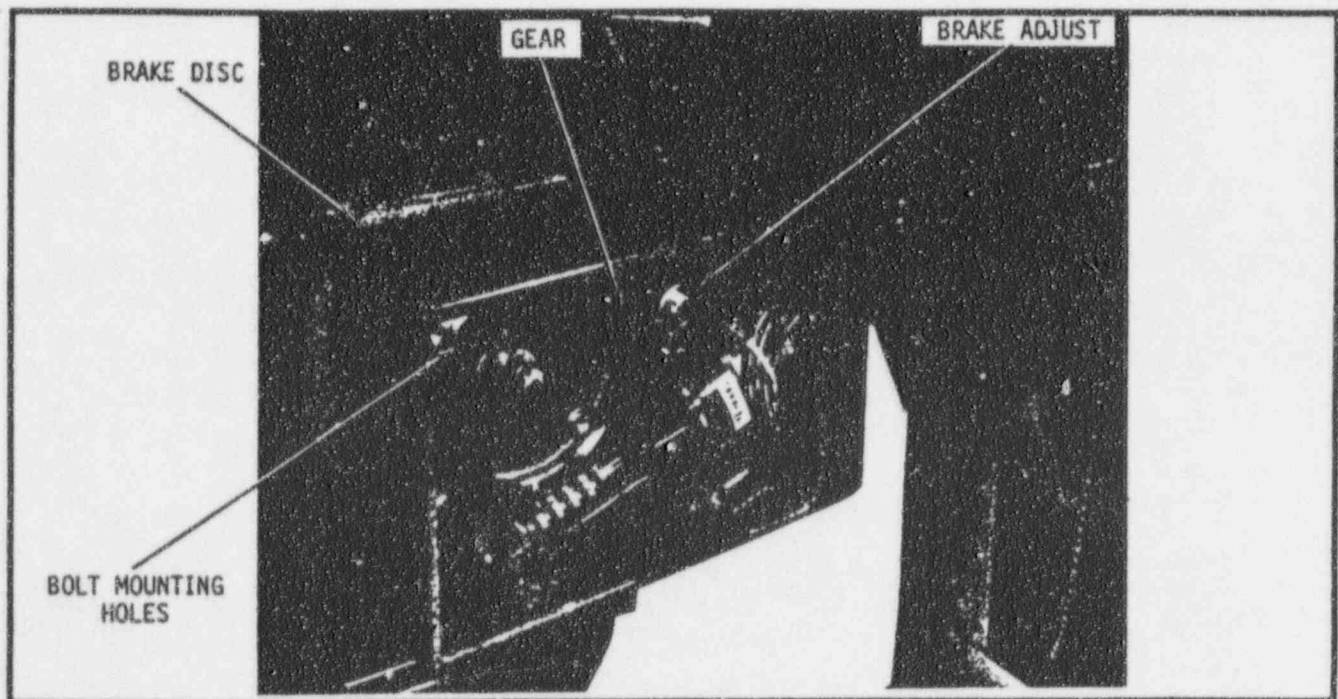
THROUGHOUT THE FOLLOWING PROCEDURE IT IS ABSOLUTELY NECESSARY THAT THE ALIGNMENT OF THE ACCESSORIES ATTACHED TO THE HEAD NOT BE DISTURBED, INCLUDING THE SHUTTER DRIVE, AND SHUTTER LOCK SEALS.

2. Remove all packing and crating from the Head shipping skid, including the lifting rig assembly and its supporting angles (if supplied).
3. Position the skid on rollers in front of and in line with the Stand.
4. Remove the two hold-down brackets and the Head will be free of attachments to the skid except for four clamping studs through the base plate.

### NOTE

Do not remove these studs at this stage. The Head skid must first be raised about 12-inches to align the trunnions.

5. With the Yoke in the horizontal position (make sure the head tilt motor is on your right side as you face the machine) raise the Head and skid into position and fasten with the four flat head heat-treated 1/2-20 x 1-inch screws provided. The right trunnion lug must line up with hole in the worm gear at the lower front of the Yoke Arm. Notice that the screws are to be installed through the holes in the worm gear. Rock the Head slightly to get proper seating of the bolts.



HEAD TILT MECHANISM

### WARNING

DO NOT REMOVE THE SKID NOW. IT SERVES TO BALANCE THE HEAD AS WELL AS TO SHIP IT. TO REMOVE IT NOW WOULD CAUSE A SERIOUS IMBALANCE WHICH COULD RESULT IN INJURY TO PERSONS AND MACHINE IF THE YOKE WERE ROTATED FROM THE HORIZONTAL.



## COLLIMATOR INSTALLATION

At this point the head, hanger and carriage are much heavier than the counterweight bucket and will remain on the blocks.

To install the collimator the head and skid must first be rotated 180-degrees as follows:

1. Release the tension on the yoke brake pucks by turning the brake tension screws in a counterclockwise direction. Refer to photo of yoke brake in Section 3.

### CAUTION

DO NOT ROTATE THE HEAD AND SKID WITH THE YOKE MOTOR. THE CHANCES OF PREMATURE GEARBOX AND YOKE MOTOR FAILURE WILL BE LESSENED.

2. Remove the three 3/8-16 x 2-inch socket head cap screws and the two dowel pins from the yoke drive gear. To remove the dowel pins place three 5/8 flat washers and a hex nut on the exposed threaded end of the dowel pin. Turn nut with a wrench to free the pin. If pin does not come out easily, place a screwdriver between the flat washers and gear and pry outwards. This will disconnect the yoke drive gear from the yoke tube. (See photo on page 17.)

### NOTE

Notice that three punch marks on the yoke tube are lined up with three punch marks on the yoke drive.

3. Manually (with extra help) rotate the head and skid in a *clockwise direction* (facing the unit) so the skid is facing upwards and two punch marks appear on top of the yoke tube inside the yoke.

### CAUTION

THE HEAD AND DRIVE GEAR MUST ROTATE IN A CLOCKWISE DIRECTION TO PREVENT LIMIT SWITCH DAMAGE.

4. Place a temporary 120-volt AC source to terminals TB4-2 and TB4-4 located in the left-hand side of yoke. Manually depress RE-21 to energize yoke motor. (RE-21 is located in box forward of yoke motor.)
5. With one man holding the head and skid the other man should energize the yoke drive motor so the drive gear rotates in a *clockwise direction* until the two punch marks on the drive are aligned with the two punch marks on the yoke tube.
6. Insert and seat both dowel pins. Reinstall and tighten the three socket head cap screws that were removed in step 2.
7. Turn each puck adjustment brake screws clockwise until they just seat and then 3-1/2 full turns in the same direction. If coasting develops turn these screws an additional 1/2-turn in the same direction.
8. Manually depress RE-18 located in the left yoke arm until the skid is level.
9. Remove the temporary AC power source from TB4-2 and TB4-4.

## INSTALLATION OF 3706A COLLIMATOR

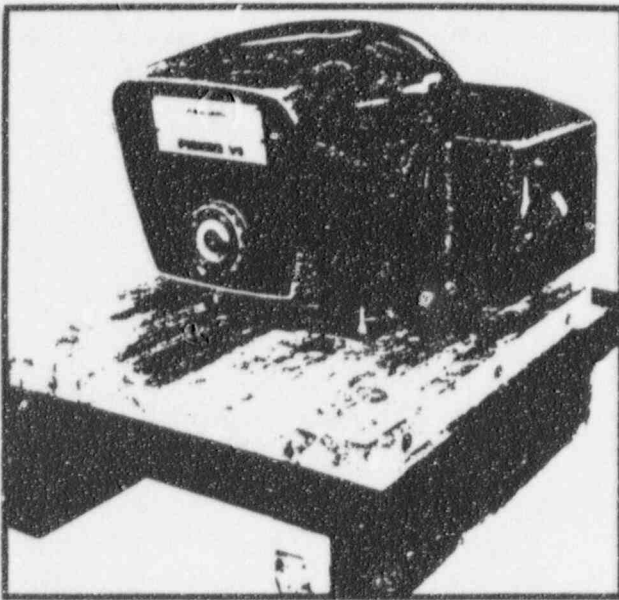
It is recommended that the service personnel read over these instructions thoroughly before removing the head from the skid. The collimator must be assembled step by step as given in the following procedure.

## Removing Skid from Cobalt Head

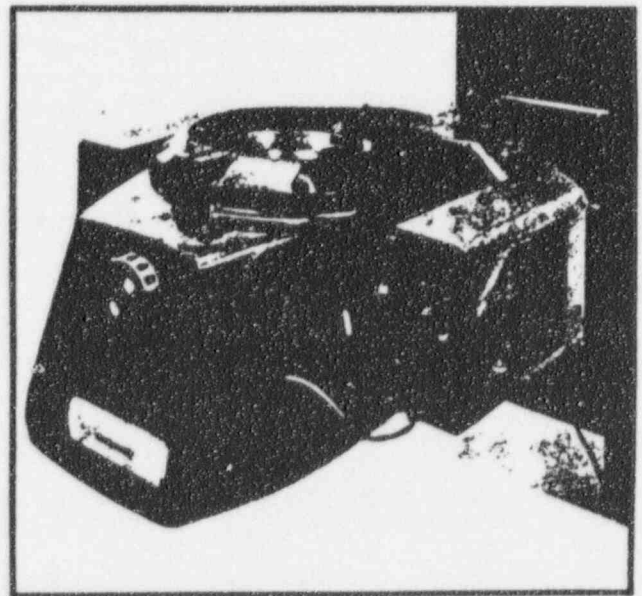
### WARNING

FROM THE TIME THE SKID IS REMOVED UNTIL THE BEARING IS INSTALLED, EXCESSIVE RADIATION IS PRESENT AT THIS END OF THE COLLIMATOR. ALL WARNINGS TO SERVICE PERSONNEL PRINTED IN THE FRONT OF THIS MANUAL MUST BE OBSERVED.

1. Back off on the upper jam nuts on the four threaded studs that secure the mounting lead plate to the head.
2. Back off on the lower jam nuts until they are tight against the upper jam nuts.
3. Turn the upper jam nuts in the direction so the studs screw out of the head.



INSTALLING HEAD TO YOKE



SHIPPING SKID REMOVED

### NOTE

If it is difficult to turn the studs, loosen the counter-sunk nut on the opposite end of the stud.

4. Remove the skid with a lift truck. The skid and lead plate weight approximately 410 pounds.

### WARNING

THE RADIATION LEVEL AT A DISTANCE OF TWO FEET FROM THE UNPAINTED PORTION OF THE HEAD IS 1000 TO 3000 MILLI-ROENTGENS PER HOUR. THE BEARING SHOULD BE INSTALLED IMMEDIATELY.

## Installing Bearing Ring

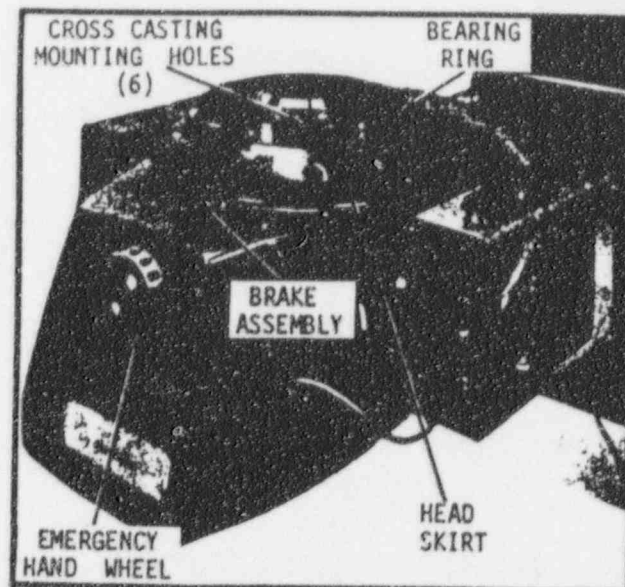
Before installing the bearing ring remove any chips of metal or tape from the bearing ring and the head.

1. Place the bearing ring in the head making sure the eight holes line up with the threaded mounting holes in the head. The bearing ring weighs approximately 40 pounds.

2. Move the inner race of the bearing ring and insert the eight 1/4-20 x 1-1/4-inch socket head cap screws one at a time when the light access opening is opposite each threaded hole.
3. Tighten the eight mounting bolts. Rotate the inner race making sure it rotates freely and does not rub against the head skirt.
4. Position the inner race bearing so the light access opening is at the rear of the head. See photo.

#### Installing the Main Housing Assembly

1. Place the main housing assembly on the bearing ring so the collimator lamp socket fits in the access lamp opening. Also make sure the six mounting holes in the casting are directly opposite the threaded holes in the bearing.



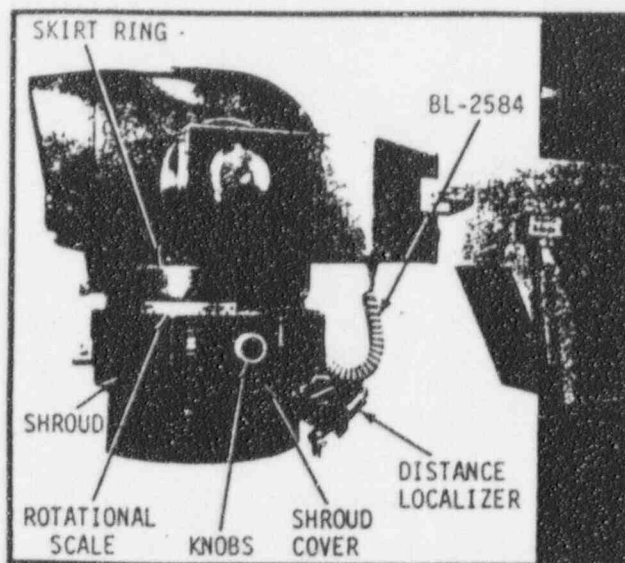
BEARING RING INSTALLED

#### CAUTION

CHECK TO SEE IF THE COLLIMATOR LAMP IS IN THE SOCKET. DO NOT TOUCH THIS LAMP WITH YOUR FINGERS; THIS WILL REDUCE THE LIFE OF THE LAMP. USE SPECIAL WRAPPING PAPER SHIPPED WITH EACH LAMP WHEN HANDLING.

2. Insert the six 1/4-20 x 3/4-inch socket head screws and tighten.
3. Install the brake assembly on the front of the head with the four 10-32 cap screws. Be sure the lead angle of brake is on the top. Refer to photo.
4. Adjust the front microswitch bracket so the microswitch is actuated by the pointer bracket on the brake assembly.
5. Rotate the housing clockwise and counterclockwise to the 90-degree positions, making sure the pointer bracket on the head skirt actuates the microswitches.
6. Place the accessory ring on top of the main casting with the two small cutouts on the ring facing the front of the collimator. The eight mounting holes in the ring should be in line with the eight holes in the main casting.
7. Place the extender casting on top of the accessory ring making sure the mounting holes in the extender casting are in line with the holes in the accessory ring and main housing casting.
8. Insert the eight socket head cap screws in the extender casting and tighten.
9. Place the extender trim cover around this casting with the cutout section at the rear of the collimator. The edge next to the accessory ring must be positioned between the ring and collimator. The opposite edge must seat on the shouldered surface of the collimator. Insert the four small screws and tighten.
10. Place the two shrouds around the main housing casting.
11. Insert the screws at the front and rear of the shroud to hold it together and lock in place with the four set screws on the accessory ring.
12. Mount the rotational scale to the shrouds with the two screws provided.
13. Place the shroud covers over the gearboxes and secure each cover with the four screws provided. The plastic windows must be centered over the scales. Reposition the two shrouds if necessary by loosening the four set screws in the accessory ring.

14. Place the knobs on the protruding shafts and tighten each with the two set screws.
15. Remove the two wires from the lamp switch making a note of the location of each wire on the switch.
16. Mount this switch in the opening of the side shroud cover by merely pushing the switch into the front opening. Reconnect the wires and install the shroud cover.
17. Mount the distance indicator bracket to the rear of the extender casting with the four socket head screws provided. (See Section 3 for Adjustment.)



COLLIMATOR INSTALLED

18. Place the two skirt rings (the angle ends at the front) mounting holes over the holes in the head. With a long Allen wrench or extension tighten the screws from the bottom of the collimator.
19. Adjust skirt ring shroud so when the collimator is rotated in either direction the main shroud does not rub against it.
20. Install the rectangular cover over the collimator lamp cavity with the two screws provided.
21. Rotate the yoke clockwise to the 90-degree position. Retighten the four bolts in the lower trunnion only. Use a 10-inch extension pipe on Allen wrench. Tighten until a stress is felt on the Allen wrench.
22. Tighten the upper trunnion retainer bearing bolts.
23. Rotate the yoke to the 270-degree position. Retighten the four bolts in the lower trunnion only in the same manner as in step 21.
24. Tighten the upper trunnion retainer bearing bolts.

### CAUTION

THESE BOLTS SHOULD BE CHECKED PERIODICALLY ONCE EVERY THREE OR FOUR MONTHS.

### Wiring Procedure—BL-2584 Cable

This cable consists of ten leads. One end in the yoke is already connected to TB4 at PXM. The opposite end of this cable must be routed into the collimator using the Heyco grip mounted to the collimator shroud cover and connect the leads to TB7 on collimator as shown below.

BL-2584 CABLE ENDS (NOT CONNECTED)	COLLIMATOR TERMINAL	LEAD COLOR	YOKE TERMINAL (CONNECTED AT PXM)	COMMENTS
Do Not Connect this End	TB7-1 TB7-2	Blue Brown	TB4-10 TB4-6	Used for C9 Halo Switch Only
	TB7-3 TB7-4	Black White	TB4-20 TB4-8	



BL-2584 CABLE ENDS (NOT CONNECTED)	COLLIMATOR TERMINAL	LEAD COLOR	YOKE TERMINAL (CONNECTED AT PXM)	COMMENTS
Do Not Connect	TB7-5	Red	TB4-2	Zonegard Only
	TB7-6 TB7-7 TB7-8	Tan Yellow Orange	TB4-4 TB4-19 TB4-18	
Do Not Connect	TB7-9	Gray	TB4-7	Zonegard Only
Purple Lead is Tied Back				

### Zonegard

Within the Yoke, on the left front side, are two mercury switches which open the shutter circuit when the Head is tilted more than a preset angle. These switches have been set at the Factory so that the radiation beam can be angled 90-degrees to either side of center and still allow the Shutter to open, based on the assumption that the machine will not be located on an upper floor but will allow the direct beam to be expelled at the ground floor only.

These shutter safety switches must be adjusted so as to allow the Shutter to open only when the Head is aimed at walls which are adequately protected against primary radiation which must only be specified by a registered physicist. If room protection allows angles of more than 90-degrees to be set, then adjust mercury switches as required (see Stand Wiring Diagram E-T61B-363). If angle limits of less than 90-degrees are desired, the parallel wired switches must be series connected instead and then adjusted.

The white "Zonegard" light, seen through the Head cover window, lights only when the Head is pointed within the limits determined by the switches, as a reminder to the operator of the machine when setting up for treatment. If the light is off, the shutter will not open even though the Control Key Switch is actuated.

### Connecting Head to Yoke (Refer to E-T61B-363, BL-1824H)

The head can be connected by routing the Head to yoke cable (BL-1824H) through the cable grip on top of the left-hand side of yoke. Leave enough slack on cable for Head tilt. Tighten lock nut on cable grip, and connect leads as follows in the yoke:

1. Connect lead marked 4G to terminal strip TB4 terminal 1. (TB4 is located on left side of yoke.)
2. Connect lead marked 1G to terminal strip TB4-2.
3. Connect lead marked 2G to terminal strip TB4-4.
4. Connect lead marked 6G to terminal strip TB4-5.
5. Connect lead marked 12G to terminal strip TB4-9.
6. Connect lead marked 9G to terminal strip TB4-11.
7. Connect lead marked 3G to terminal strip TB4-12.
8. Connect lead marked 10G to terminal strip TB4-13.
9. Connect lead marked 11G and 14G to terminal strip TB4-19.
10. Connect lead marked 7G and 13G to terminal strip TB4-8.



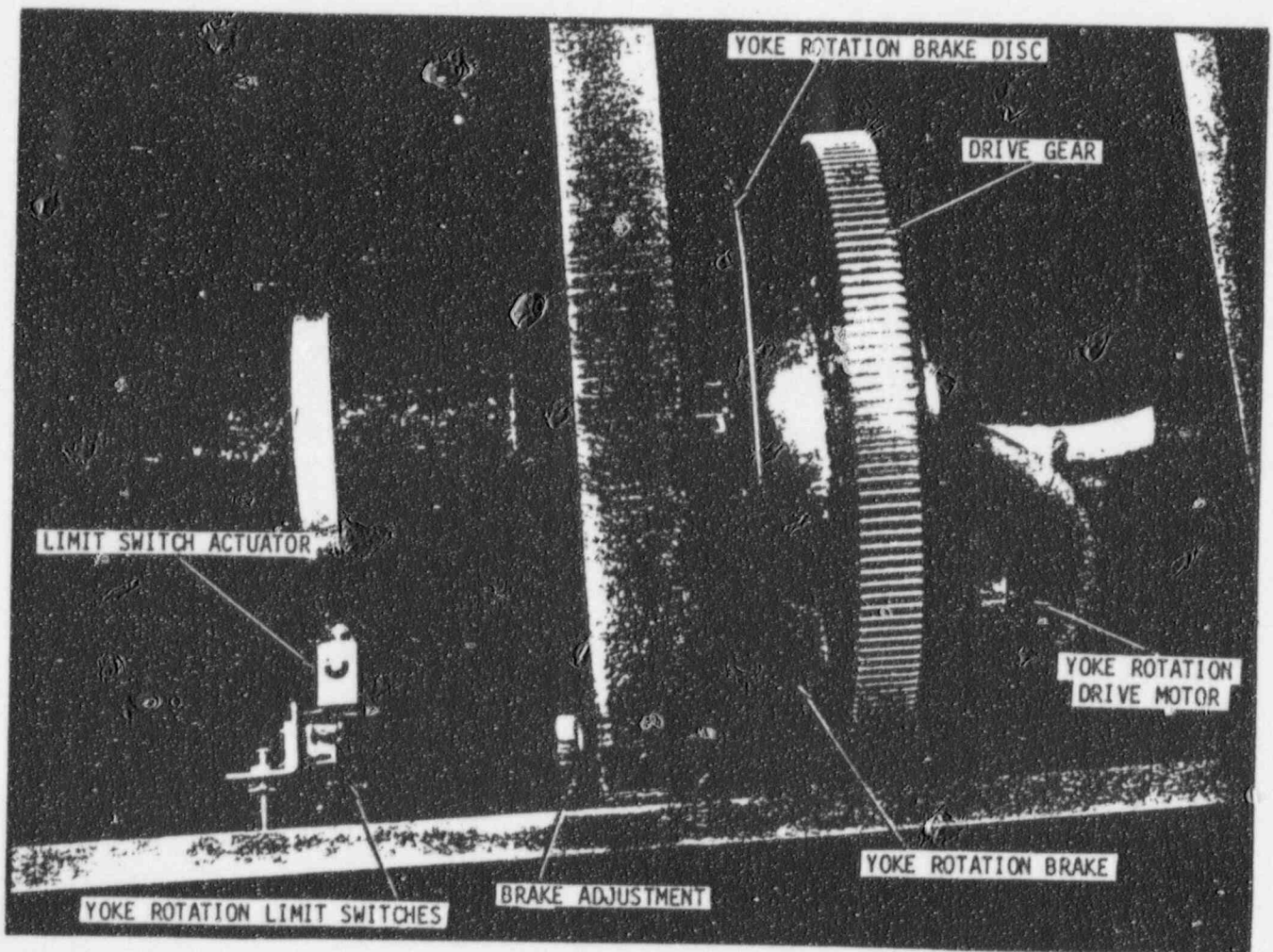
11. Connect lead marked 5G and 8G to terminal strip TB4-20.

### Pendant Switch

The Pendant Switch, prewired on all units, is mounted on the right side of the Carriage according to the wiring diagrams and instructions included with it. This switch controls the direction of the yoke rotation, head tilting, and vertical drive. The Pendant Switch Cord connects into the receptacle on the bottom of the vertical carriage.

### Setting the Yoke Rotation Brake

To the rear of the counterclockwise limit switch is the brake adjustment screw. To adjust this brake turn screw clockwise until the brake engages the brake disc, then turn screw 3-1/2 turns in clockwise direction.



YOKE ROTATION MECHANISM

### Final Balancing and Leveling of Stand

With the Collimator completely attached, the Head will be balanced in rotation but will not be balanced perfectly with the counterweighting in the Stand. Additional counterweighting (from bags) will have to be added. While filling the counterweight, use a rawhide or rubber mallet from time to time to "shake down" the shot. Check the balance periodically. It is best that the upward motion be set so that the unit will move up with a light touch.

### NOTE

Recheck the plumb of the stand. It must be level.

The "V" belt can be installed and adjusted after the balancing. Clean the large drum surface and "V" belt surface *oil free*. But if it has been done previously, it should be loosened to allow more sensitive adjustment of final balance. After the unit is balanced the tension of the "V" belt can be adjusted to overcome the rolling friction of the Carriage. To adjust the "V" belt loosen the two hex head screws approximately one full turn in the slotted holes of the motor mounting plate. Back off the two lock nuts on the two 1/4-20 x 2-inch Allen head screws located on the top rear of the motor plate. Tighten each screw the same amount until the "V" belt is snug. Tighten lock nuts and the motor mounting screws. This will be rechecked with power on later.

Adjust the tension of the idlers riding on the "V" belt by loosening the idler bracket screws that fasten the bracket to the motor mount. Tighten the nuts on the long threaded rod until the idlers move toward one another placing a tension on the belt. Tighten the bracket bolts.

### Electrical Connections

The VG-8D Control ordinarily will rest on a desk or bench in the control room, near the view window or TV monitor. To connect the cables from the Control to the "B" box, refer to drawings D-T64-382 and E-T61B-363.

Connect the wires from the "C" box to the terminal strip at the top back of the Stand. Connect the Carriage cable to the terminal strip and dress it carefully so that the cable will not foul on the Carriage or Carriage roller bolts.

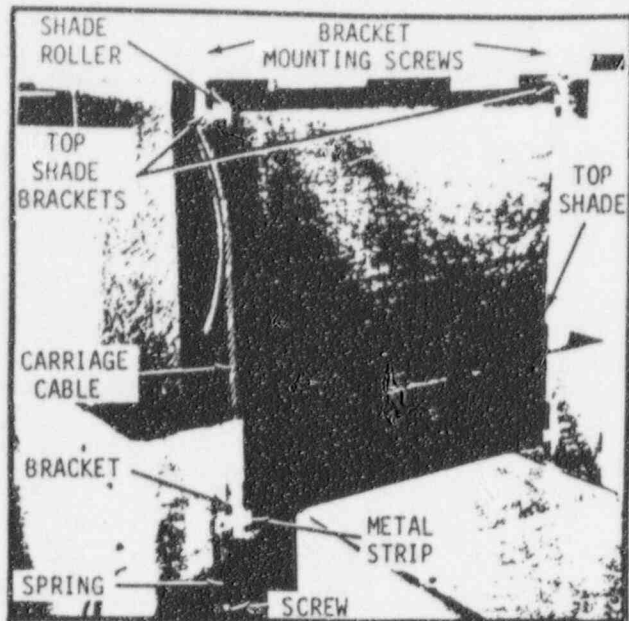
### Connecting VG-8D Control (Refer to E-T61B-363, BL-1863A)

1. Connect green lead marked GND to earth ground.
2. Connect red lead marked L1 to the 117 VAC (Hot) side of 117 VAC power source.
3. Connect black lead marked L2 to the ("0" Volt) side of 117 VAC power source.
4. Connect the gray lead marked SW5-2 to door switch SW5 terminal 2.
5. Connect the violet lead marked L2 to terminal 12 of the stand terminal strip.
6. Connect the brown lead marked 11 to terminal 11 of the stand terminal strip.
7. Connect the orange lead 10 to terminal 10 of the stand terminal strip.
8. Connect the white lead 6 to terminal 6 of the stand terminal strip.
9. Connect the yellow lead 4 to terminal 4 of the stand terminal strip.
10. Connect the blue lead 3 to terminal 3 of the stand terminal strip.
11. Connect the red lead marked 2 to terminal 2 of the stand terminal strip.
12. Connect the black lead marked #1 to terminal #1 of the stand terminal strip.
13. The spare green lead is marked spare.

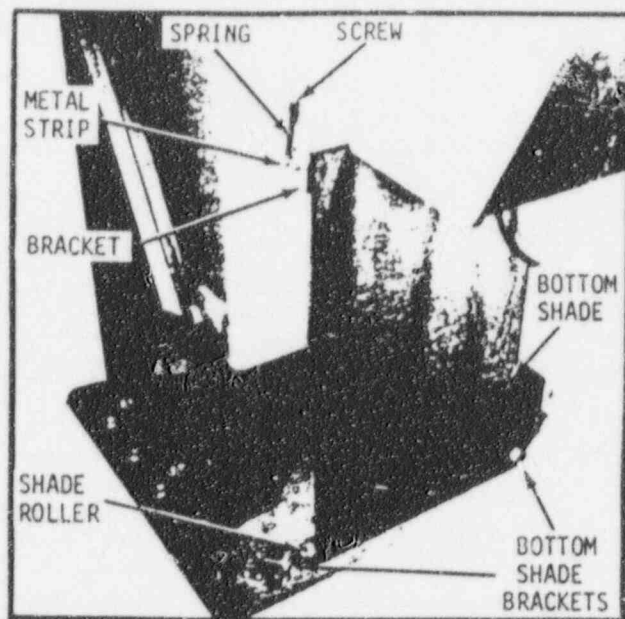
### MOUNTING THE BACKGROUND SHADES

#### Top Shade

1. Position the top of the carriage approximately two feet below the top of the stand.
2. Install the two roll shade brackets to the top underside of the stand as shown in the photo. The holes are predrilled for mounting. Insert the roll shade in between these two brackets.
3. On the top front side of the carriage install the two brackets as shown in the photo. Place the two spacers between each bracket and the carriage. Insert the screws through the bracket holes and spacers and tighten.



TOP SHADE MOUNTING



BOTTOM SHADE MOUNTING

4. Pass the metal strip through the free end of the shade and each bracket as shown in the photo.
5. Attach a coil spring in each hole at the ends of this metal strip.
6. Insert the screws in the tapped holes below the brackets and attach the opposite end of both springs to these screws.

#### NOTE

Springs are used to keep the shades self-aligning and wrinkle free.

7. Raise and lower the carriage making sure the shade moves freely without any binding.

#### Bottom Shade

The bottom shade is installed in the same manner as the top shade with the exception that the roll shade brackets are mounted to the bottom of the stand. Refer to photo.

#### Stand Trim Covers

The top, side, and bottom trim covers should not be installed on the stand until after the carriage checkout procedures in Section 3.

#### OPTIONAL DEVICES (INSTALLATION)

##### Accessory Attachment Post (3499E)

This is a rugged metal post that is attached to the Accessory Mounting Ring on the 3706A Collimator housing. The Post is required for mounting the Pin-and-Arc (3500C), and the Mechanical Back Pointer (3298C). The vertical position of the Post can be varied by turning a knurled knob on the side of the Post. Distance scales are field installed—for use of the Pin-and-Arc accessory.

To install this device release the lock clamps on each side of the post and insert the post into the two front slotted openings of the accessory ring. Position the post on the ring away from the slotted openings. Tighten the two clamps when the desired position is reached.

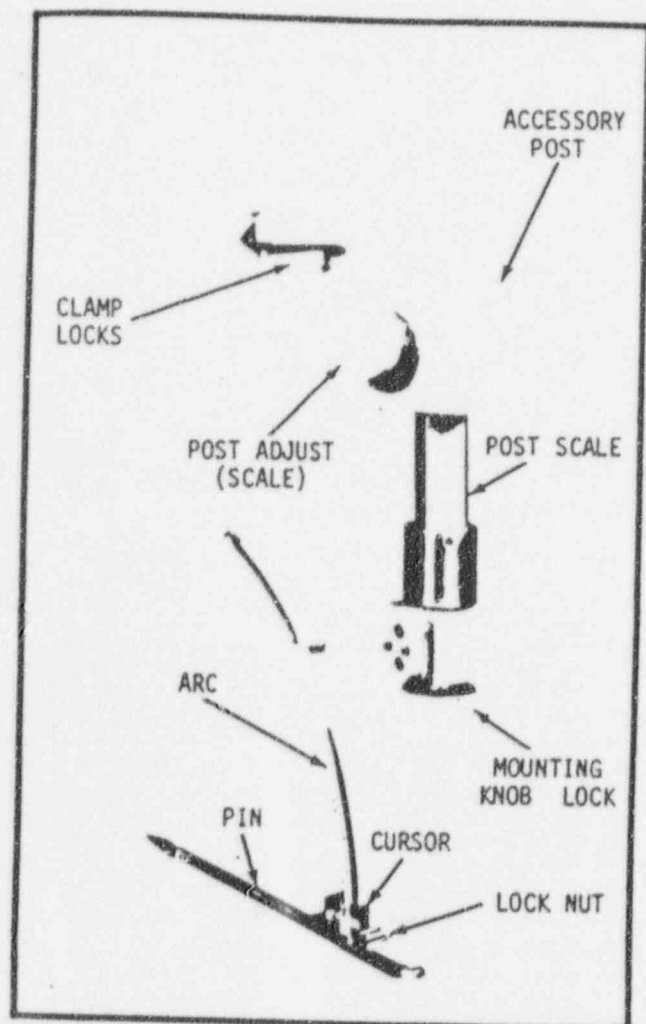
## PIN-AND-ARC (3500C)

This beam directing device permits the user to quickly, conveniently, and accurately set the radiation beam at any desired angle and bring the patient to the proper treatment distance using a single reference point marked on the patient's skin.

The Pin-and-Arc can be easily attached to the Accessory Post by inserting the tapered adapter of the mounting bracket into the bottom of the Accessory Post. Turn the large knurled knob to tighten.

To properly install the scales on both the Attachment Post and the Pin-and-Arc the following procedure should be followed:

1. With this accessory mounted to the Post set the pin slider on the arc to the 90-degree position.
2. Reposition the Post to the 90-degree position on the accessory ring and secure with the clamp locks.
3. Turn on the collimator lamp. Place a sheet of white paper below the collimator on a table.
4. Turn on the Optical Distance Indicator and set it at 80cm.
5. Adjust the arc tilt set screws until the pin passes through the central ray of the collimator.
6. Set the pin so that the tip is on the central ray (on the cross hair of the paper).



PIN AND ARC MOUNTING ACCESSORY POST

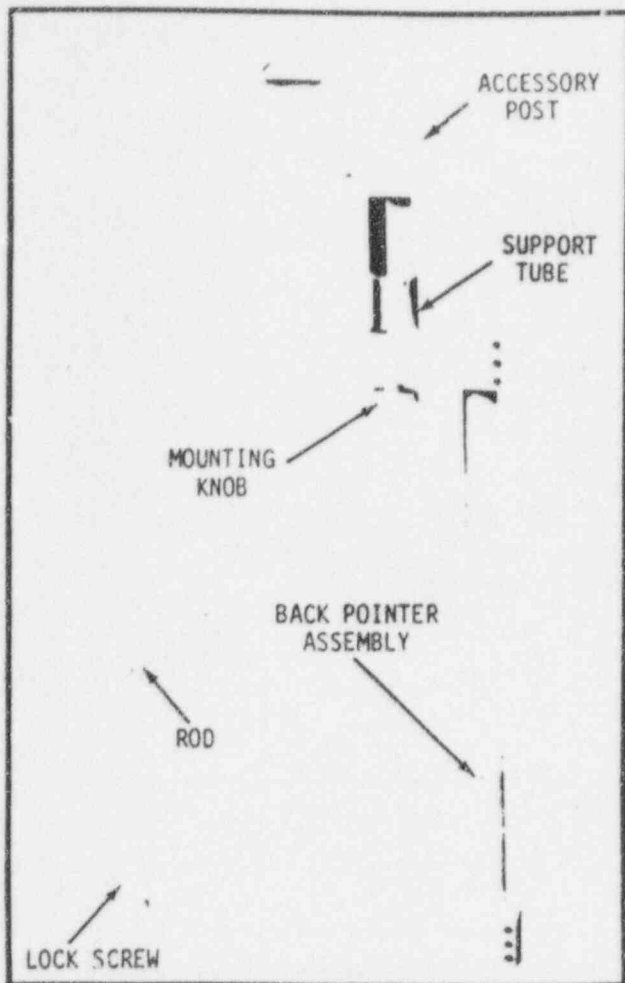
7. With the large knurled knob on the Attachment Post adjust until the pin tip is 80cm from the source as measured with the Optical Distance Indicator.
8. Glue the scale to the pin in such a position that it reads zero ("0").
9. Glue the scales to the Accessory Post in such a position that they read zero ("0").
10. Readjust the arc tilt set screws as required.
11. Check that the tip of the pin stays centered on the central ray as the pin slider is moved from one end of the arc to the other.
12. Turn out collimator lamp and Optical Distance Indicator and remove the device.

## Mechanical Back Pointer Assembly (3298C)

This is a beam directing device which quickly locates the exit point of the radiation beam on the patient's skin. This device is rigidly mounted to the Accessory Post by inserting the tapered adapter of the mounting bracket into the bottom of the Post. A large knurled knob secures this device to the Post.

The Back Pointer consists of a "C" type assembly with adjustable backpointing rod accurately centered in the radiation beam.





MECHANICAL BACK POINTER

#### COLLIMATOR MOUNTED BEAM-SHAPING ASSEMBLY (3022)

The above accessory permits the user to position lead blocks in the radiation beam to achieve irregularly shaped treatment fields and to shield predetermined areas of the patient.

This assembly consists of a beam-shaping support platform replaceable tray and beam-shaping lead blocks. The support platform is clamped to the bottom surface of the Collimator housing with a large knurled knob and stud located at the front of the support platform.

The perforated tray permits convenient visualization of position of lead shielding blocks (with collimator beam defining light field). Lead blocks are firmly clamped in any position on the perforated tray which can be removed from the support platform with the blocks clamped in position and stored so that the beam-shaping configurations can be quickly reproduced.

The following steps should be followed when installing the Back Pointer Assembly:

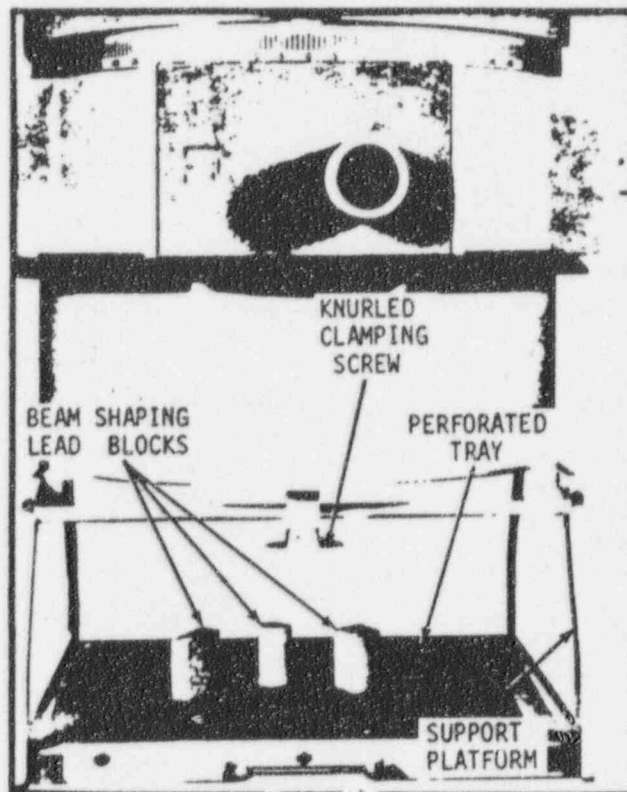
1. Install the mounting bracket to the support tube so the bracket surface and end of the support tube are flush.
2. Adjust the pointer arm so it is parallel to the mounting bracket. Secure all bolts.
3. Mount this assembly to the Accessory Post. Set the Post to zero ("0") on the scale.
4. Insert the pointer rod into the pointer arm and turn on the collimator lamp.
5. Adjust the height of the pointer rod so the tip of the rod is set at the central ray, then lock in place with the thumb screw.

#### NOTE

The mounting bracket may have to be repositioned (see step 1) to align the pin at collimator center.

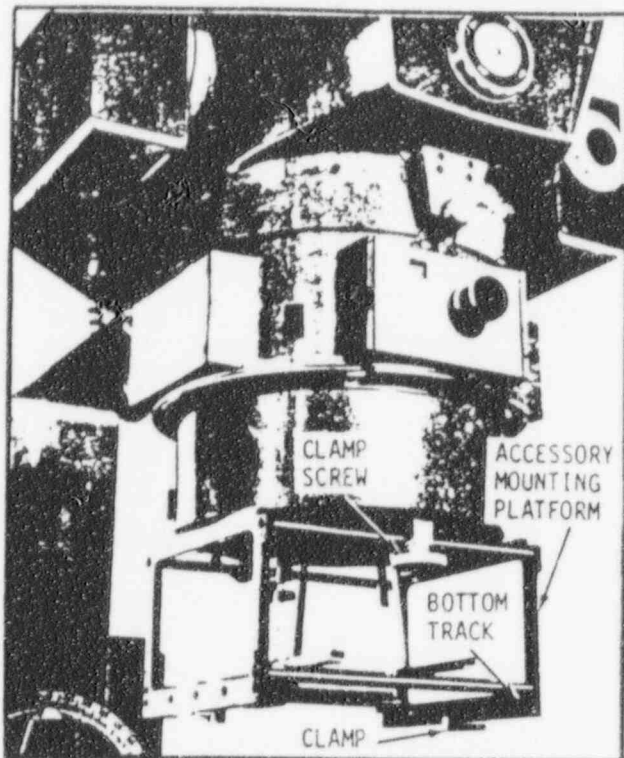
6. Turn out collimator lamp and remove the Back Pointer Assembly.

21

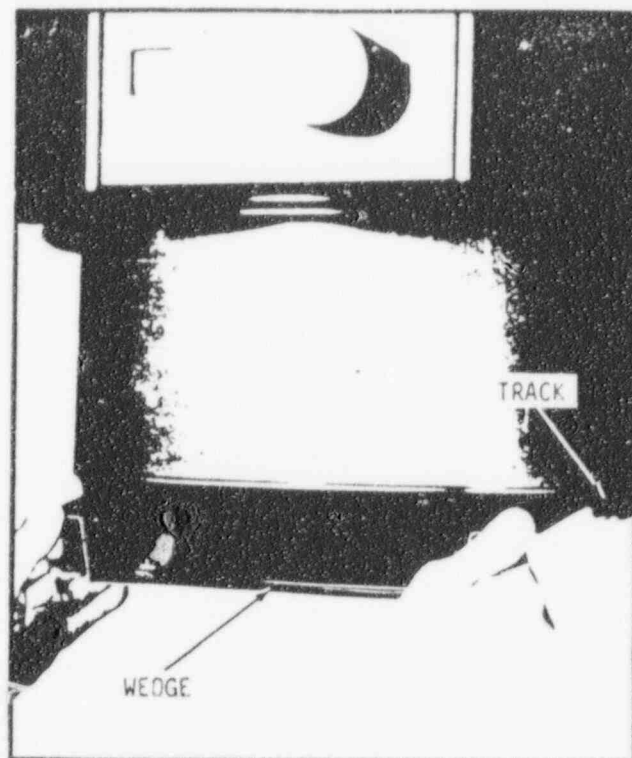


BEAM SHAPING ASSEMBLY





ACCESSORY MOUNTING PLATFORM



WEDGE MOUNTED TO COLLIMATOR

#### Accessory Mounting Platform (3754A)

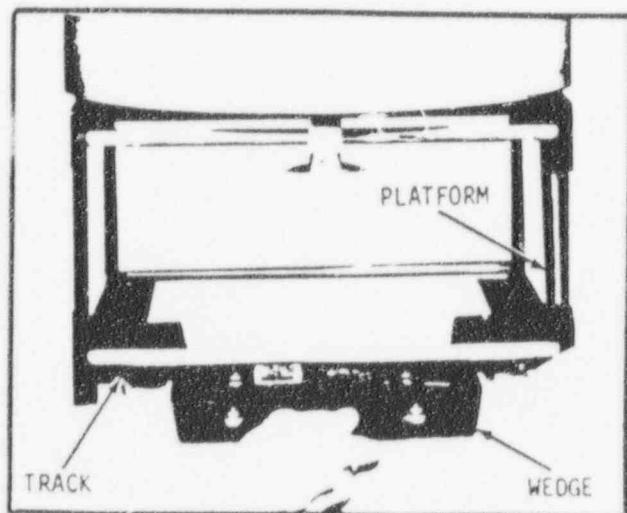
This platform is required when using the Wedge Filter (3021, 3021B), or the Oblique Brass Compensator (3021A).

The top of the platform mounts to the bottom tracks of the collimator. The large knurled knob and stud at the front of the platform secures this device to the threaded hole in the collimator.

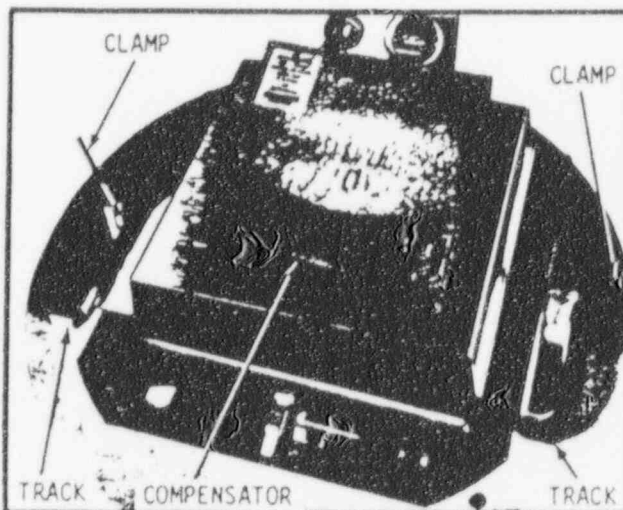
#### Wedge Filter (3021 and 3021B)

The Wedge Filter is made of lead and can be installed on the bottom tracks of the Collimator and locked in the desired position. The 3021 is a 45-degree wedge and the 3021B is a 60-degree type.

The Wedge can also be installed on the bottom tracks of the Mounting Platform (3754A).



WEDGE INSTALLED ON PLATFORM



COMPENSATOR MOUNTED TO COLLIMATOR (BOTTOM VIEW)

## NOTE

Whenever a Wedge Filter is used with an Oblique Compensator the Wedge should always be mounted nearest the source.

### Oblique Compensator (3021A)

The above can be used and installed in the same manner as the Wedge. The Oblique Compensator is made of brass. It must be mounted with the brass section away from the source.

The Oblique Compensator can be installed and locked on the bottom of the Collimator as shown in the photo.

### THERAPY TABLE (3702A)

The 3702A is a traveling cantilevered table top which permits precise patient positioning prior to treatment with fixed or moving radiation beams. The table top longitudinal and transverse motions are manually controlled. The vertical elevation is motor-controlled. The entire table can be pivoted 180 degrees about the vertical beam axis.

Table top positioning locks and table floor brakes are normally applied to protect the patient and the therapist. In an emergency the table and patient can be instantly removed from the path of the radiation beam by a firm backward pull on the rear table handle.

### DUAL LIGHT SOURCE (3595C)

The Dual Light Source consists of two individual light sources mounted on opposing treatment room walls that project a pencil thin coincident light beams that intersect at the cobalt machine isocenter. The lamp assembly in each unit can be adjusted to compensate for walls not parallel to the axis of the cobalt unit. Each wall unit can be operated from any 115 VAC wall outlet. Detailed instructions and drawings (A-T60A-487 and C-T60A-489) will accompany each unit.

### Section 3

## CHECKOUT AND ADJUSTMENT

Be sure to read thoroughly the Special Warning and initial operation as outlined in "WARNING TO SERVICE PERSONNEL" in the front of this manual.

Upon completion of the installation, the checkouts and adjustments should be made in the following sequence. All adjustments were made at PXM but since the unit was disassembled for shipment and reassembled at installation some adjustments may be necessary.

Use a survey meter at times until proper operation of unit has been established.

#### "V" BELT AND CAM FOLLOWERS

25

Raise and lower the vertical carriage with the Pendant Switch. Check to see if the "V" belt shows any signs of slipping around the cable pulley. If this occurs, readjust the idlers for a greater tension against the belt.

Adjust the cam followers by tightening the set screws on both sides of the cam follower mounting blocks, until the Carriage rolls easily along the edges of the column channels. Be sure that the cam followers do not jam or bind during vertical motion of the Carriage.

#### Yoke and Head Leveling

1. Using the pendant switch, rotate the yoke assembly to its zero position on the rotational angular scale.
2. Hold a level across the bottom of the collimator (crosswise facing the unit). If not level, rotate the yoke slightly until it is level. A tolerance of  $\pm 1/2$  degree is acceptable.
3. The pointer on the angular scale should now be at zero degrees. If not, reposition the pointer to zero. Also check the gravity-operated angulation dial on the front of the yoke.
4. Hold the level lengthwise across the bottom of the collimator. If not level, tilt the head in the desired direction until it is level.
5. Check the tilt angular scales making sure it is set on zero.

#### Collimator Checkout

1. Place a Therapy Table (3702A or equivalent) below the collimator.
2. Check the field symmetry as follows:

- a. Set the head and yoke at their 0° positions and rotate the collimator to either one of its 90° positions. Set the field size to about 10 x 10cm.

### CAUTION

AT NO TIME SHOULD THE TRIMMER BARS BE RETRACTED OR EXTENDED BEYOND A 20 x 20CM PROJECTED LIGHT FIELD SIZE.

- b. Mount a small pointer or dial indicator from the table top and adjust the height of the carriage so the pointer just touches the inside surface of one of the collimator vane bars.

### CAUTION

DO NOT LEAN ON THE STRETCHER WHILE MAKING THIS CHECKOUT.

- c. Manually rotate the collimator 180 degrees. The pointer should now touch the opposing vane bar. The error should not exceed 1/64-inch. If the vanes are off center; i.e., not symmetrically placed around the collimator axis, it will be necessary to adjust the positions of the two sets of cable pulleys (which hold the vane drive cables)—the ones nearest the end of the collimator. The pulleys must be moved in pairs so as to keep the cable between them taut. The pulley support locking screws should be loosened slightly, and the support blocks can then be moved by means of set screws which work against stops on the main frame casting.

When the adjustment is completed, the set screws which tighten the cable should be set to a torque of 4-1/2 inch-pounds.

- d. Repeat for the other set of vanes.
- e. Turn on the field illumination light. Lay a white paper on the stretcher top, and tape it so that it won't move. Set the field size for a 10 x 10cm. The collimator should be at one of its 90° positions.
- f. Using a ruler, draw a pencil line on the paper coincident with one edge of the field. Draw another line at 90 degrees to the above line for the other edge of the field. The two lines will resemble an "I". Rotate the collimator 180-degrees and check that the field edges line up with the pencil marks. If they don't, and if the previous steps have been carried out properly, then the mirror is bent or defective or somehow at the wrong angle. There is no adjustment—this is merely a check for shipping damage. Contact PXM if damage is evident.
3. Set the collimator field dials to 4 x 4cm at 80cm with the extenders "in"; i.e., retracted.

### NOTE

The distance from the source to the bottom of the lowest trimmer bar of the collimator is 45cm with the vanes closed. The distance from the bottom of this trimmer bar to the paper should be 35cm (13-29/32 inches) for the 80cm setting.

4. Loosen the collimator locking knob on the front of the collimator and rotate the collimator to one of its 90-degree positions. Place a mark on the paper where the projected cross hairs intersect.
5. Rotate the collimator to a 180-degree position. The center cross hairs should remain at the center of the mark on the paper. If the center deviates away the cross hairs are not centered. The cross hair positions are adjustable at their mounting points and must be adjusted on exact center.
6. Rotate the collimator to its zero-degree position and tighten the collimator knob.

7. Reposition the alignment paper so it is at a 90-degree angle with the top of the book.
8. Rotate the yoke to the 90-degree clockwise position and observe the location of the cross hairs projection on the alignment paper. Mark accordingly.
9. Rotate the yoke to the 90-degree counterclockwise position off of the zero position and note the location of the cross hairs projection image in comparison with the 90-degree projection marking in step 8. The deviation should not exceed  $\pm 2$ mm.

If the deviation is greater than  $\pm 2$ mm, rotate the yoke toward the center of rotation, splitting one-half the difference. Reset the alignment paper at the center of the cross hair projection. Recheck both steps 8 and 9.

### CAUTION

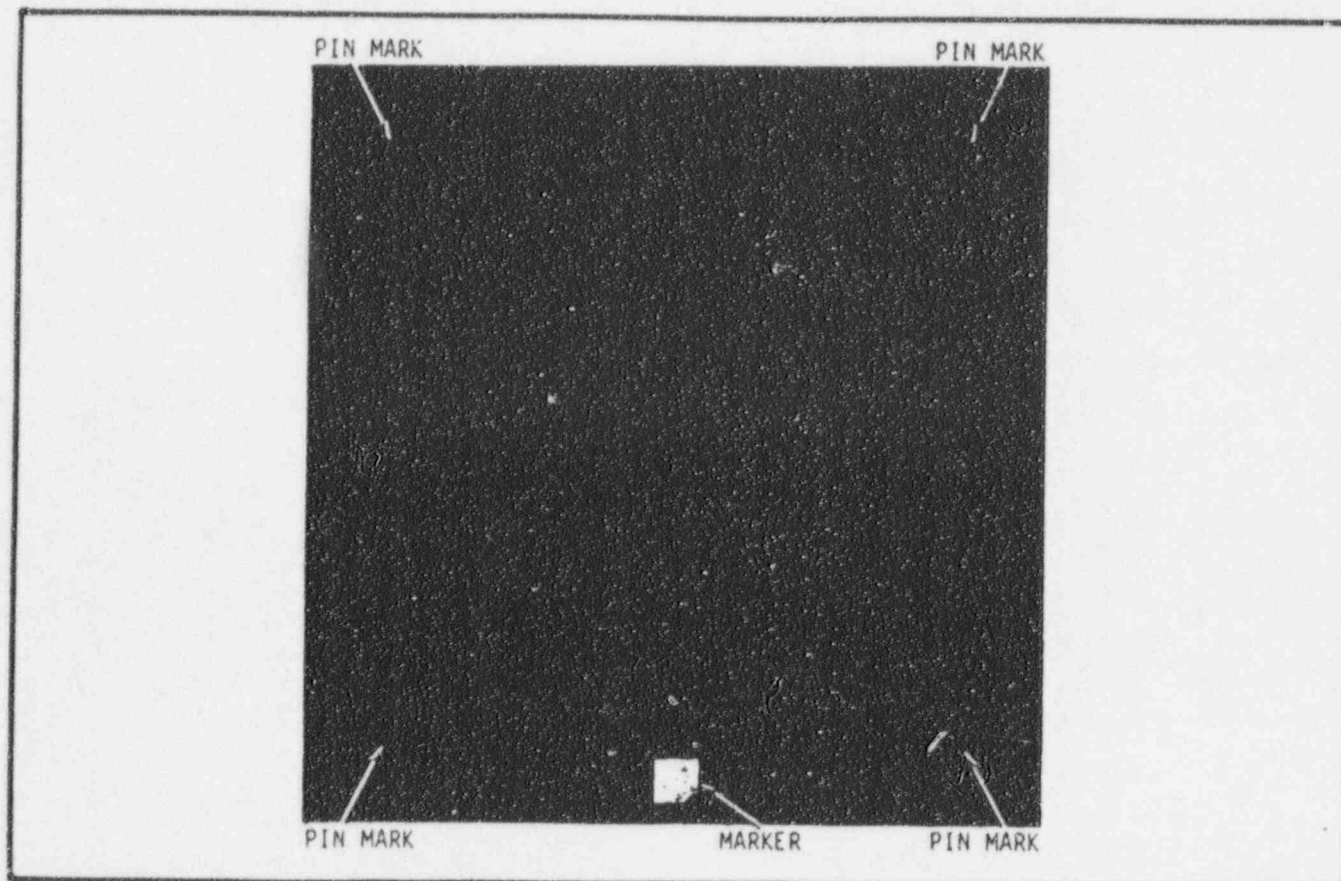
DO NOT MOVE THE STRETCHER OR THE ALIGNMENT FIXTURE.  
LEAVE THEM IN PLACE FOR SUBSEQUENT TESTS.

### COLLIMATOR FILM CHECK

This check should be made by a Physicist.

Using type "M" or type "R" film in a paper cassette, place this cassette at right angles to the collimator axis at 80cm from the source. Set the field size for a 10 x 10cm with the trimmers extended.

Turn on the field illumination light. Place pin marks as reference in the four corners of the illuminated field. Also place a marker in the middle of the field to identify the front (radiation input) side and to orient the film with respect to the collimator and machine. Expose to about 35 roentgens (type "M") or 70 roentgens (type "R"). The blackened part of the film should line up with the pin marks.



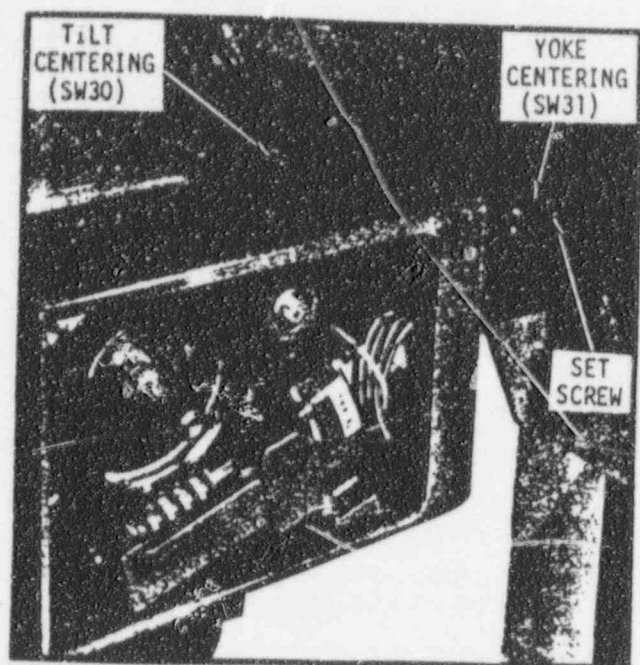
CORRECT FIELD ILLUMINATION PATTERN



## Head Tilt Centering Switch (SW30)

Switch SW30 is located on the front center of the yoke and the switch actuator is mounted on the rear center of the Cobalt Head.

1. Place the Yoke Hanger at its zero-degree position and turn on the collimator light so the cross hairs project upon the alignment paper at a distance of 80cm. Mark the intersection of the projected cross hairs.



HEAD AND YOKE CENTERING SWITCHED

2. Since the head assembly has been previously adjusted to be on isocentric center and leveled "in" and "out," actuate the "in" and "out" buttons on the pendant switch to check that the cross hairs return to a position within  $\pm 2\text{mm}$  of the centered position.
3. To adjust the switch the following procedure is recommended:
  - a. Center the head for zero positioning of the cross hairs on the previously marked paper in step 2.
  - b. Loosen the large chrome hex nut on the actuator box (on the back of the head) and move the switch actuator so it is in line with the centering switch roller (on the yoke hanger). Tighten the large hex nut.
  - c. Position the actuator "in" or "out" so it will depress the centering switch on the yoke. A locking nut is used to accurately set this adjustment.

- d. Check these adjustments by tilting the head assembly "in" and "out" and observe the cross hair projections for centering accuracy.

## Yoke Swivel Centering Switch (SW31)

The yoke swivel centering switch is located on the right rear surface of the yoke and is actuated by a pointed screw on the actuator bracket of the hanger.

1. Position the yoke with the pendant switch until the collimator cross hair projection is on the center of the alignment paper. The centering switch should be actuated at this point. If not, readjust as described in the following step.
2. The actuator bracket on the hanger contains a pointed Allen set screw that should depress the limit switch roller when the yoke is in the center position. By loosening the small Allen set screw on the bracket the large Allen set screw can be rotated until the switch roller "clicks." Tighten the small Allen set screw.
3. If the switch roller is not depressed loosen the two Philips head screws on the switch cover. Position the switch so the point of the actuator screw depresses the roller. Remount switch cover and tighten the two Philips head screws.
4. Check by rotating the yoke with pendant switch.

## Optical Distance Indicator

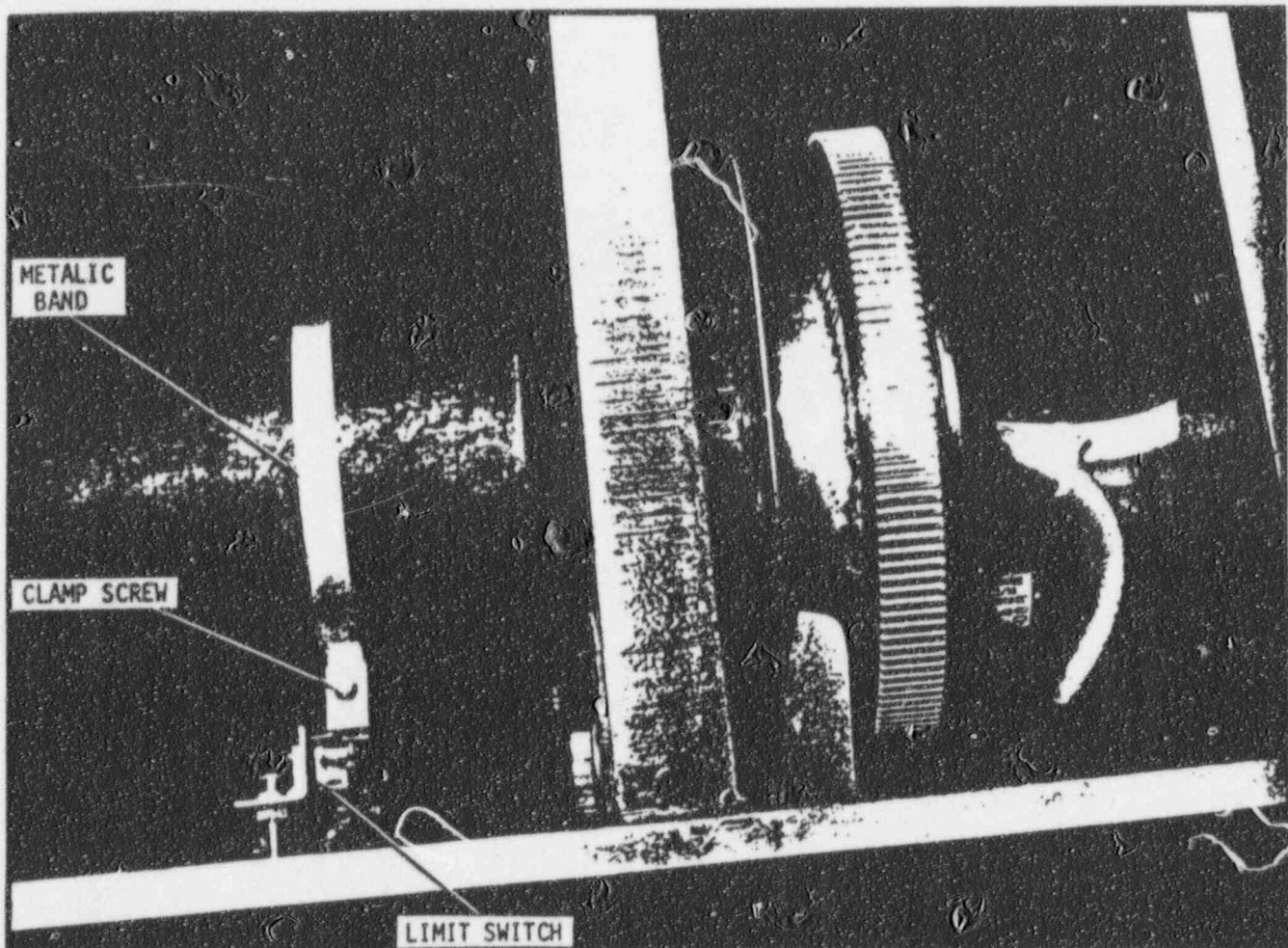
1. Set the collimator field dials for 20 x 20cm with the trimmers retracted.

2. Place a piece of white paper at a distance of 35cm (13-29/32 inches) from the bottom edge of the trimmer bar. The paper is now 80cm from the source.
3. Turn on the collimator lamp switch which also controls the distance indicator.
4. An etched reticle in the distance indicator contains a graduated scale ranging from 55cm to 100cm. The 80cm mark on the projected indicator scale should fall exactly on the intersection of the collimator cross hairs.
5. To adjust distance indicator loosen the four screws that secure the lamp bracket to the collimator.
6. Adjust the three set screws in bracket until the 80cm graduation falls on the intersection of the cross hairs. No further adjustment of the distance indicator is necessary. Tighten the four bracket screws.

#### Yoke Rotation Limit Switches

The yoke rotation limit switches are located in the rear top of the hanger. These are adjusted to give the yoke a 175-degree clockwise and counterclockwise rotation from the zero or center position. To adjust these switches the following steps should be followed:

1. Set the yoke to its zero position as indicated on the yoke angular dial.
2. Remove the four screws and cover to expose the switches and actuator.
3. Rotate the yoke to the 175-degree clockwise position.



YOKE ROTATIONAL SWITCH ADJUSTMENT

4. The metallic band clamped around the yoke shaft with a screw and a nut should now actuate the clockwise rotation switch SW14.
5. If the tab on band does not depress SW14, loosen the screw and reposition the band until the tab actuates the switch.
6. Switch SW13, the counterclockwise limit switch, should now be actuated when the yoke is rotated to 175 degrees in the counterclockwise direction.

#### CAUTION

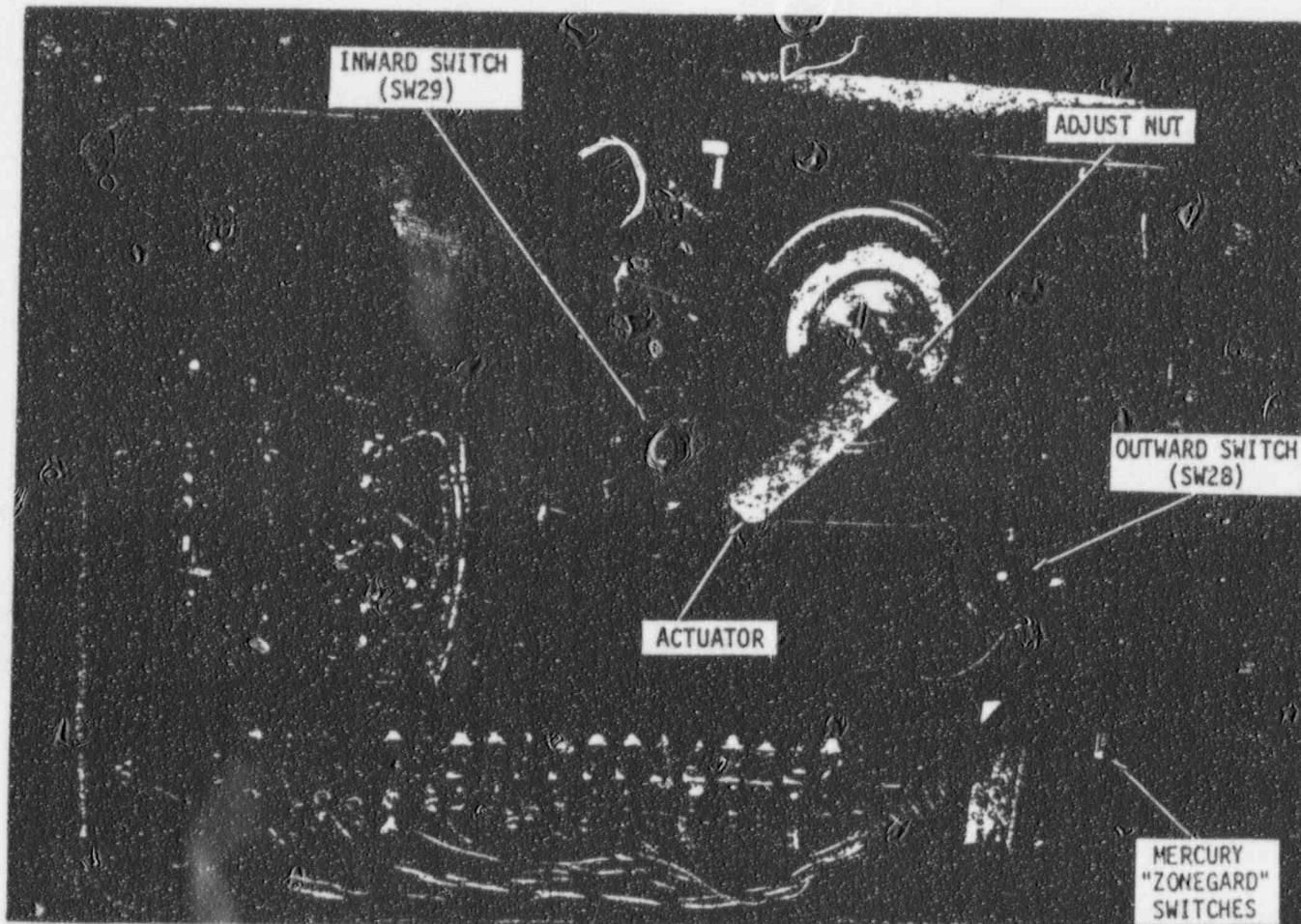
NEVER ROTATE THE YOKE IN A CONTINUOUS 360-DEGREE ROTATION OR THE ELECTRIC CABLES MAY TWIST AROUND EACH OTHER AND BREAK THE CONNECTIONS.

#### Source Head Tilt Limiting Switches

Switch SW28 limits the outward tilt up to an angle of 90 degrees, while SW29 limits the inward tilt to 20 degrees. Both switches are located in the left yoke.

Depress the Pendant Switch "OUT" tilt button and watch the Angular Tilt Dial. The head tilt should stop at 90 degrees. If not, the following procedure is recommended:

1. Position the head to the 90-degree position.
2. Loosen the nut on the actuator arm. (Refer to photo.)
3. Place the actuator arm directly over the switch SW28 making sure the switch arm is fully depressed. Tighten actuator arm.



LEFT SIDE OF YOKE

4. Depress the Pendant Switch "IN" tilt button.

### CAUTION

MAKE SURE THE COLLIMATOR DOES NOT STRIKE THE YOKE.

5. At the 20-degree angle the actuator arm should depress the "IN" limit switch SW29 removing power from the tilt motor.

### BRAKE ADJUSTMENT

The head tilt brake and the yoke brake are both adjusted in the same manner. (Refer to photos "Head Tilt Brake" and "Yoke Limit Switches, Brake, and Drive Motor".)

1. Turn the brake adjustment screw until the brake touches the disc.
2. Turn adjustment screw 3-1/2 turns in a clockwise direction.
3. Turn adjustment screw an additional 1/2-turn if a coast condition is evident.

### REPLACING COLLIMATOR LAMP (Sylvania Type FCS or Picker Part No. T72-109)

1. Remove all power from the unit.
2. Remove the rear shroud cover.
3. Remove the two screws that secure the terminal block TB7 to the collimator casting.

### CAUTION

ANY CONTACT WITH FINGERS, DIRT OR OIL WILL DRASTICALLY REDUCE THE LIFE OF THIS LAMP. USE WRAPPER FURNISHED WITH EACH LAMP.

4. Replace the lamp.

### REPLACING OPTICAL DISTANCE INDICATOR LAMP (General Electric Part No. 1731 or Picker Part No. T72-111)

The Distance Indicator housing should not be removed from the mounting bracket to change the lamp. Merely unscrew the end of the lamp housing (the end where the cord enters) and the lamp is exposed for replacing.

It is not necessary to readjust the optical distance indicator assembly.

---

Section 4  
**REFERENCE DATA**

EO-775	Decay Time in Months ✓
EO-776	Decay Time in Days
C-T61A-557	WD/SD for VG-8D and VG-8E
E-T61B-363	Wiring Diagram for 1373D Stand
D-T61B-364	Schematic Diagram for V9
C-T61B-575	Head Wiring Diagram
D-T64-382	V9 Room Layout



**ADDENDA "B"**  
**TO**  
**V9 COBALT 60 UNIT**  
Cat. No. 6268 Series  
**INSTALLATION INSTRUCTIONS**  
PH59:I3 (T55-571)

**SUMMARY**

1. This addenda supplements Installation Instructions PH59:I2 (T55-571) dated April 1970 and should be filed and used in conjunction with that manual.
2. This addenda supercedes addenda PH59:I2 dated September 1971 which is obsolete and may be discarded.
3. Make changes to the Installation Instructions (noted in item 1 above) as directed on pages ii and iii of this addenda.

**PICKER CORPORATION**  
595 MINER ROAD, CLEVELAND, OHIO 44143

# ADDENDUM

PH59:12

## VERTICAL MOTOR CIRCUIT V-9

### PURPOSE:

On later models the electronics chassis includes a new relay chassis for controlling motor direction and speed. The following is the procedure for adjusting this new relay circuit.

### THEORY OF OPERATION:

K1 and K2 are slow release relays. These relays allow the motor to stop before the direction can be electrically reversed. The release time is determined by C1 and C2 and is approximately 200 ms.

K3 is a slow energize relay that shorts out current limiting resistor R2 in downward direction for approximately 1 sec, during starting only. This permits the motor to have maximum starting torque which is in excess of 100 pounds. After approximately 1 sec K3 will pull in removing the short from R2. At this time the current is reduced in the motor, reducing running torque to approximately 50 pounds. The greater the value of R2, the less the torque. In the up drive condition K1 contacts short out R2 and the motor delivers maximum torque regardless of time.

### ADJUSTMENT AND SETUP:

#### FACTORY AND INITIAL SETUP ONLY:

Loosen the motor so that the gears are free to move. With all normal shrouding, and minimum head attachments in place, determine that the head is balanced with the bucket and that the maximum torque needed to run is less than 50 pounds. To do this, use a scale and make at least 10 measurements in the downward direction. If the head needs more than 50 pounds, pull to move in any spot, determine the cause, and correct. After it has been determined that the unit is balanced (pull up is equal to pull down, and there is less than 50 pounds needed to pull down) retighten motor to gears.

#### FIELD ADJUSTMENT WITH NEW TORQUE LIMITING CIRCUIT:

The object is to produce as little torque in the downward direction as possible and still run from the upper to lower limit without stalling. To do this, adjust the R2 resistor for 200Ω. Starting from the upper limit run to the lower limit, if the unit stalls, reduce the resistor value by adjusting wiper. Decrease the value by 10% each time. After reducing the resistor value, test the run from the upper limit to the lower limit. Repeat the above procedure until the unit runs from the upper limit to the lower limit without stopping. Use a scale to determine the force required to stop the head after the motion has started. Do this in at least four places. The stopping force should be less than 50 pounds.



## SUMMARY OF CHANGES

- Page 3 Beam Collimator 3706A is changed to a 3706E. An optional motorized collimator 3706D can also be installed instead of the 3706E, the manually operated collimator. Refer to attached sheets on Collimators. Delete retractable trimmers. Add: The 3706D & E Collimators incorporate removable trimmers. See attached sheets.
- Page 7, Step 1 Under heading of "Erecting the Stand" change layout drawing D-T64-318 to D-T64-382.
- Page 11 Delete Head Tilt Mechanism Photo and see new photo in attached sheet.
- Page 14, Step 10 Under "Installing the Main Housing Assembly" delete steps 4, 6, 7, and 8. Add: "Remove wires from switches (make note of wire location) and remount switches on shroud."
- Page 15, Step 16 Delete Step 16. Under wiring - BL-2584A Cable, delete the last portion of the second sentence "the leads to TB7 on Collimator as shown below" and CHANGE "to the plastic connector".
- Pages 15 & 16 Delete Wiring Procedure - BL-2584 Cable  
Add: "WIRING PROCEDURE - BL-2584A CABLE (3706D, E Collimators). This cable consists of eleven leads. One end in the yoke is factory connected to the yoke terminal board TB4. The opposite end of this cable is attached to plug J2. The J2 connector fits into the J2 receptacle located on the collimator. During shipment this cable and plug, along with the collimator cover, is taped to the yoke. For individual connections refer to C-T61B-914 and C-T61B-915 in the reference section."
- Page 17 Under Pendant Switch, add sentence: "A switch SW49 is incorporated in the handle portion and must be depressed by the fingers before any of the control buttons on the pendant switch can be used." Delete Yoke Rotation photo and see new photo in attached sheet.
- Page 19 Add: "VERTICAL TRAVEL LIMIT SWITCHES." See attached sheet for photos and description.
- Page 21 Change Collimator Mounted Beam-Shaping Assembly to Cat. No. 3022A. See new photo in attached sheet.
- Page 22 Change Accessory Mounting Platform to Wedge and Compensator Mounting Platform 3918. See photo in attached sheet.  
Change Wedge Filter Cat. No. to 3021M and 3021N. See photo in attached sheet.
- Page 23 Change Oblique Compensator Cat. No. to 3021L. See photo in attached sheet.  
Change second paragraph to read, Oblique Compensator requires the 3918 Platform.
- Page 26, Step 3 Change CAUTION at top of page to read "Do not install or remove Trimmers beyond a 20 x 20 cm field."  
Delete paragraphs B, C, & D.  
Change to read "with extenders removed."

## RADIATION WARNING

X-Rays and Gamma-Rays are dangerous to both patient and operator unless established safe exposure procedures are strictly observed.

The useful beam can produce serious or fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in the National Council on Radiation Protection and Measurements (NCRP) "Medical X-Ray and Gamma-Ray Protection for Energies up to 10 Mev — Equipment Design and Use" NCRP Report #33 as revised or replaced in the future.

Those responsible for the planning of X-Ray and Gamma-Ray equipment installations must be thoroughly familiar and comply completely with the structural shielding requirements outlined in NCRP #34 as revised or replaced in the future.

Failure to observe these warnings may cause serious or fatal bodily injuries to the operator, patient or those in attendance.



## SUMMARY OF CHANGES Con't.

- Page 27 Under Collimator Film Check, change the second sentence of paragraph 2 to read: "Set the field size for a 10 x 10 cm with the trimmers installed."
- Page 28 Delete Head Tilt Centering Switch and Yoke Swivel Centering Switch and refer to the attached sheets for the adjustment procedure.
- Page 29, Step 3 Under Optical Distance Indicator delete the first sentence. Change second sentence to read: "Turn on the distance indicator switch:"
- Page 30 A latching relay R29 was added in the left yoke arm to the rear of the yoke terminal strip TB4. When the shutter reaches 142-degrees of rotation, switch SW10 is actuated turning off the collimator field lamp. Refer to attached sheet for photo.
- Page 31 Add: "BRAKE ADJUSTMENTS - For Brake Procedure refer to C-9 Maintenance Manual H57:M Pages 6 and 7. The head tilt should be set at 60 to 80 pounds pull at the end of the collimator with the gear mesh disengaged. The yoke swivel set at 80 to 100 pounds pull at end of collimator with gear mesh disengaged (motor removed)."
- Page 33 Reference Data
- Add the attached revised schematics:
- |            |                                    |
|------------|------------------------------------|
| C-T61B-575 | Head Wiring Diagram - 590E         |
| D-T61B-717 | Schematic Diagram for V9 Unit      |
| E-T61B-722 | Wiring Diagram of 1373E Stand      |
| C-T61B-914 | Wiring Diagram of 3706D Collimator |
| C-T61B-915 | Wiring Diagram of 3706E Collimator |

111

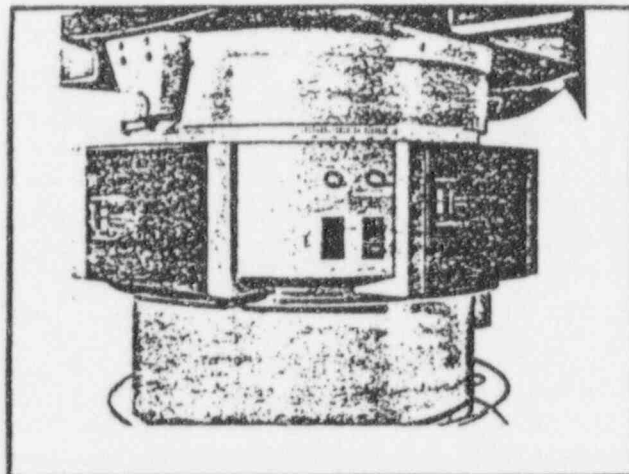
## 3706D COLLIMATOR

The 3706D is a Motorized Collimator which is an optional choice when purchasing the present V9 Cobalt Therapy Unit. Switches mounted on the side of the collimator, when depressed, set the desired field size. The field size dials are the same type used on the 3706E. The trimmer bars on both collimators are no longer built into the collimators but must be installed when required.

The field sizes are 3cm x 3cm (minimum) to 35cm x 35cm (maximum) at 80cm with the trimmers installed. With the trimmers removed the field sizes are 4cm x 4cm to 35cm x 35cm. Limit switches are installed for the minimum and maximum field sizes as shown in the photos.

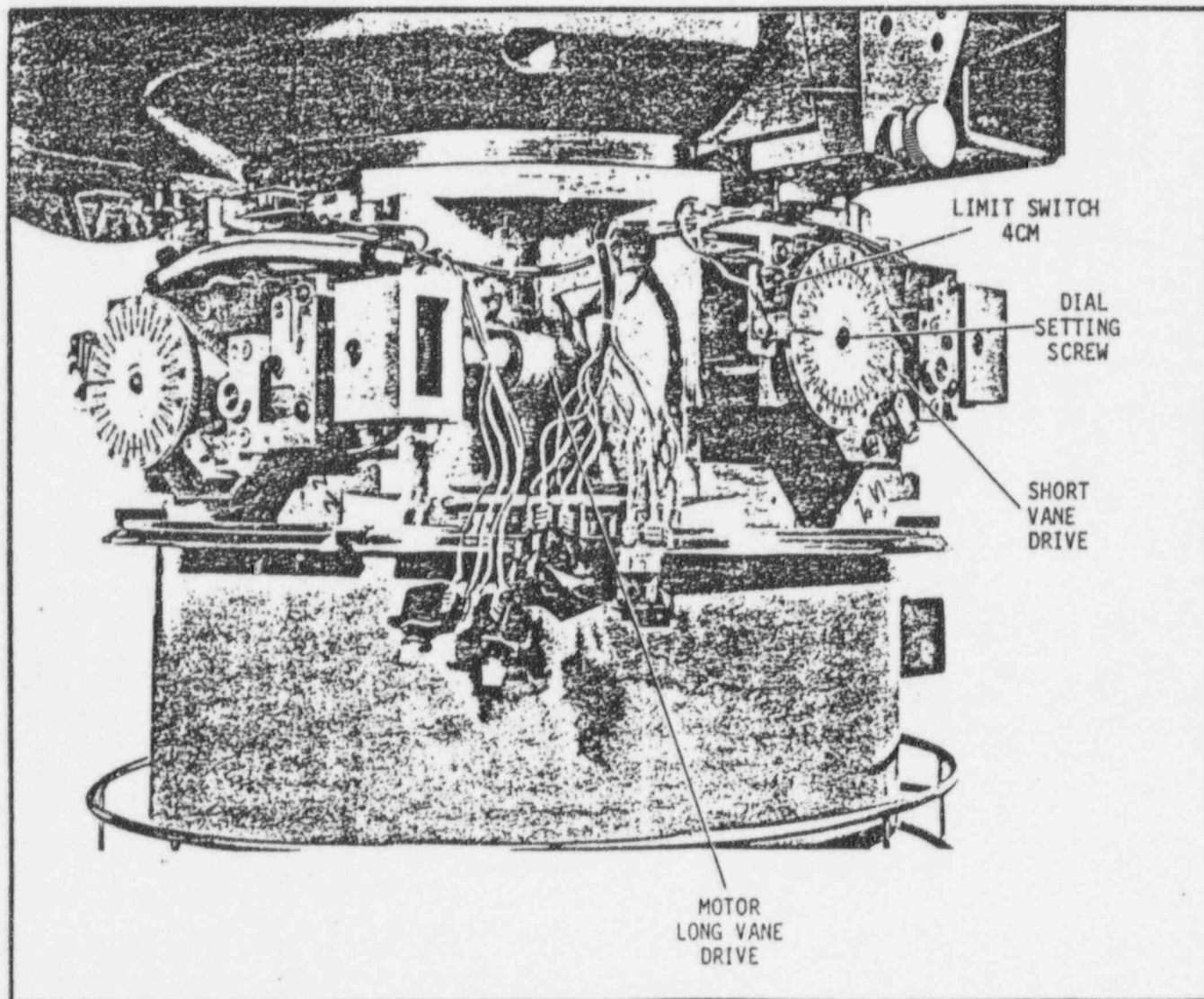
### NOTE

The field size electrical limiting switches are only installed on the 3706D Collimator.

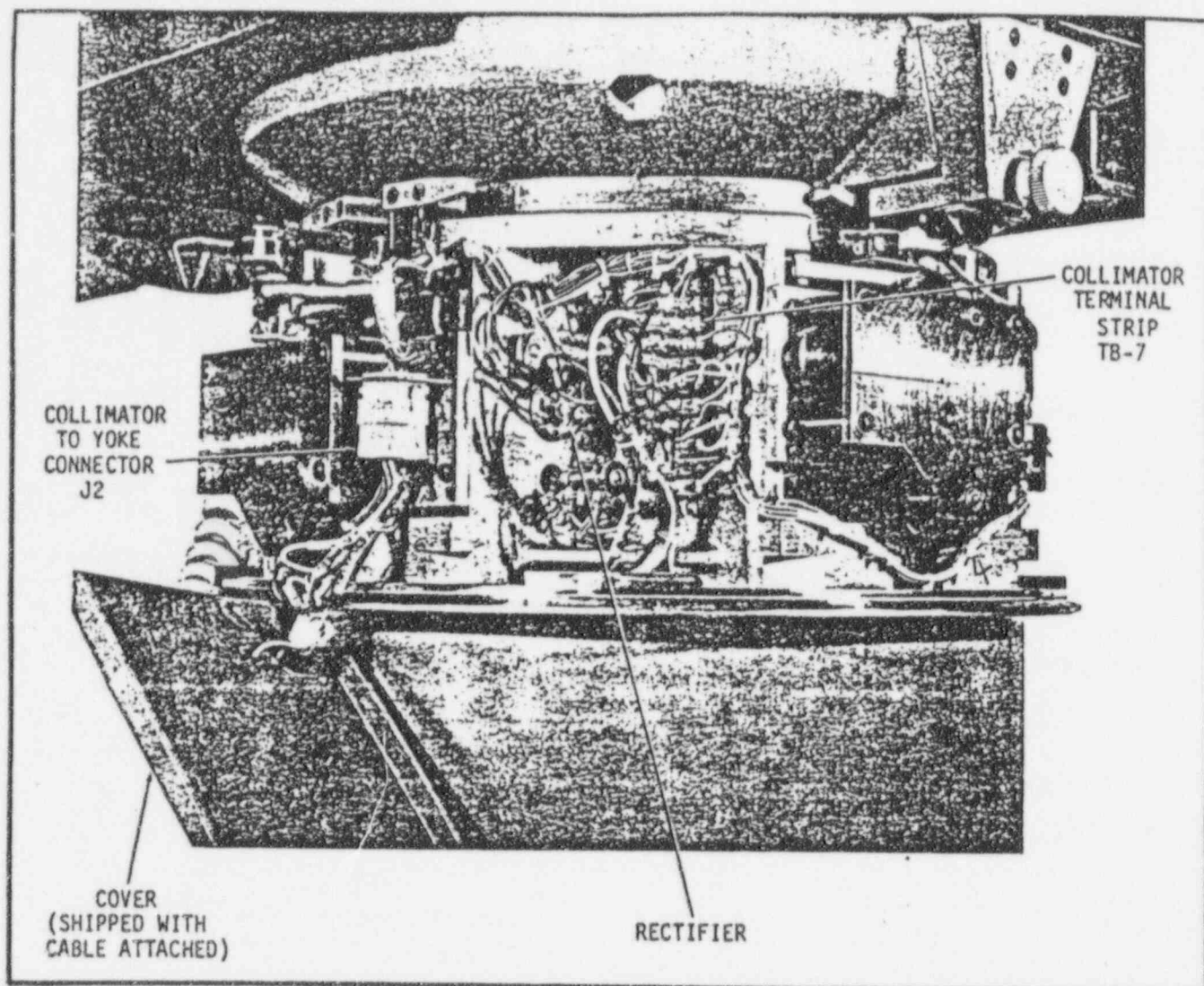


3706D MOTORIZED COLLIMATOR

The vane movement for field size is no longer controlled by cables. A new line shaft which is gear-coupled from the gear box of one vane to its opposite vane is now used for greater accuracy. Four gear boxes are now used instead of two. Adjustments can be made for each set of vanes.



SHROUDS REMOVED ON 3706D



### 3706D ELECTRICAL TERMINALS

The vanes are motivated by two 24 volt DC motors. A power supply mounted next to the collimator terminal strip consists of silicon rectifiers, a 60 mFD capacitor, and a semi-variable resistor, 10 ohms, 20 watts, to furnish 24 volts at 4 amps to the drive motors. Refer to photo.

#### ADJUSTMENT OF LIMIT SWITCHES

The limit switches can be adjusted by positioning the switch on its mounting. The cobalt head should be in a vertical position with the collimator facing downwards. A table should be placed below the Collimator to measure the field size. To adjust the following procedure is recommended:

1. Remove the extender shroud.
2. Set the field size dial without the extenders for 4cm x 4cm.
3. Measure the light field size on the table top. It should measure 4cm x 4cm.

#### NOTE

With the trimmers installed adjust dials for a 3cm x 3cm field.

4. Position the limit switches mounted alongside of each field size dial so the roller on the switch is open by the notch on the dial.
5. Open the field size with the motor switches to about 10cm x 10cm. Close the opening and see if the motors cut-off at 4cm on the dial.
6. To adjust the maximum (35cm x 35cm) field size switches remove the extender shroud.
7. Operate the field size switches until the dials read 35cm.

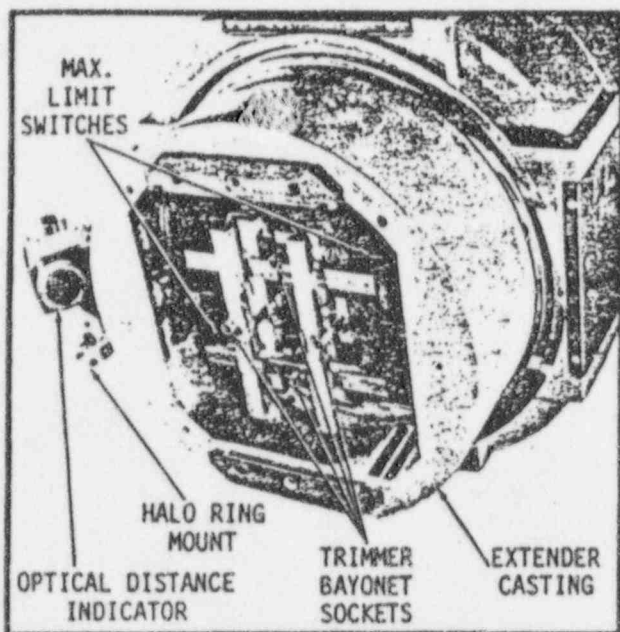
#### CAUTION

DO NOT TRY TO EXCEED THE 35 X 35cm MAXIMUM FIELD SIZE OR BEARING DAMAGE MAY RESULT.

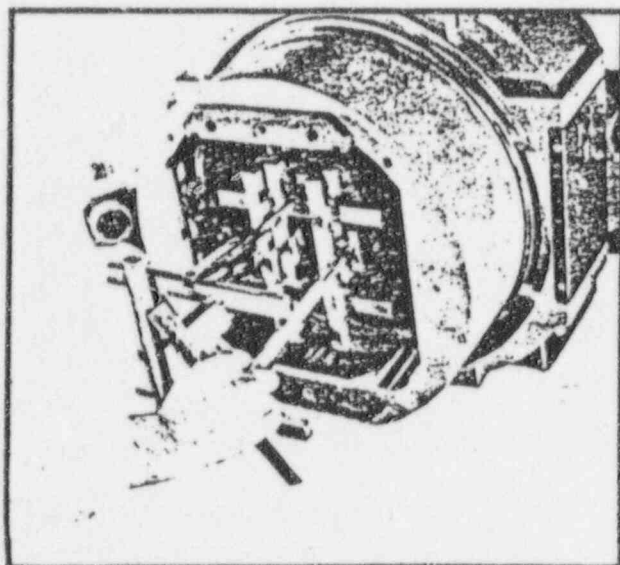
8. The two field size limit switches should now be actuated to remove power from the field motors. If not, reposition the switches.
9. Operate the field size switches so the field decreases to about 25cm. Operate the field size switches to open and all movement of the vanes should stop when the 35cm field size is reached.

#### TRIMMERS

The trimmers can be removed and installed manually. To install, open the collimator vanes to a field size of 15 x 15cm and rotate the yoke to 90-degree position. The trimmers now bayonet into place at the ends of each of the four collimator vane assemblies. The trimmers are interchangeable--any one may be installed on any vane.



INSIDE VIEW OF COLLIMATOR



INSTALLING REMOVABLE TRIMMERS

#### BL-2584 CABLE

This is the coil cord that connects the yoke terminal board TB4 to the collimator connector (white plastic).

This cord is factory connected to TB4 and the opposite end terminates in a white plastic receptacle. Since this cord passes through a cable grip on the collimator shroud, the shroud and cord are taped to the yoke for shipment.

#### 3706E COLLIMATOR

The 3706E is a manually-operated collimator which replaces the 3706C on the present C9 and V9 Cobalt Therapy Units. The 3706E is identical in all respects to the 3706D, with the one exception that the 3706D is motor-driven. No electrical field limit switches are installed on the 3706E. This collimator is of the line shaft type.

#### NOTE

Field conversion to motor operation is not possible.

#### YOKE SWIVEL CENTERING SWITCHES

V9 Cobalt units now shipped from the factory will incorporate a new yoke centering device. This device consists of two roller type switches (SW31 and SW48), and two adjustable actuators. This new type can be installed on any of the existing V9 units in the field by purchasing Kit No. 9974. Detailed instructions are furnished.

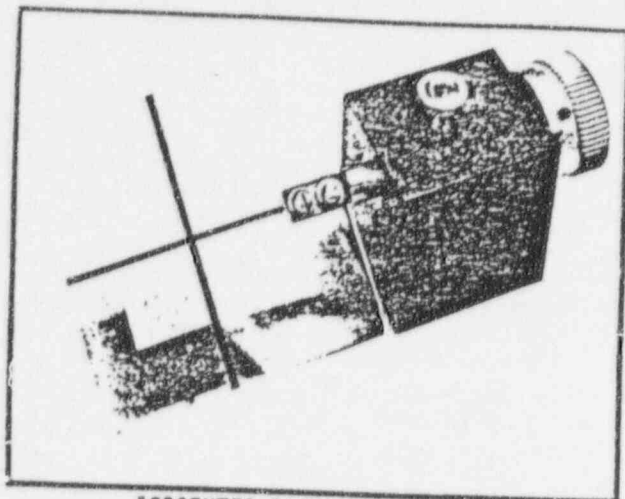
#### NOTE

Kit No. 9974 includes both the new yoke and head new type of centering switches and actuators.

To make the adjustment for the yoke centering, the following procedure is recommended:

1. Referring to Manual T55-571, use the techniques explained on pages 27 and 28 for proper centering. If an Isocenter Alignment Fixture, Cat. 181704, is available, this can be used as explained in the following steps.
2. Place the yoke to its zero-degree position and turn on the collimator field lamp. The cross hairs should project on the alignment paddle at a distance of 80cm. Remove the covers over the yoke centering switches and actuators.

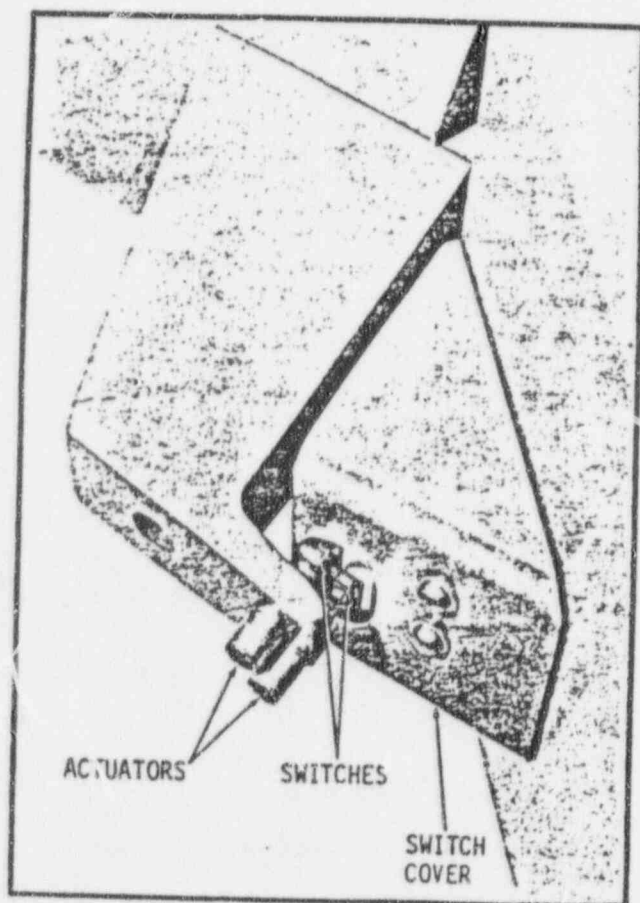




ISOCENTER ALIGNMENT FIXTURE

3. Center the yoke and head for zero positioning of the cross hairs on the alignment fixture by joggng the pendant switch.
4. Position the yoke centering switches so the roller actuators on the switches line up with the actuators on the yoke.
5. Loosen the lock set screws in the yoke actuator bracket. Turn the threaded actuators individually against the switch roller until a "click" is heard inside the switch. Both switches must be actuated at the same time.

4



YOKE CENTERING

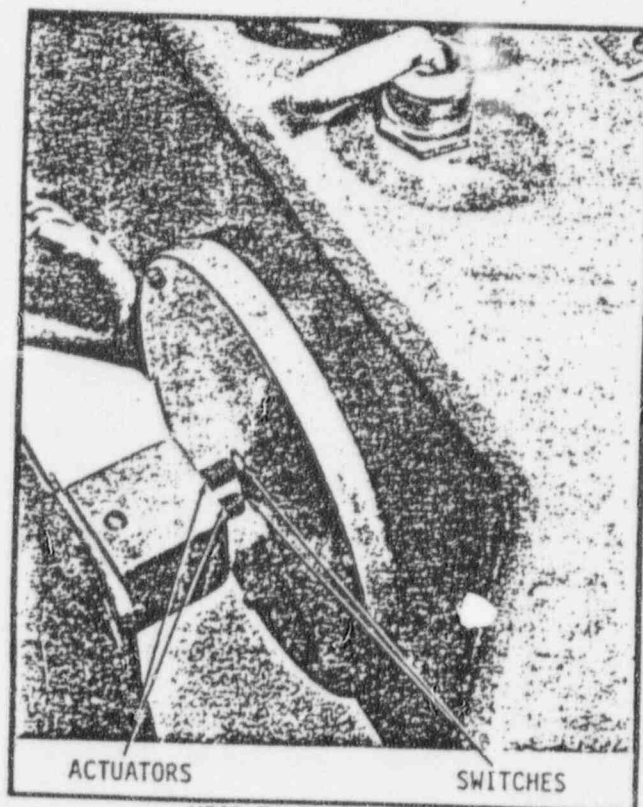
## CAUTION

BOTH SETS OF ACTUATORS MUST BE ADJUSTED SO THEY JUST TRIP THE SWITCHES WITHOUT USING ALL THE OVERTRAVEL.

6. Electrically, rotate the yoke clockwise, then counterclockwise and observe the cross hair projection on the alignment fixture to check if centering is consistent in both directions. If not, recenter yoke and readjust the actuator screws.
7. If the yoke stops before center consistently from one direction and the actuator screws do not correct this condition, then loosen the switch bracket and slide the switch assembly in the direction of rotation and readjust the actuator screws.
8. Check centering again and when satisfactory, tighten all mounting screws and actuator set screws. Reinstall covers and make a final check.

## HEAD TILT CENTERING SWITCH

To adjust the head tilt centering device the procedure is similar to the yoke centering. The head is tilted inwards and outwards and the actuators and switches are adjusted to automatically stop the head tilt movement when centered at zero-degrees.



HEAD TILT CENTERING



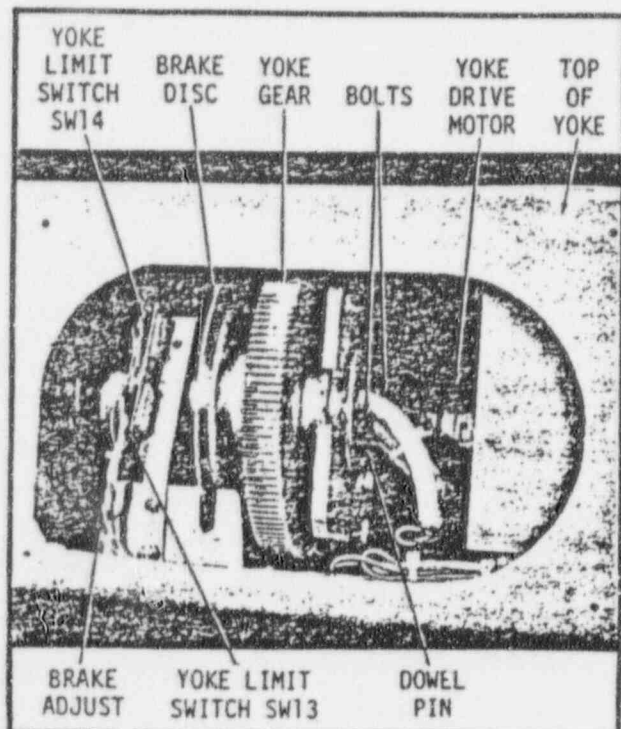
## COLLIMATOR FIELD AND DISTANCE LOCALIZER LAMPS

The above lamps on the 3706D and E Collimators are turned "on" and "off" by separate switches mounted on the shroud.

The field lamp is turned off automatically when the shutter reaches 142-degrees of rotation. This was made possible by using the other portion of switch SW10 and installing a latching relay RE29 in the left arm of the yoke. To turn on the field lamps the manual switch must be used.



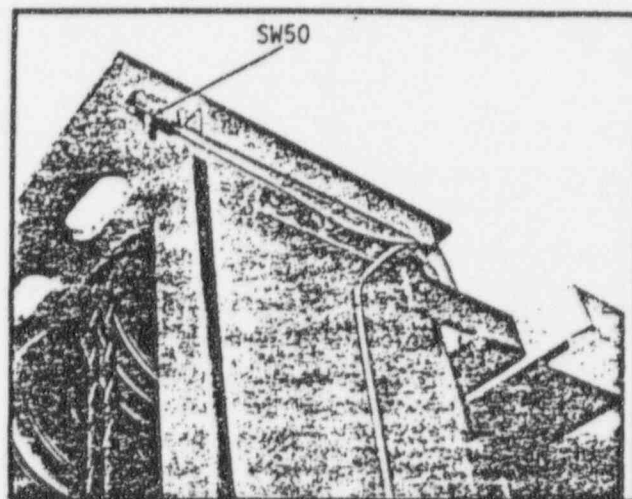
HEAD TILT BRAKE



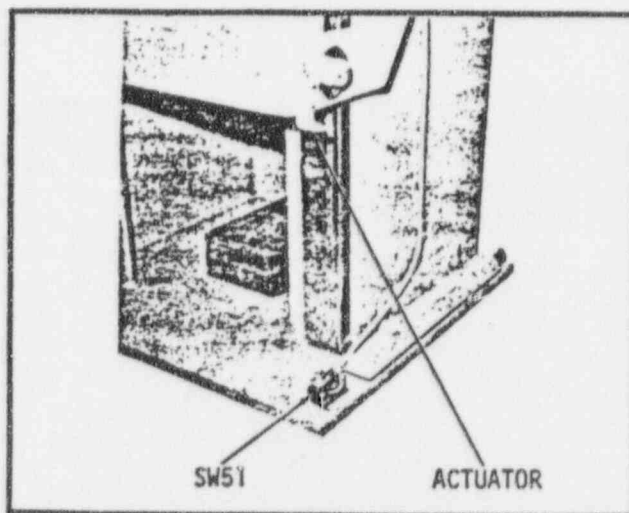
YOKE LIMIT SWITCHES, BRAKE, AND DRIVE MOTOR

## UPPER AND LOWER VERTICAL TRAVEL LIMIT SWITCHES

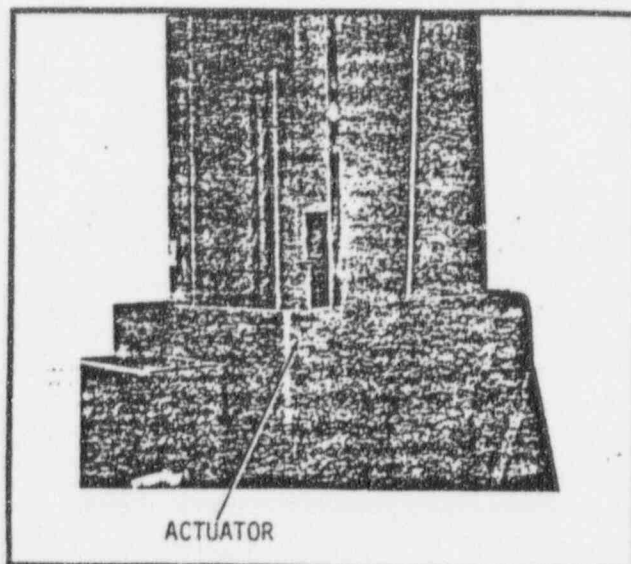
An upper limit switch (SW50) and a lower limit switch (SW51) are now installed to remove power from the main drive motor when the limits of travel are reached.



UPPER LIMIT SWITCH



LOWER LIMIT SWITCH



UPPER SWITCH ACTUATOR

Adjustable actuators are mounted on the top and bottom right side of the vertical carriage to actuate these switches when the limits are reached.

## VERTICAL DRIVE REVISION

A direct drive is now incorporated which will now overcome up to 100-pounds maximum out-of-balance condition. This will overcome the various weights of accessories.

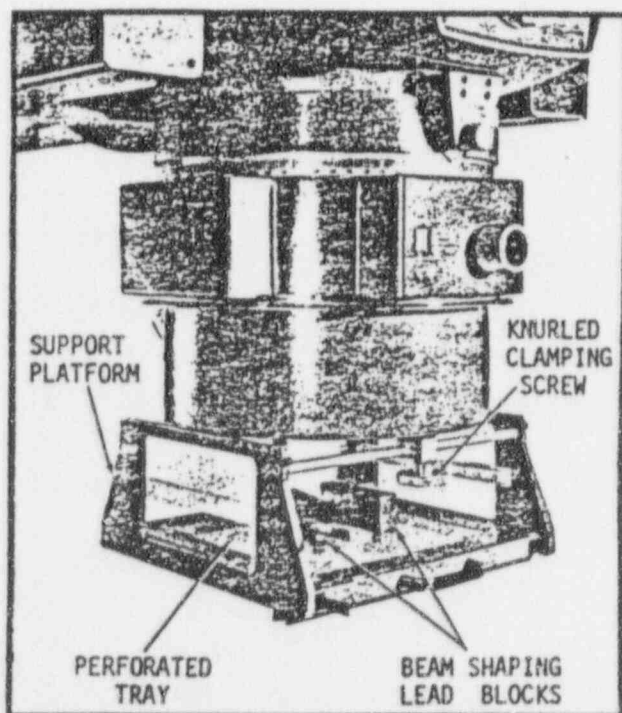
## ACCESSORIES

### Collimator Mounted Beam-Shaping Assembly, Cat. 3022A

The above accessory permits the user to position lead blocks in the radiation beam to achieve irregularly shaped treatment fields and to shield predetermined areas of the patient.

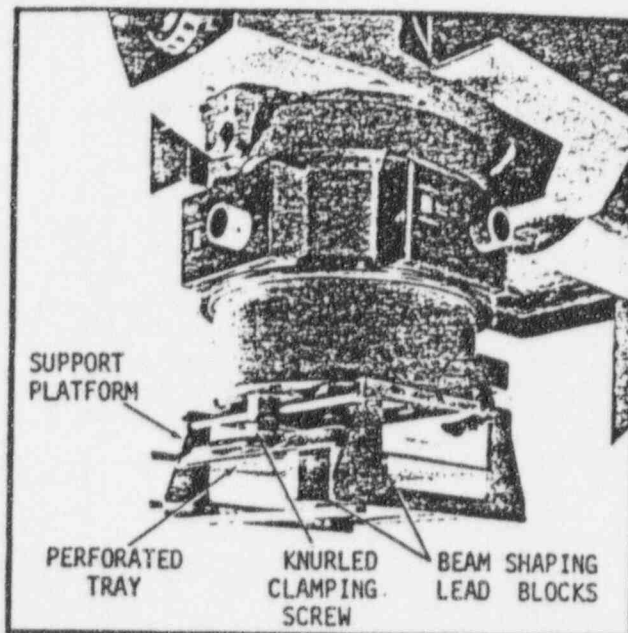
This assembly consists of a beam-shaping support platform replaceable tray and beam-shaping lead blocks. The support platform is clamped to the bottom surface of the Collimator housing with a large knurled knob and stud located at the front of the support platform.

6



BEAM SHAPING ASSEMBLY (3022A)

The perforated tray permits convenient visualization of position of lead shielding blocks (with collimator beam defining light field). Lead blocks are firmly clamped in any position on the perforated tray which can be removed from the support platform with the blocks clamped in position and stored so that the beam-shaping configurations can be quickly reproduced.



BEAM SHAPING ASSEMBLY (3022A)

The tray can be moved closer to the source but the lead blocks must be mounted on the bottom as shown in photo.

The following steps should be followed when installing the Back Pointer Assembly:

1. Install the mounting bracket to the support tube so the bracket surface and end of the support tube are flush.
2. Adjust the pointer arm so it is parallel to the mounting bracket. Secure all bolts.
3. Mount this assembly to the accessory post. Set the post to zero (0) on the scale.
4. Insert the pointer rod into the pointer arm and turn on the collimator lamp.
5. Adjust the height of the pointer rod so the tip of the rod is set at the central ray, then lock in place with the thumb screw.

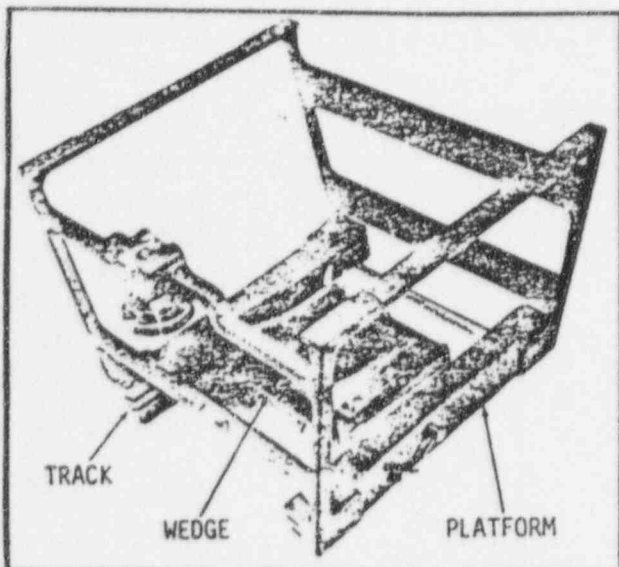
## NOTE

The mounting bracket may have to be repositioned (see Step 1) to align the pin at collimator center.

6. Turn out collimator lamp and remove the Back Pointer Assembly.

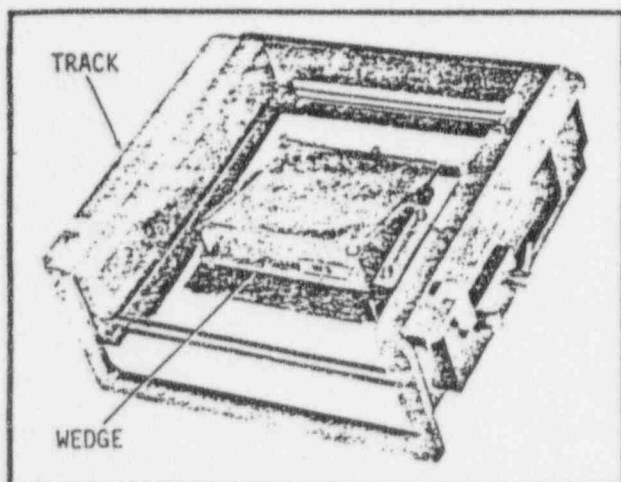
### Accessory Mounting Platform, Cat. 3918

This platform is required when using the Wedge Filter (3021M, 3021N, or the Oblique Brass Compensator 3021L).

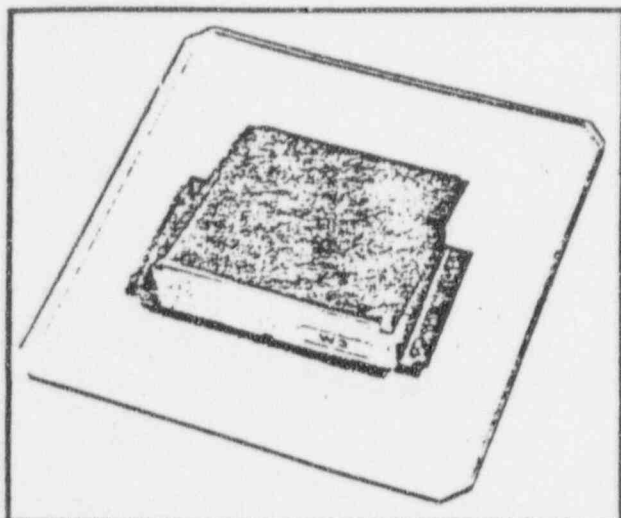


EXTENDED WEDGE AND COMPENSATOR ASSEMBLY

The top of the platform mounts to the bottom tracks of the collimator. The large knurled knob and stud at the front of the platform secures this device to the threaded hole in the collimator.



STANDARD MOUNTING BRACKET ASSEMBLY WITH WEDGE AND COMPENSATOR



3021M, 3021N LEAD WEDGE FILTER ASSEMBLY

### Wedge Filter (Cat. 3021M and Cat. 3021N)

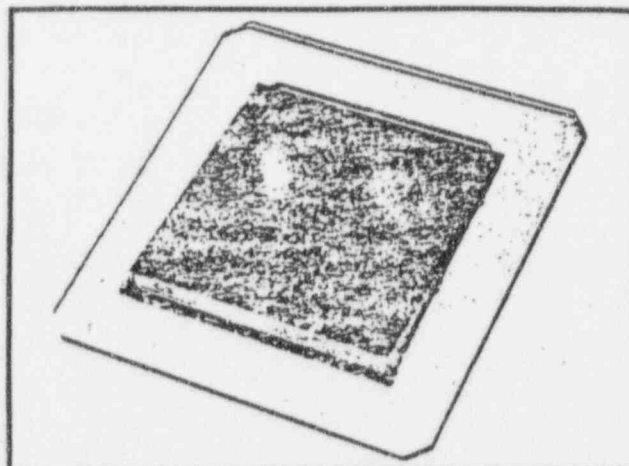
The Wedge Filter is made of lead and can be installed on the bottom tracks of the Collimator and locked in the desired position. The 3021M is a 45-degree wedge, and the 3021N is a 60-degree type.

### NOTE

Whenever a Wedge Filter is used with an Oblique Compensator, the Wedge should always be mounted nearest the source.

### Oblique Compensator, Cat. 3021L

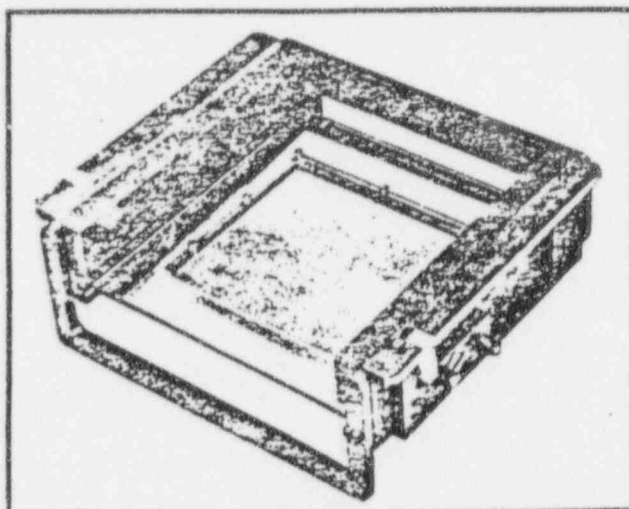
The Oblique Compensator can be used and installed in the same manner as the Wedge.



OBLIQUE COMPENSATOR ASSEMBLY (3021L)

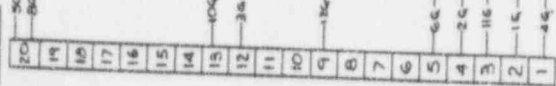
The Oblique Compensator is made of brass. It must be mounted with the brass section away from the source.

The above compensator requires the 3918 mounting platform.



STANDARD MOUNTING BRACKET ASSEMBLY FOR WEDGE AND COMPENSATOR

FOR FIGURE 1  
BL 1824-H



TBA YONE TERMINAL STRIP

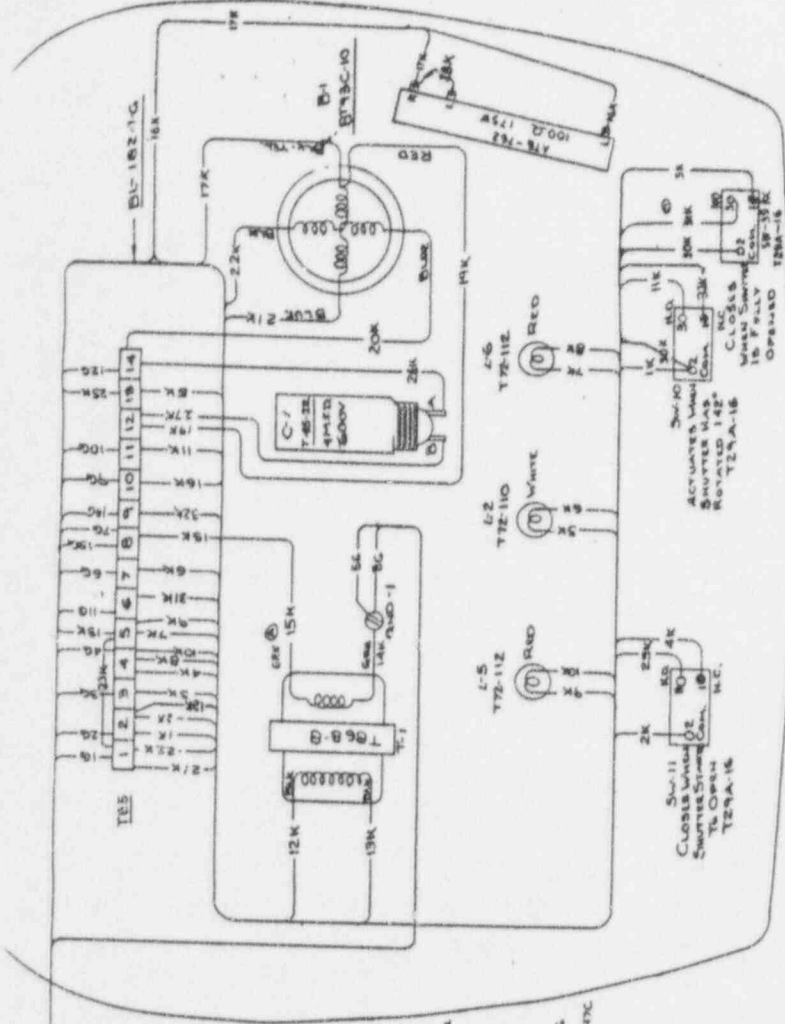
SPICE LINES 18, 19, 20 TO LINE 18 OF BL 1824-H

SPICE LINES 18, 19, 20 TO LINE 18 OF BL 1824-H

SPICE LINES 18, 19, 20 TO LINE 18 OF BL 1824-H

SPICE LINES 18, 19, 20 TO LINE 18 OF BL 1824-H

SPICE LINES 18, 19, 20 TO LINE 18 OF BL 1824-H

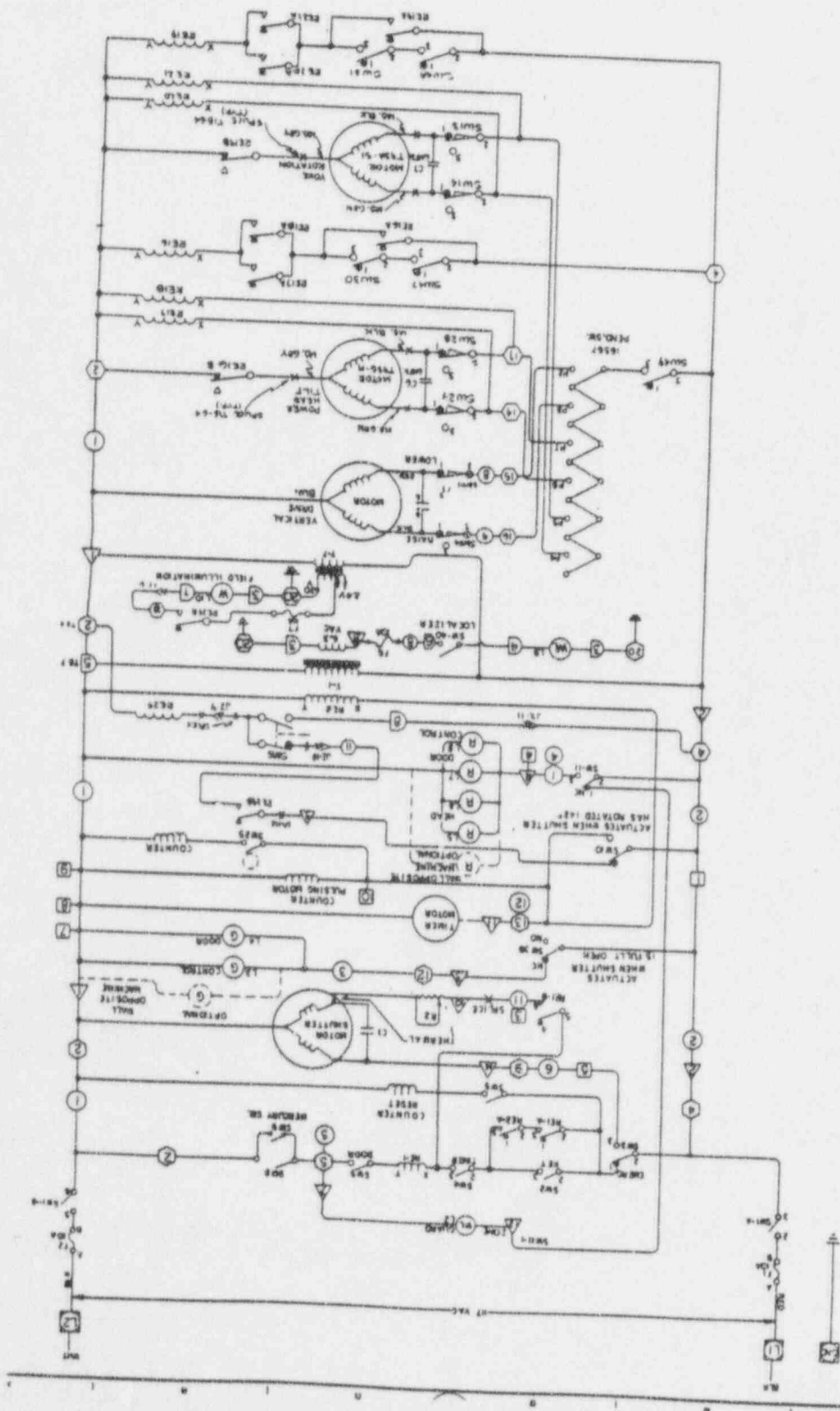


TITLE: BL 1824-H DATE: 10/1/54 DRAWN: J. L. HARRIS CHECKED: J. L. HARRIS APPROVED: J. L. HARRIS PART: 1 OF 1		PROJECT: X-RAY MANUFACTURING C-1618575	
MATERIAL: V/D C 7/80 HEAD QUANTITY: 60		NATIONAL TV/P	
DIMENSIONS: 1.5" x 1.5" x 1.5" WEIGHT: 1.5" x 1.5" x 1.5"		PARTS LIST:	
PARTS LIST:		PARTS LIST:	



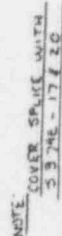
PROJECT: X-RAY MANUFACTURING	
DATE: 10/1/54	BY: J. E. B. 717
SYMBOLS: FOR VLS CORRELATION	
UNIT WITH STOPS	
REVISIONS:	
NO.	DESCRIPTION
1	INITIAL DESIGN
2	REVISION
3	REVISION
4	REVISION
5	REVISION
6	REVISION
7	REVISION
8	REVISION
9	REVISION
10	REVISION

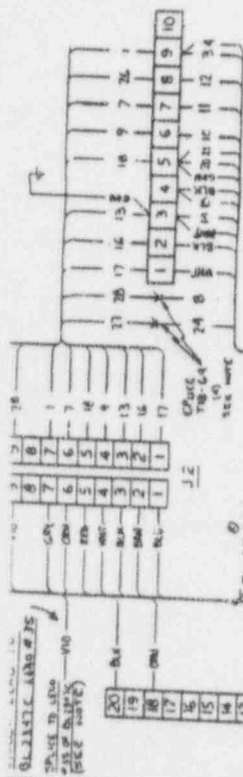
- SYMBOLS:
- COLLIMATION
  - POWER INPUT
  - △ HEAD TERM. STRIP
  - VOLT TERM. STRIP
  - STAND TERM. STRIP



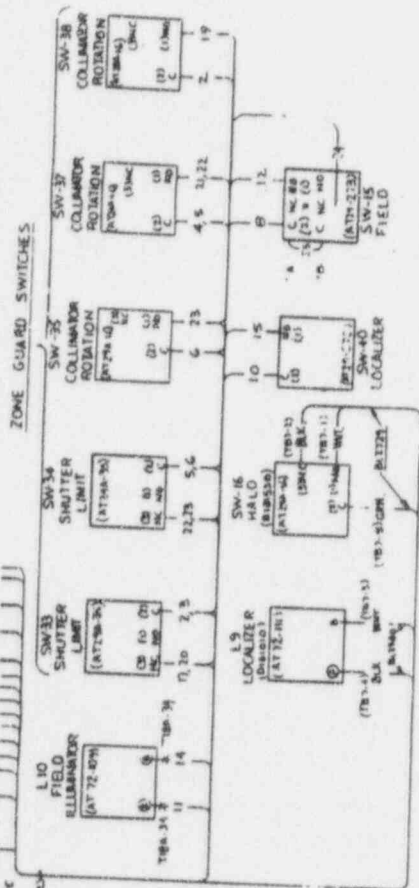




[illegible]



TB-7 COLLIMATOR TERM. STRIP

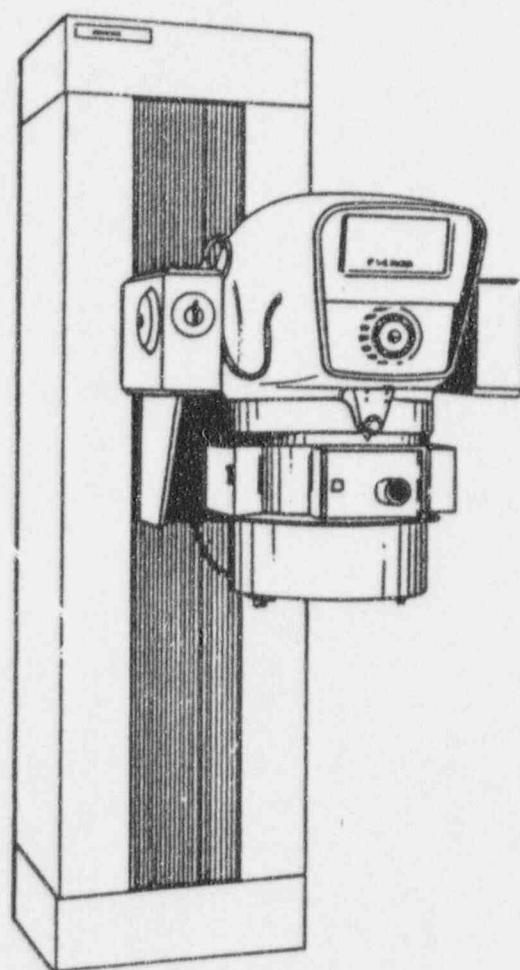


TB-4 Yoke Term Strip

NOTE: COVER SPACE WITH 5378 E-17 B-20



WIRING DIAGRAM 3706 C COLLIMATOR	
DATE	5-2-51
BY	J. H. L.
CHECKED	J. H. L.
SPECIFIC X-RAY MANUFACTURING	
C-1618-315	



**6268 V9 COBALT THERAPY UNIT**

**APR'71**

**H59:P**

# PARTS LIST

H59:P

## V9 COBALT THERAPY UNIT

Cat. No. 6268

## CONTENTS

- (1) MEDICAL PRICE BOOK REFERENCES
- (3) V9 COBALT UNIT  
PART NO. 6268
- (5) V9 COBALT HEAD  
PART NO. 590E
- (7) SHUTTER DRIVE MOTOR ASSEMBLY  
PART NO. 181856
- (9) COBALT COLLIMATOR  
PART NO. 3706A
- (10) OPTICAL INDICATOR ASSEMBLY  
PART NO. 181010
- (11) COBALT COLLIMATOR BEARING RING  
ASSEMBLY PART NO. 181459
- (12) COBALT COLLIMATOR FIELD LENS  
ASSEMBLY PART NO. 181461
- (13) COBALT COLLIMATOR MAIN CROSS  
ASSEMBLY PART NO. 181460
- (13) COBALT COLLIMATOR MAIN CROSS  
PULLEY ASSEMBLY PART NO. 181445
- (15) COBALT COLLIMATOR MAIN CROSS  
HAND GEAR DRIVE ASSEMBLY  
PART NO. 181470
- DDS 1001 PART NO. 181470A
- (17) COBALT COLLIMATOR EXTENDER  
ASSEMBLY PART NO. 181507
- (18) COBALT COLLIMATOR HALO SWITCH  
PART NO. 181558
- (19) COBALT COLLIMATOR ROTATIONAL BRAKE  
ASSEMBLY PART NO. 181464
- (21) V9 COBALT CONTROL  
PART NO. VG8D

DDS 1401 PART NO. VG8E



# CONTENTS

- 23 V9 COBALT FIXED STAND  
PART NO. 1373E
- 25 CARRIAGE ASSEMBLY  
PART NO. 15956C
- 27 COBALT YOKE ASSEMBLY  
PART NO. 16833A
- 28 COBALT HEAD WORM DRIVE ASSEMBLY  
PART NO. 180999
- 29 COBALT HEAD TILT CONTROL ASSEMBLY  
PART NO. 181009
- 30 V9 COBALT YOKE ROTATION CONTROL  
ASSEMBLY PART NO. 181003
- 31 VERTICAL DRIVE ASSEMBLY  
PART NO. 15958
- 33 COLUMN ASSEMBLY  
PART NO. 15955B
- 35 ACCESSORY ATTACHMENT POST ASSEMBLY  
PART NO. 3499E
- 36 BACK POINTER ASSEMBLY  
PART NO. 3298C
- 37 BEAM DIRECTING PIN-AND-ARC  
ASSEMBLY PART NO. 3500C
- 39 WEDGES AND COMPENSATOR ASSEMBLIES
- 40 WALL MOUNTED LIGHTS  
PART NO. 3595C
- 41 FRONT-FINAL POINTER ASSEMBLY  
PART NO. 181560
- 42 SCALE POINTER MOUNTING ASSEMBLY  
PART NO. 181564
- 43 ACCESSORY MOUNTING PLATFORM  
ASSEMBLY PART NO. 3754A

## INTRODUCTION

## PURPOSE

This parts list was written with the intent of providing the user with a complete listing of all parts and components used in the assembly of this unit, with the exception of hardware items such as screws, nuts, bolts and washers. The contents of this manual has been so arranged as to offer maximum usability to all users. Suggestions on improving the format, and/or corrections to this manual are welcome and encouraged. Send all correspondence concerning this book to Picker Corporation, Medical Products Division, National Service Department, 595 Miner Road, Cleveland, Ohio 44143, attention Parts Listing.

## USE OF PARTS LIST (See Fig. 1)

This parts list incorporates the indenture or assembly, subassembly method of parts listing. With this method of listing indenture 1 is the primary assembly for the indicated figure, indenture 2 is either a direct part or subassembly of indenture 1, and indenture 3 is either a direct part or subassembly of indenture 2, which is a subassembly of indenture 1, etc. This system is also useful because the user knows what parts are a part of which assemblies. All indent 2 items are a part of indent 1 and will be found on the indent 1 Bill of Material. All indent 3 items are a part of the preceding indent 2 item and will be found on that indent 2 Bill of Material. All parts are identified once and only once and in their proper sequence.

## DIFFERENCE DATA SHEET

The Difference Data Sheet (DDS) is a supplement to an existing parts list and is referenced to the existing list by Figure No.

The DDS does not list any parts which are common to both units, but only those parts which are different. If the word "delete" is used then that part is not used on the unit of the DDS but is used on the referenced unit. If an item number is found on the DDS and not on the referenced parts list then that part is found on the unit of the DDS but not on the referenced unit.

## NOTE

All parts found on the parts list of the referenced unit apply to the unit of the DDS except those parts indicated on the DDS.

iii

## ORDERING

When ordering parts include the Parts List DRS No. and Date of Publication, Figure and Item No., and Part Description. If the part cannot be found in the parts list, include the Catalog Number of unit, Serial Number, and detailed description of part in question.

## EXAMPLE:

FIGURE 1

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	1348L		Mobile Chassis and Tubestand	1
- 1	13559		Cover, Back	1
- 2	T7D-117		Filter, 1/2 mm	2
- 3	11337A		Indexing Plate, Tube Arm, and Locking Assembly	1
- 4	27904		Nameplate	1
- 5	37797		Plug, Tube End	2
- 6	T5-204		Spring, Front Stop	1
- 7	T54-3		"O" Ring, 1 x 1-1/4"	2
- 8	40822		Bracket, Transport	1

## MEDICAL PRICE BOOK REFERENCES

## V/9 VERTICAL STAND UNITS

6268B V/9 Cobalt-60 unit with motorized biplane sourcehead, automatic centering.

6268A V/9 Cobalt-60 unit with motorized biplane sourcehead, automatic centering AND 3706B MOTORIZED COLLIMATOR.

NOTE: V/9 units operate on 115 volts, single phase. For other supply voltages, a suitable transformer (about 1 kVA) is required and is to be furnished locally.

## ACCESSORIES FOR V/9

3499E Accessory attachment post (see ordering information #1).

3500C Pin-and-arc beam directing device.

3298C Back pointer beam directing device.

3755 Front pointer beam directing device.

3595C Wall mounted positioning lights (set of 2).

3754A Accessory mounting platform for wedge filter (see ordering information #2).

3021 Wedge filter set for 45° (set of 2); includes isodose curves.

3021B Wedge filter set for 60° (set of 3); includes isodose curves.

3021A Oblique incidence compensator set (set of 6).

3022 STANDARD Collimator mounted beam shaping platform with blocks and replaceable tray (see ordering information #4 for extra tray and blocks).

#17 RELIANCE treatment stretcher (V/9 only: see ordering information #3).

3759 Motor drive attachment for field modification of standard 3706A collimator. Converts 3706A collimator to 3706B for motorized operation.

3719 Cobalt rotational calculator.

## ORDERING INFORMATION

1. A 3499E Accessory post must be ordered if any of the following is to be supplied:

- a. 3500C Pin-and-Arc,
- b. 3298C Back pointer,
- c. 3755 Front pointer,
- d. 3770 Cassette Holder.

2. A 3754A Accessory mounting platform must be ordered if any of the following is to be supplied:

- a. 3021 Wedge filter set,
- b. 3021B Wedge filter set,
- c. 3021A Oblique incidence compensator set.

3. Order #17 RELIANCE stretcher from F & K Koenigkramer Co., 96 Caldwell Drive, Cincinnati, Ohio.

4. Additional trays and blocks for 3022 standard collimator mounted beam shaping platform may be ordered as follows:

181763 Beam shaping block tray

Beam Shaping Blocks

181497 1-1/4 x 2-1/2 x 2"

181497A (Set of 2) - 1-1/4 x 1-1/4 x 2"

181497B (Set of 2) - 5/8 x 1-1/4 x 2"

181497C 1-1/4 x 5 x 2"

181497D 1-1/4 diameter x 2

181497E (Set of 2) - 5/8 x 2-1/2 x 2"

181497F (Set of 2) - 5/8 diameter x 2"

5. All accessories are shipped separately for installation in the field.

FIG. 1 - V9 COBALT UNIT  
Part No. 6268

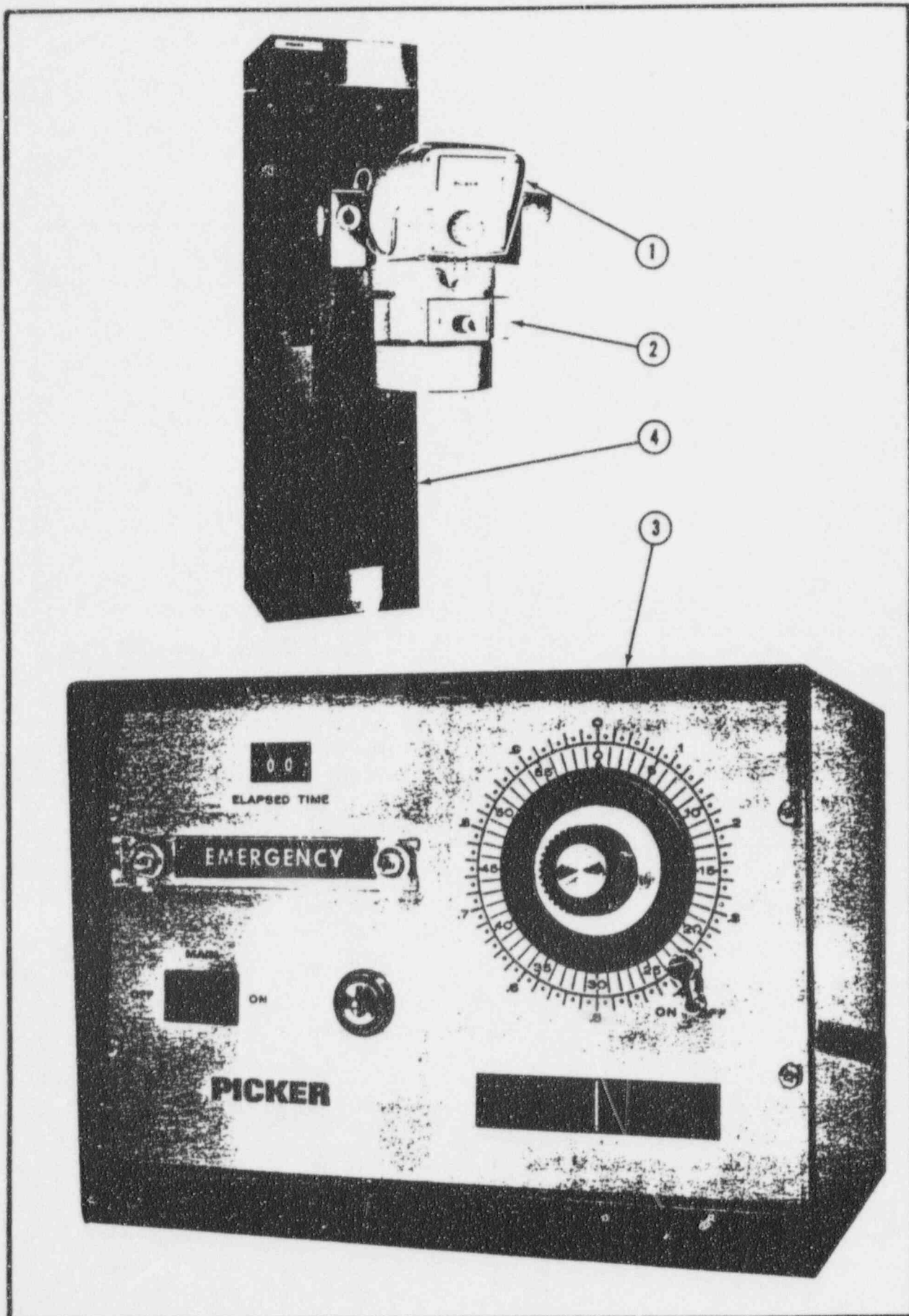


FIG. 1 - V9 COBALT UNIT  
Part No. 6268

H59:P

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
1 -	6268		V9 Cobalt-60 Therapy Unit	1
1	590E		Head, Cobalt (See Fig. 2)	1
2	3706A		Collimator (See Fig. 4)	1
2A	3706B		Collimator (See DDS 401) (Substitution Part)	1
3	VG8D		Control, Cobalt, 60 Hz (See Fig. 14)	1
3A	VG8E		Control, Cobalt, 50 Hz (See DDS 1401) (Substitution Part)	1
4	1373E		Stand, V9 Fixed (See Fig. 15)	1
			OPTIONAL EQUIPMENT	
5*	3499E		Post, Accessory Attachment (See Fig. 23)	1
6*	3022A		Support, Beam Blocks	1
7*	3298C		Back Pointer (See Fig. 24)	1
8*	3500C		Pin-and-Arc, Beam Direction (See Fig. 25)	1
9*	3021		Filter Assembly, Wedge 45°, (See Fig. 26, Item 1)	1
10*	3021A		Compensator Assembly, Oblique (See Fig. 26, Item 15)	1
11*	3021B		Filter Assembly, Wedge 60°, (See Fig. 26, Item 40)	1
12*	3595C		Lights, Wall-mounted Position (See Fig. 27)	1
13*	3755		Pointer Assembly, Front	1
14*	181560		Pointer Assembly, Front - Final (See Fig. 28)	1
15*	181564		Mounting Assembly, Scale Pointer (See Fig. 29)	1
16*	3913		Holder, Cassette	1
17*	14421E		Spare Parts	1
18*	3702A		Stretcher, Motorized Therapy (See Manual H72:P, "Motorized Therapy Stretcher" for Breakdown)	1
19*	3754A		Platform, Accessory Mounting (See Fig. 30)	1
			*Not shown.	



FIG. 2 - V9 COBALT HEAD  
Part No. 590E

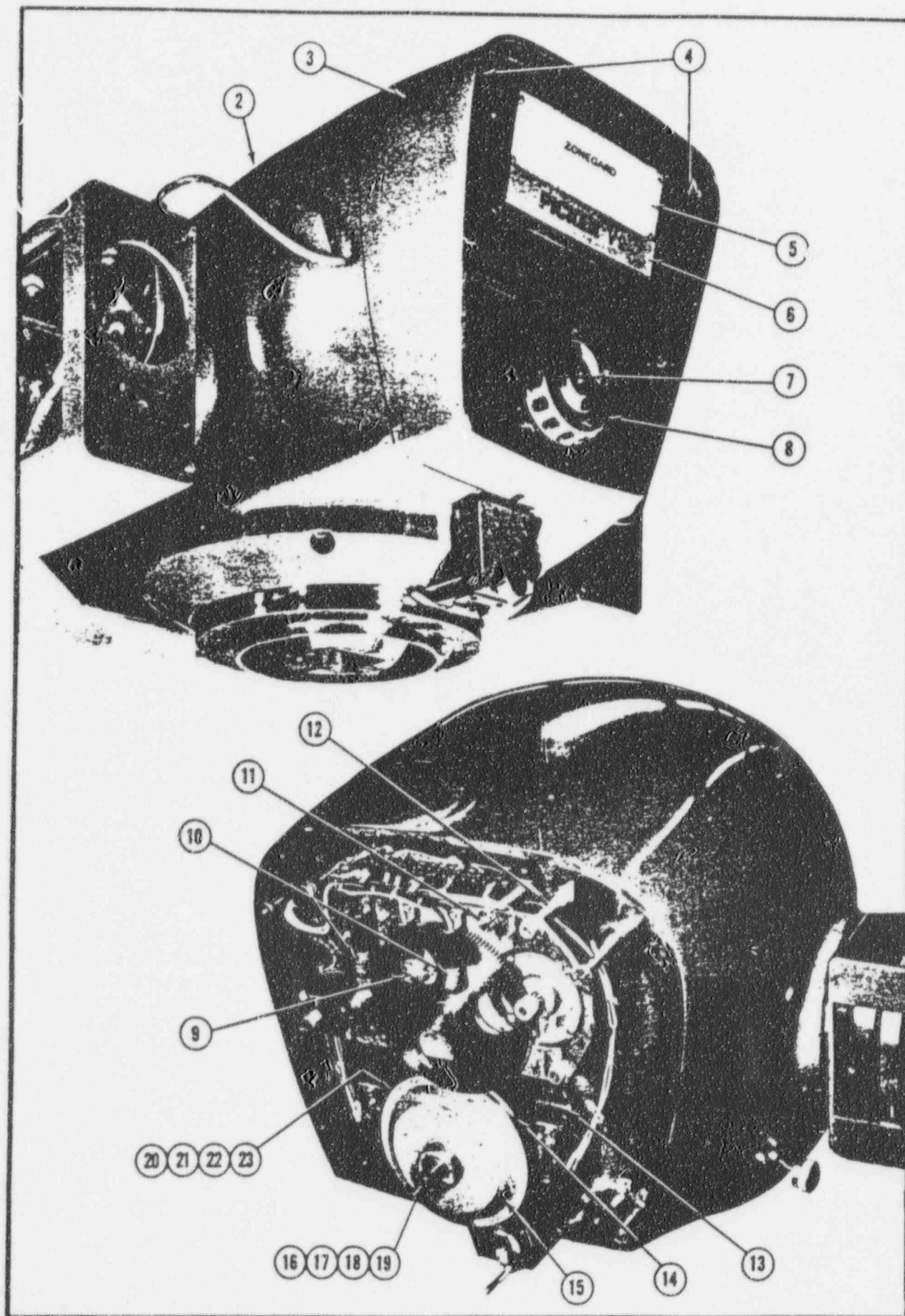


FIG. 2 - V9 COBALT HEAD  
Part No. 590E

H59:P

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
2 -	590E		Head, Cobalt (See Fig. 1, Item 1)	1
1	165688		Head, Cobalt, Final Weldment	1
2	16568A		Head, Cobalt	1
3	46672		Cover, Front, Cobalt Head	1
4	T2F-185		Screw, Shutter Drive Plate Mounting	2
5	46717		Window, Head	1
6	T92-193		Nameplate, "Picker"	1
7	41582		Indicator, Shutter Position	1
8	403788		Wheel, Hand	1
9	T72-110		Lamp, GE Cat. No. 6S6 DC, 120 V, clear or equivalent	1
10	T72-112		Lamp, GE Cat. No. 6S6 DC-R, 120 V, Red or equivalent	2
11	181856		Motor Assembly, Shutter Drive (See Fig. 3)	1
12	T10C-444		Spacer, Shutter Drive	4
13	16424E		Plug, Shutter Final Mach. Assembly	1
14	T26A-11		V-Belt, Shutter Drive	1
15	T84-21		Pulley, V-Belt	1
16	16423C		Rotor Assembly, Shutter	1
17†	14423B		Stop, Shutter Rotor	1
18†	181851		Stop, Shutter	1
19†	T14L-12		Pin	5
20	37137A		Spring, Shutter Power	1
21	37138		Cover, Shutter Power Spring	1
22	37138A		Cover, Shutter Spring	1
23	37144		Collar, Shutter Power Spring	1
24*	57408		Bushing	1
25*	56818		Stop, Shutter Rotor	1
26*	50234		Block, Shield	1
27*	T10C-260		Spacer, 13/32 x 17/64 x 1/4	1
28*	T14-911		Pin, Dowel, 1/4 x 1 (Brg. Plate)	2
29*	T14A-59		Pin, Groove 1/8 x 1-1/2	1
30*	T14A-117		Pin, Roll 3/16 x 1-1/4	1
31*	T14A-70		Pin, Roll 3/32 x 5/8	1
32*	T32-434		Decal, Radiation Warning	1
33*	T66A-5		Clamp, Cable	1
34*	T92-176		Nameplate, Rating	1
35*	T92-445		Plate, Shipping Spec.	1
36*	T92-78		Nameplate, Calibration	1
37*	T92-79		Emblem, Radiation Warning	1

\*Not shown.

†Order next assembly.

FIG. 3 - SHUTTER DRIVE MOTOR ASSEMBLY  
Part No. 181856

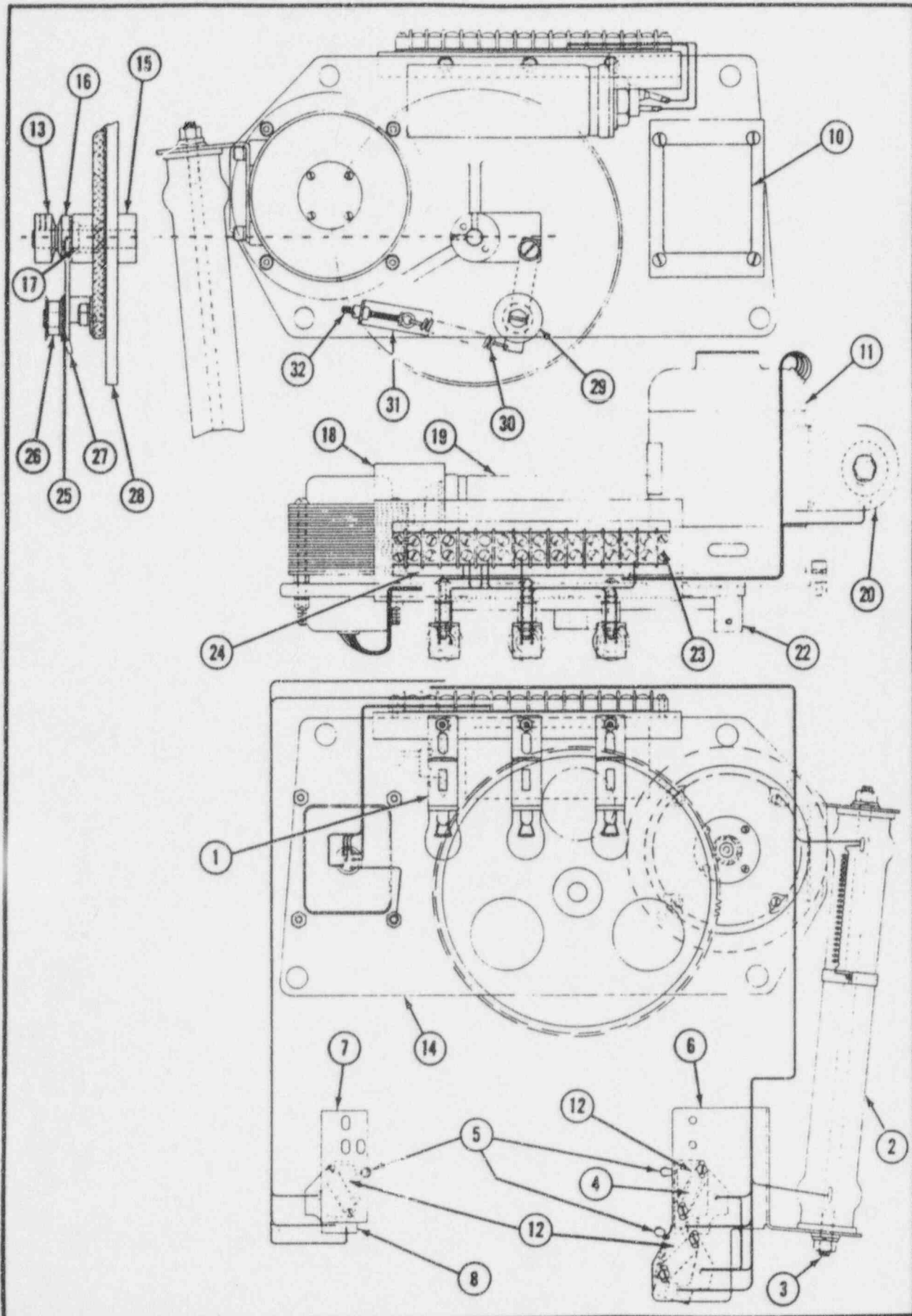


FIG. 3 - SHUTTER DRIVE MOTOR ASSEMBLY  
Part No. 181856

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
3 -	181856		Motor Assembly, Shutter Drive (See Fig. 2, Item 11)	1
1	56148		Holder, Lamp - Bayonet Type	3
2	T6-762		Resistor, 100 Ohm, 175 W	1
3	T13A-80		Stud, 1/4 x 9-7/8	1
4	T4-248		Plate, Switch Retainer	3
5	35088		Actuator, Switch	3
6	56326		Bracket, Limit Switch Mounting	1
7	40548		Plate, Limit Switch Mounting	1
8	T9-74		Barrier, Microswitch	6
9*	L-18246		Lead List, Head	1
10	T86B-8		Transformer	1
11	T93C-10		Motor	1
12	T29A-16		Switch, Micro	3
13	181845		Mounting Assembly, Shutter Drive	1
14	43153A		Mounting Assembly, Shutter Drive Motor	1
15	181826		Gear and Shaft Assembly, Shutter Drive	1
16	56582		Pulley, Shutter Wheel Drive	1
17	T12-447		Bearing, Shaft	2
18	43261A		Plate, Condenser Mounting	1
19	T45-22		Condenser	1
20	56668		Bracket, Resistor Mounting	1
21*	T14A-70		Pin, Roll, 3/32 x 5/8	1
22	T77-130		Gear, Shutter Drive	1
23	T81A-4		Strip, Terminal	1
24	T81B-4		Marker, Terminal Strip	1
25	T10C-10		Spacer, Bearing	4
26	T12-82		Bearing	1
27	43262		Strap, Idler Pulley	1
28	T77-130		Gear, Shutter Drive	1
29	T10B-370		Flange, Bearing	1
30	T5-170		Spring, Shutter	1
31	26521		Bracket, Support, Idler Pulley	1
32	T2-211		Eyebolt (Long)	1
*Not shown.				

FIG. 4 - COBALT COLLIMATOR  
Part No. 3706A

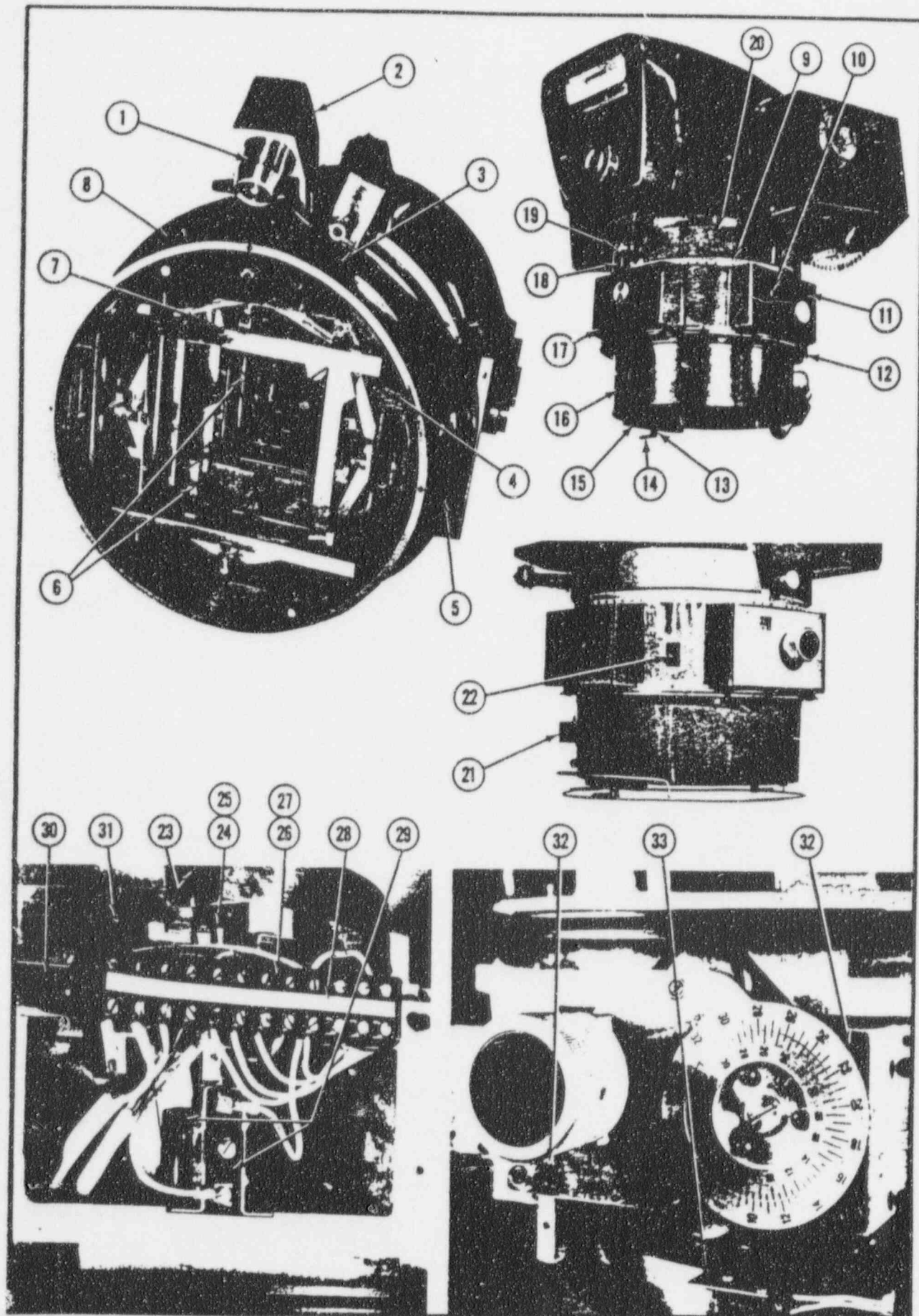




FIG. 4 - COBALT COLLIMATOR  
Part No. 3706A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
4 -	3706A		Collimator (See Fig. 1, Item 2)	1
1	181010		Indicator, Optical Distance (See Fig. 5)	1
2	55560A		Mounting, Localizer	1
3	T92-419		Nameplate, Serial and Patent Pending	1
4	55589A		Enclosure, Extender	1
5	55586A		Cover, Collimator Shroud	1
6	55595		Wire, Cross	2
7	55789		Bracket, Cross Wire Mounting	4
8	55586		Cover, Collimator Shroud	1
9	55976		Scale, Rotation, 90° - 0° - 90°	1
10	55847		Window, Dial Pointer	2
11	55584		Cover, Dial Upper Collimator	1
12	55575		Ring, Collimator Accessory Mounting	1
13	55648		Clamp, Screw Assembly	2
14	55649		Clamp, Handle Assembly	2
15	55652		Clamp, Nose Assembly	1
16	55583		Shroud, Lower	1
17	55585		Cover, Dial Lower Collimator	1
18	181474		Skirt Assembly, L.H. Adapter	1
19	181464		Brake Assembly, Rotational (See Fig. 13)	1
20	181473		Skirt Assembly, R.H. Adapter	1
21	55644		Plate, Halo Switch Cover	1
22	T29-246		Switch, Rocker	1
23	55977		Shield, Collimator Light	1
24	T36-388		Socket, Clamp	1
25	T72-109		Lamp, Sylvania Type ASA #FCS, 24 V, 150 W, 4500 Lumens, T4 Clear Quartz	1
26	T81A-73		Strip, Mounting Block Terminal	12
27	T81A-74		Block, End	1
28	T81B-48		Strip, Marker	1
29	T29J-11		Switch, Button	2
30	56116		Strip, Mounting Bracket Terminal	1
31	55590A		Bracket, Lamp Mounting	1
32	T14A-148		Pin, Dowel, 3/16 x 5/8	2
33	57339		Bracket, Switch Mounting	3
34*	181459		Ring Assembly, Bearing (See Fig. 6)	1
35*	181460		Cross Assembly, Main (See Fig. 8)	1
36*	181494		feeler Assembly	1
37*	181507		Extender, Assembly (See Fig. 11)	4
38*	181558		Switch Assembly, Halo (See Fig. 12)	1
39*	181634		Shroud, Collimator	2
40*	181953		Actuator Assembly, Switch	2
41*	35088		Actuator, Roller	3
42*	55751		Actuator, Switch	2
43*	55954		Ring, Wear Strip Accessory Mounting (Short)	1
44*	55955		Ring, Wear Strip Accessory Mounting (Long)	1
45*	56786A		Barrier, Arc (Long)	3
46*	56785B		Barrier, Arc R.H.	2
47*	56785A		Barrier, Arc L.H.	2
48*	57355		Barrier, Arc	1
49*	T2-516		Plunger, Spring, 10-32 x 9/16	2
50*	T4-279		Plate, Nut	3
51*	T9-74		Barrier, Fiber	3
52*	T22-165		Truarc, Walds Cat. No. 5144	1
53*	T66-505		Collimator and Head	1

\*Not shown.

DDS 401 - COBALT COLLIMATOR  
Part No. 3706B

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
4 -	3706-B		Collimator, Therapy Cobalt (See Fig. 1, Item 2A)	1
19	Delete			
35	181460A		Cross Assembly, Main	1
39	181634-A		Shroud, Collimator	1
54	T29-256		Switch, Tippette	2
55	T92-442		Plate, Drive Switch Mounting	2

FIG. 5 - OPTICAL INDICATOR ASSEMBLY  
Part No. 181010

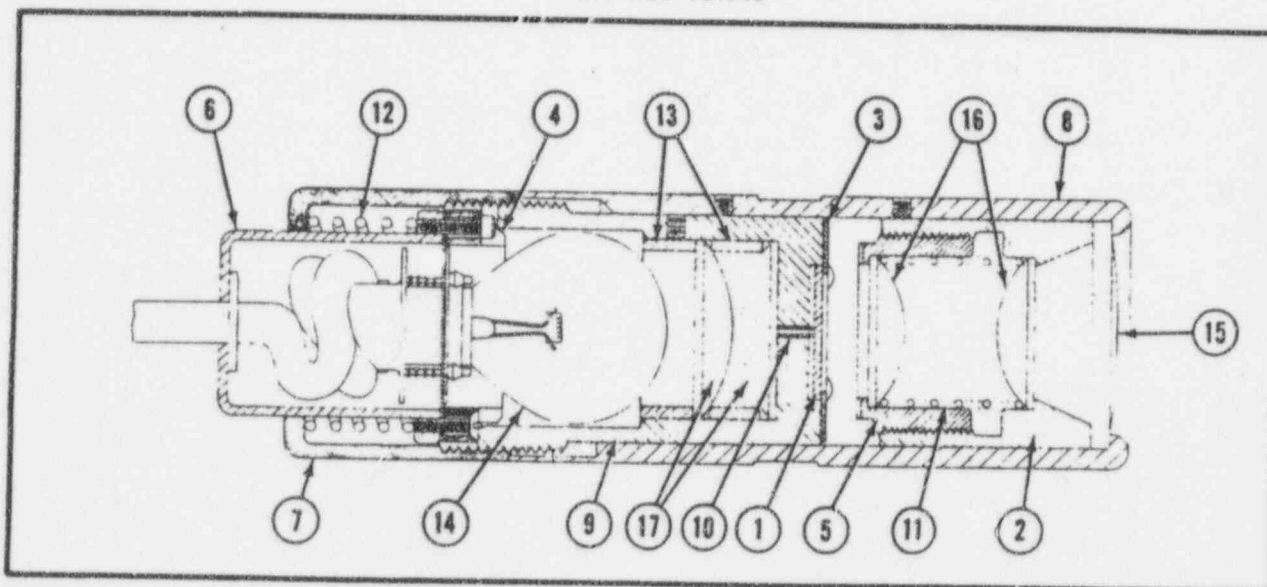


FIG. 5 - OPTICAL INDICATOR ASSEMBLY  
Part No. 181010

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
5 -	181010		Indicator Assembly, Optical Distance (See Fig. 4, Item 1)	1
1	55546		Reticle	1
2	55829		Holder, Lens Front	1
3	55830		Mask	1
4	55831		Holder, Lamp Base	1
5	55832		Holder, Lens Rear	1
6	55833		Cover, Lamp Base	1
7	55834		Cap, End	1
8	55835		Housing	1
9	55836		Holder, Cond. Lens	1
10	T5A-271		Spring, Compression	2
11	T5A-272		Spring, Comp. Col. Lens	1
12	T5A-273		Spring, Lamp Base	1
13	T10C-584		Spacer, Condensing	2
14	T72-111		Lamp, GE Cat. No. 1731, 6.3 V, 50 CP	1
15	T87-128		Lens, Plano, 608mm	1
16	T87-129		Lens, Plano, 39.25mm	2
17	T87-130		Lens, Plano, 63.5mm	2

FIG. 6 - COBALT COLLIMATOR BEARING RING ASSEMBLY  
Part No. 181459

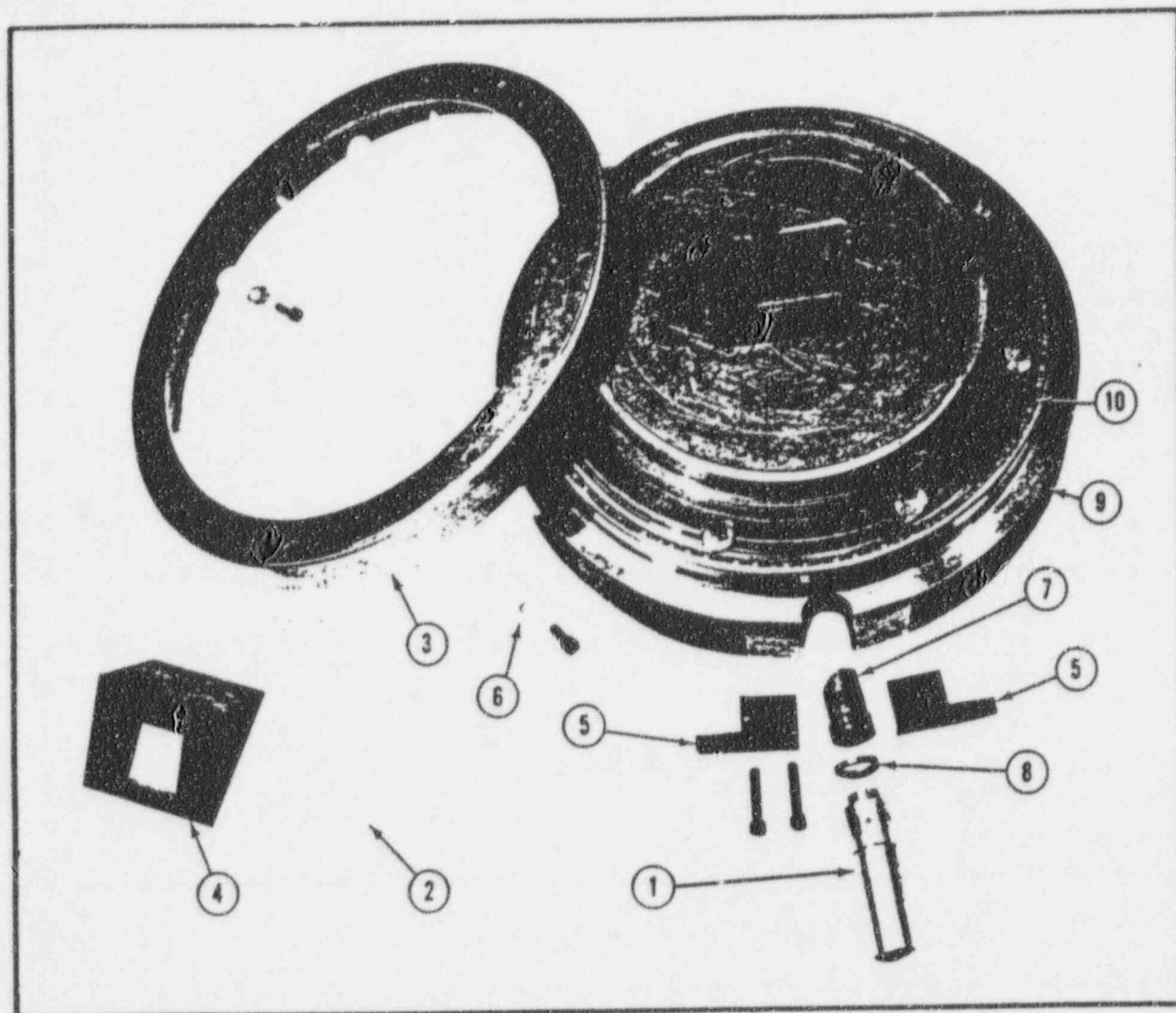


FIG. 6 - COBALT COLLIMATOR BEARING RING ASSEMBLY  
Part No. 181459

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
6 -	181459		Ring Assembly, Bearing (See Fig. 4, Item 34)	Ref.
1	181461		Lens Assembly, Field Illuminator (See Fig. 7)	1
2	55432		Mirror, Collimator	1
3	55591		Adapter Ring, Bearing	1
4	55592		Retainer, Mirror	1
5	55748		Block, Rotation Stop	2
6	55593		Retainer, Bearing	16
7	55594		Aperture	1
8	56210		Spacer, Aperture	1
9	181389A		Ring Assembly, Bearing-Machined	1
10	T13-438		Bearing, Ball - 4 Point Contact	1

FIG. 7 - COBALT COLLIMATOR FIELD LENS ASSEMBLY  
Part No. 181461

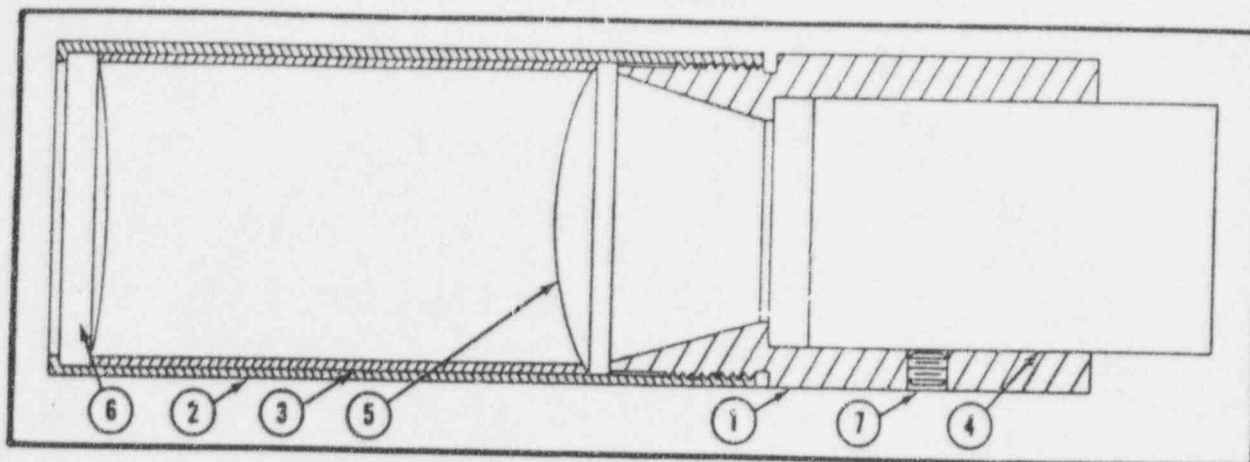


FIG. 7 - COBALT COLLIMATOR FIELD LENS ASSEMBLY  
Part No. 181461

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
7 -	181461		Lens Assembly, Field Illuminator (See Fig. 6, Item i)	Ref.
1	55826		Holder	1
2	55827		Sleeve	1
3	55825		Spacer	1
4	T87-127		Lens, Wide Angle Proj.	1
5	T87-126		Lens, Plano 56mm F.L.	1
6	T87-125		Lens, Plano 207.2mm F.L.	1
7	S33-98		Screw, Socket Set, #4-40 x 1/8	1

FIG. 8 - COBALT COLLIMATOR MAIN CROSS ASSEMBLY  
Part No. 181460

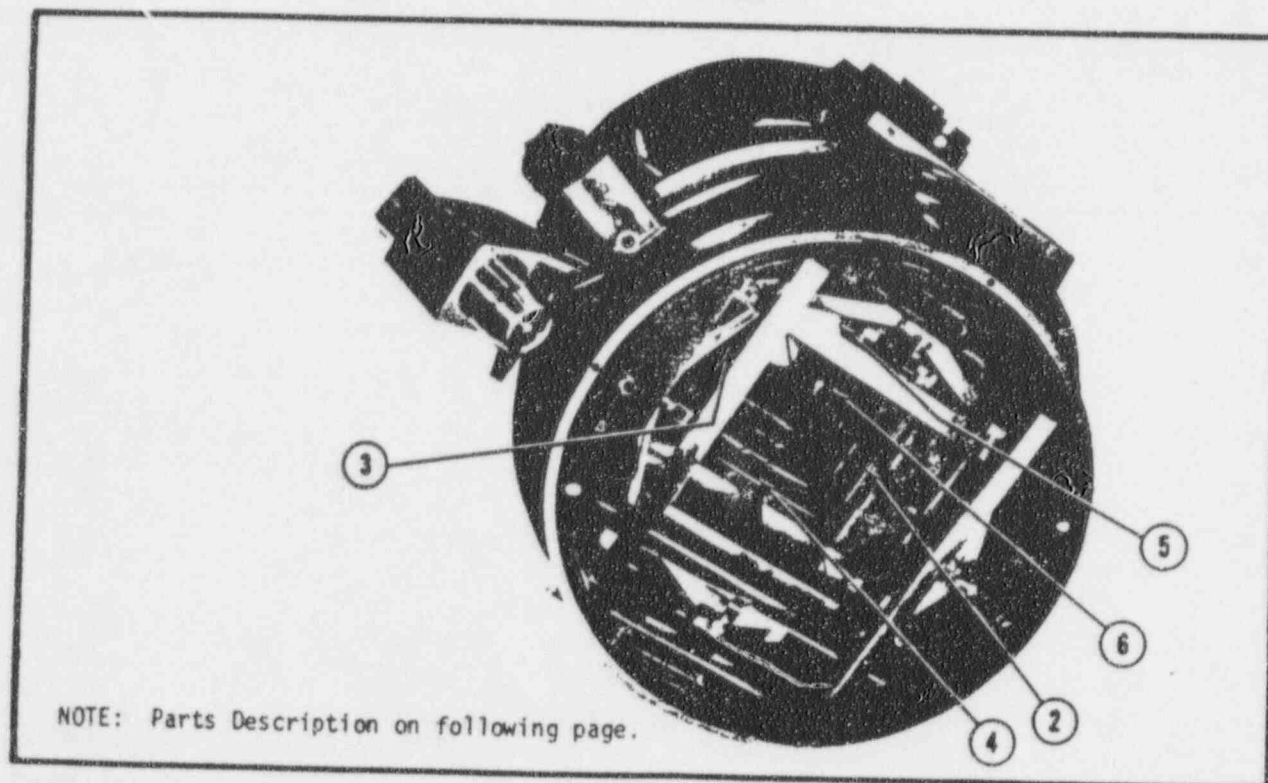




FIG. 8 - COBALT COLLIMATOR MAIN CROSS ASSEMBLY  
Part No. 181460

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
8 -	181460		Cross Assembly, Main (See Fig. 4, Item 35)	Ref.
1*	181445		Pulley Assembly, Idle Side Take-up (See Fig. 9)	16
2	181467		Parallelogram Assembly, "X" Motion (with split nut)	1
3	181467A		Parallelogram Assembly, "X" Motion	1
4	181468		Parallelogram Assembly, "Y" Motion (with split nut)	1
5	181468A		Parallelogram Assembly, "Y" Motion	1
6	181469		Vane Assembly, Top	2
7*	181470		Drive Assembly, Gear (See Fig. 10)	1
8*	181470A		Drive Assembly, Gear - with special dials (See DDS 1001)	1
9*	55166A		Frame Casting, Main	1
10*	55597		Rod, Guide	4
11*	T10C-590		Spacer, Counterbalance Pivot	8
12*	T11P-251		Washer, Large O.D.	8
13*	T14D-182		Pin, Vane Pivot	8
14*	T82-96		Cable, Bottom Counterbalance	16
*Not shown.				

FIG. 9 - COBALT COLLIMATOR MAIN CROSS PULLEY ASSEMBLY  
Part No. 181445

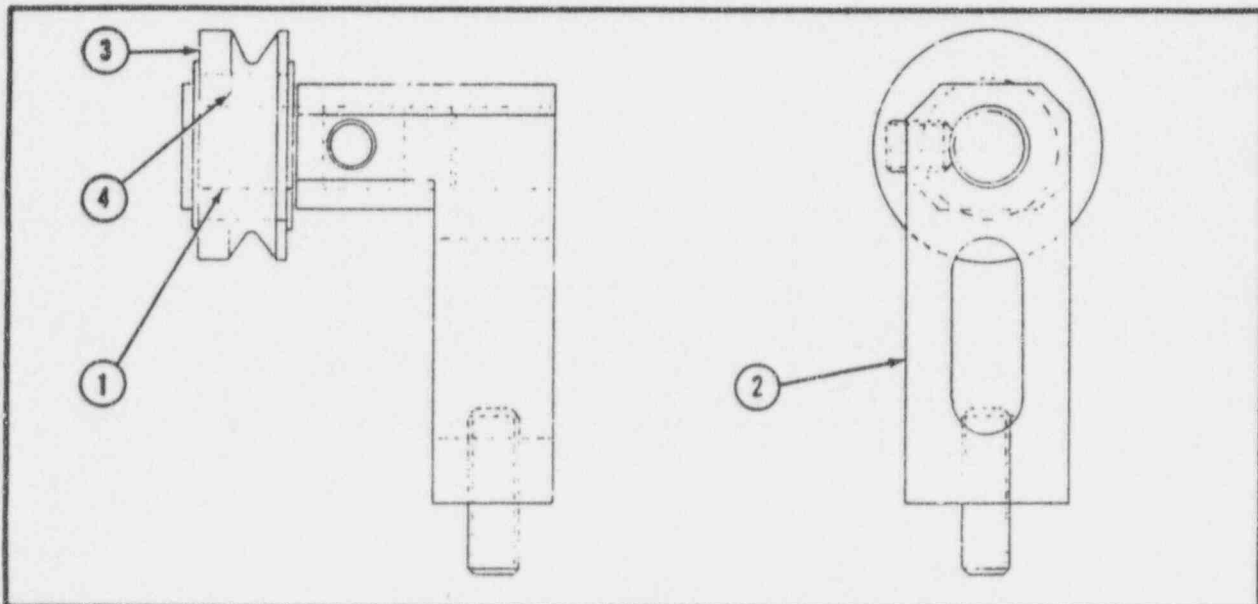


FIG. 9 - COBALT COLLIMATOR MAIN CROSS PULLEY ASSEMBLY  
Part No. 181445

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
9 -	181445		Pulley Assembly (See Fig. 8, Item 1)	16
1	55600		Shaft, Pulley	1
2	55602		Block, Take-up	1
3	55599A		Pulley	1
4	T12-443		Bearing, Needle	1



FIG. 10 - COBALT COLLIMATOR MAIN CROSS HAND GEAR DRIVE ASSEMBLY  
 Part No. 181470  
 DDS 1001 - COBALT COLLIMATOR MAIN CROSS HAND GEAR DRIVE ASSEMBLY  
 Part No. 181470A

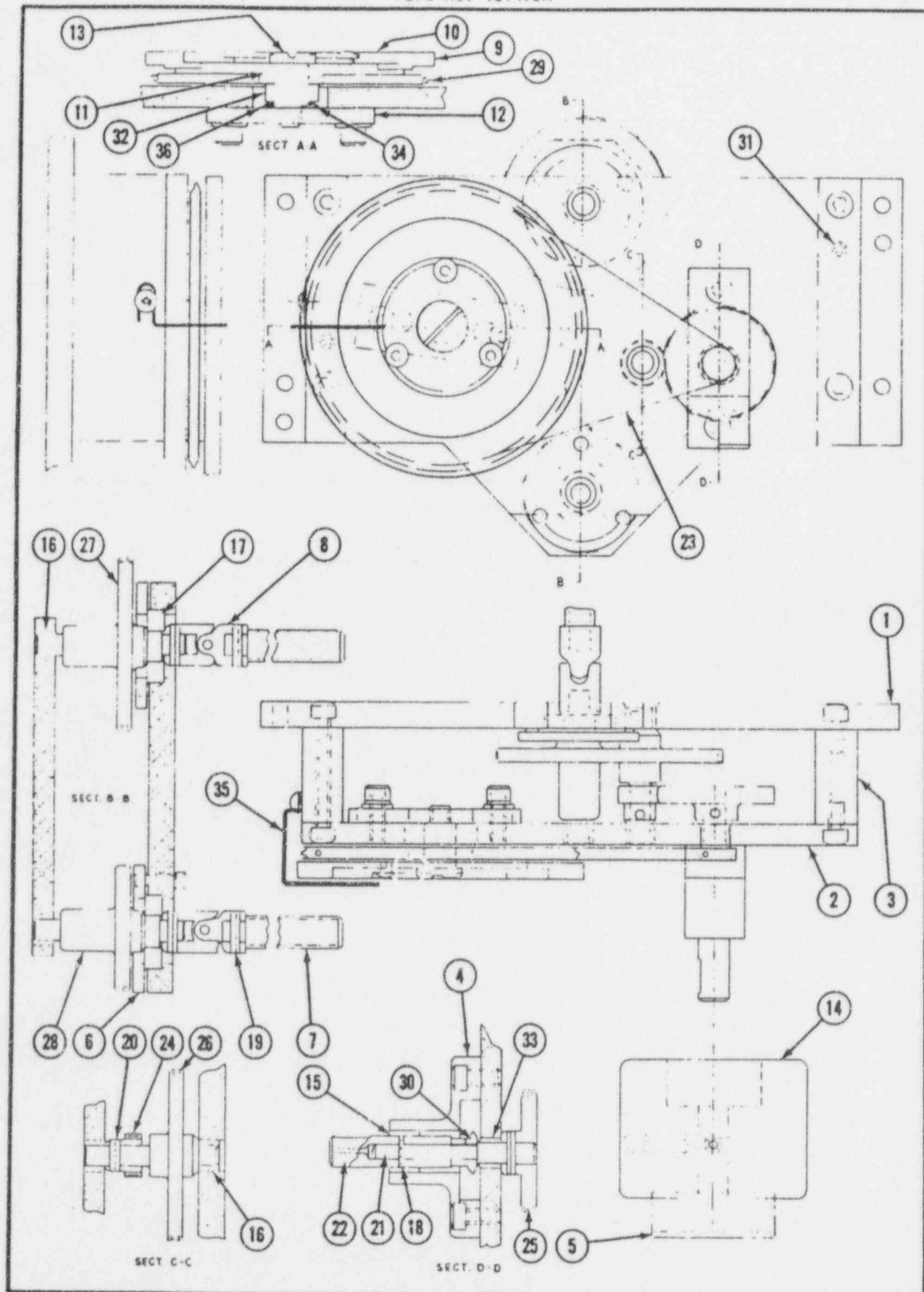


FIG. 10 - COBALT COLLIMATOR MAIN CROSS HAND GEAR DRIVE ASSEMBLY  
Part No. 181470

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
10 -	181470		Gear Drive Assembly, Hand (See Fig. 8, Item 7)	1
1	55841		Plate, Rear	1
2	55842		Plate, Front	1
3	55843		Spacer, Plate	2
4	55844A		Support, Bearing	1
5	55845		Plug, Knob	1
6	55846		Retainer, Bearing	2
7	55848		Screw, Lead	2
8	55849		Joint, Universal	2
9	55850		Dial, Outer	1
10	55851		Dial, Inner	1
11	55852		Ring, Dial	1
12	55853		Plate, Adj.	1
13	T2-519		Screw, Shoulder	1
14	T3-166		Knob, Dial	1
15	T10F-35		Bushing	1
16	T10F-86		Bushing	4
17	T12-447		Bearing	2
18	T14A-110		Pin, Roll, 1/16 x 3/8	1
19	T14A-79		Pin, Roll, 1/8 x 1/2	5
20	T14A-84		Pin, Roll, 1/8 x 3/8	1
21	T14L-73		Shaft	1
22	T14L-74		Shaft, Adapter	1
23	T26-140		Chain, Roller	1
24	T77-326		Gear, 24 T., 48 D.P.	1
25	T77-327		Gear, 66 T., 48 D.P.	1
26	T77-328		Gear, 96 T., 48 D.P.	1
27	T77-329		Gear, 96 T., 48 D.P.	1
28	T77-330		Gear, 66 T., 48 D.P.	1
29	T77-38		Sprocket, 70 T.	1
30	T77-39		Sprocket, 10 T.	1
31	T14D-181		Pin, Dowel, 3/16 x 1/2	2
32	T10C-309		Bushing	1
33	56428		Bushing	1
34	T5-675		Washer, Spring	1
35	56637		Pointer, Dial	1
36	T11P-4		Shim	2

15

### DIFFERENCE DATA SHEET

DDS 1001 - COBALT COLLIMATOR MAIN CROSS HAND GEAR DRIVE ASSEMBLY  
Part No. 181470A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
10 -	181470A		Gear Drive Assembly, Head (See Fig. 8, Item 8)	1
9	55850A		Dial, Outer	1
10	55851A		Dial, Inner	1

FIG. 11 - COBALT COLLIMATOR EXTENDER ASSEMBLY  
Part No. 181507

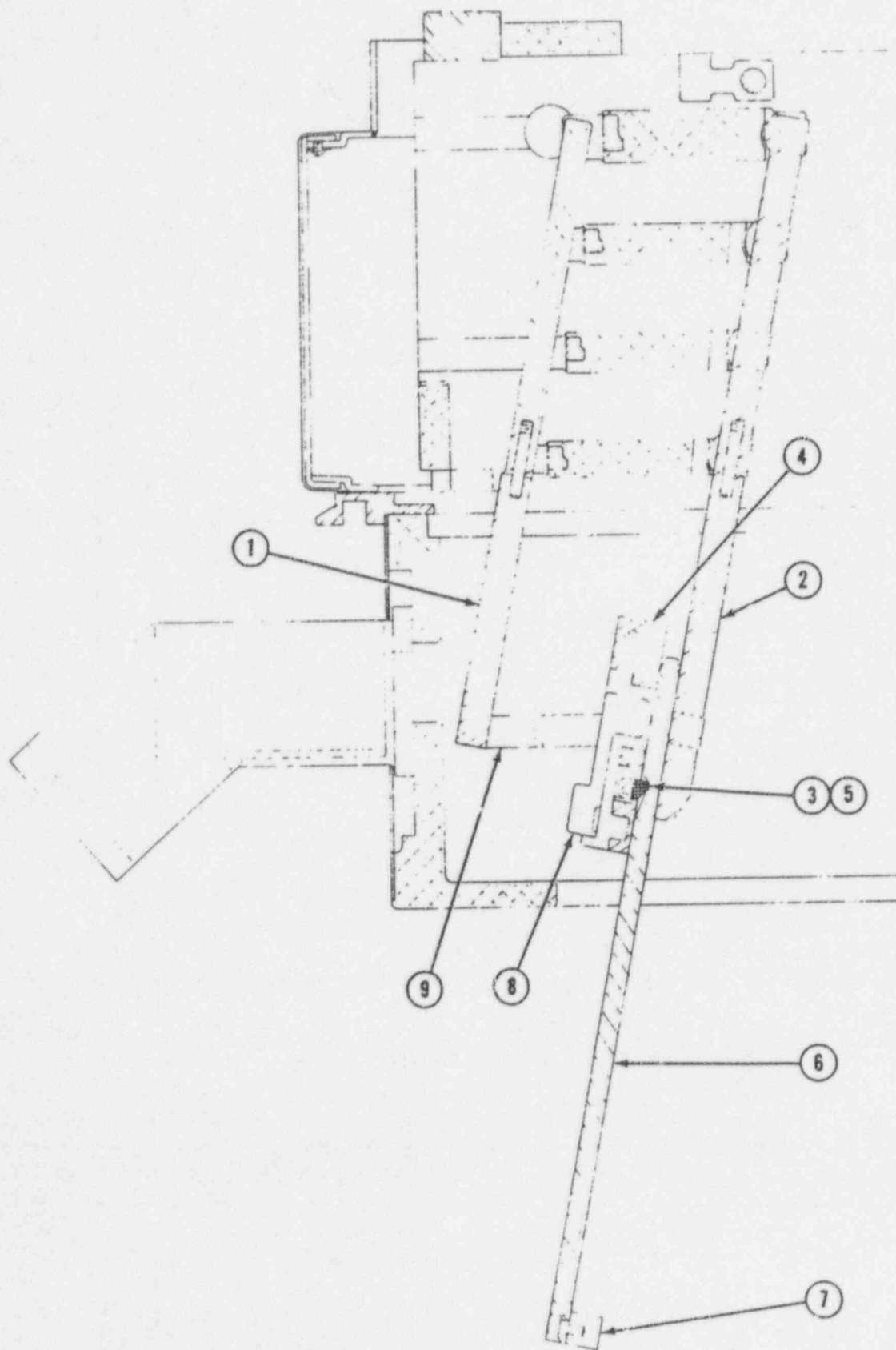


FIG. 11 - COBALT COLLIMATOR EXTENDER ASSEMBLY  
Part No. 181507

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
11 -	181507		Extender Assembly (See Fig. 4, Item 37)	Ref.
1	181462		Bar Assembly, Support	1
2	181463		Bar Assembly, Trimmer	1
3	56106		Stop, Extender	1
4	55576A		Guide, Extender	1
5	56107		Stop, Spring Extender	1
6	55578		Bar, Extender Mounting	1
7	55170		Extender	1
8	55580A		Lever	1
9	55581A		Yoke, Trimmer Bar Support	1
10*	56770		Lever, Keeper Plate	1
11*	T2-548		Screw, Cam Lever, Eccentric	1
12*	T5A-270		Spring, Compression	1
13*	T14F-35		Pin, 1/4 Diameter, Connecting	2
14*	T22-65		Retainer, Ring, Truarc	2
15*	T14D-189		Pin, 3/16 x 1"	1
			*Not shown.	

FIG. 12 - COBALT COLLIMATOR HALO SWITCH  
Part No. 181558

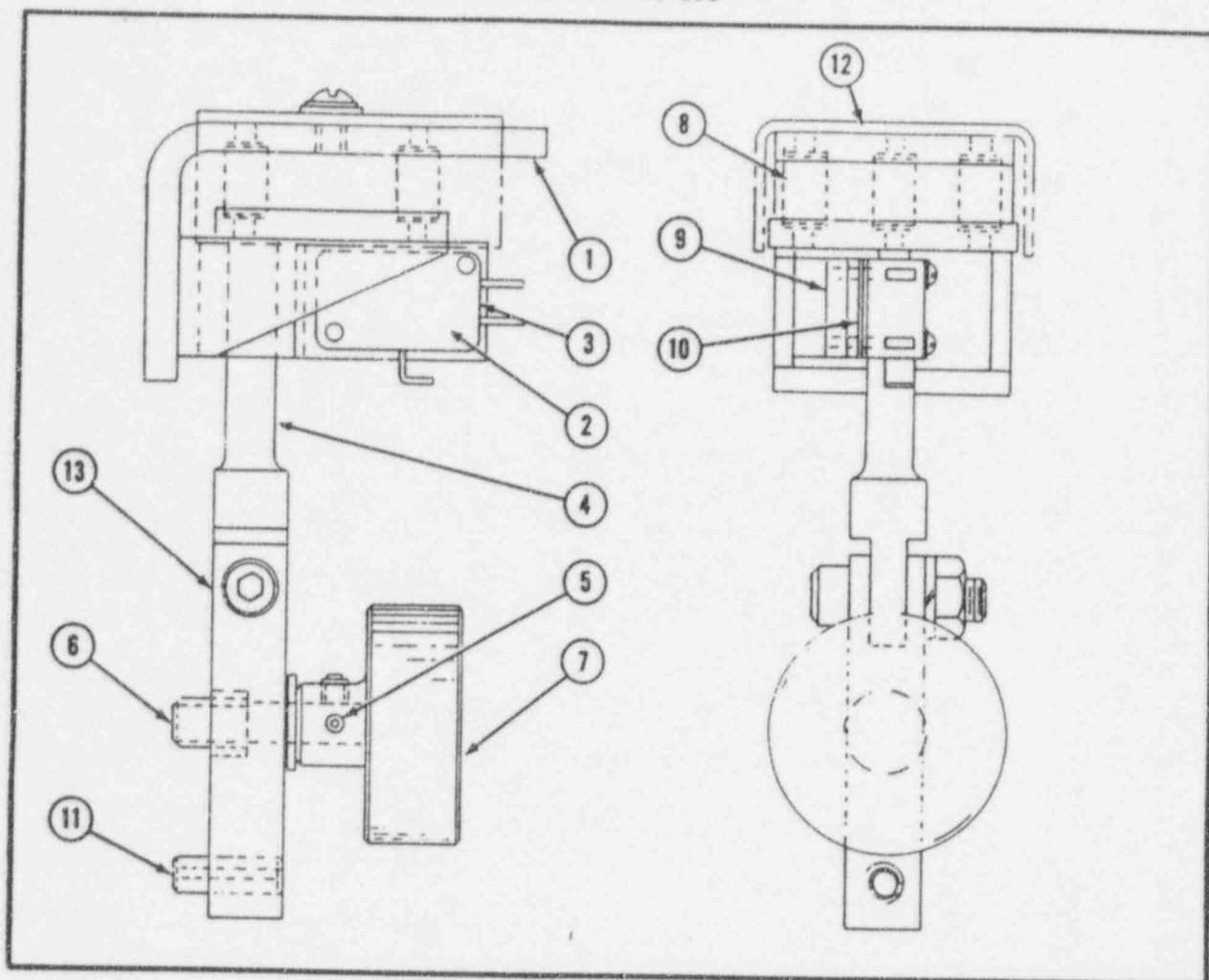
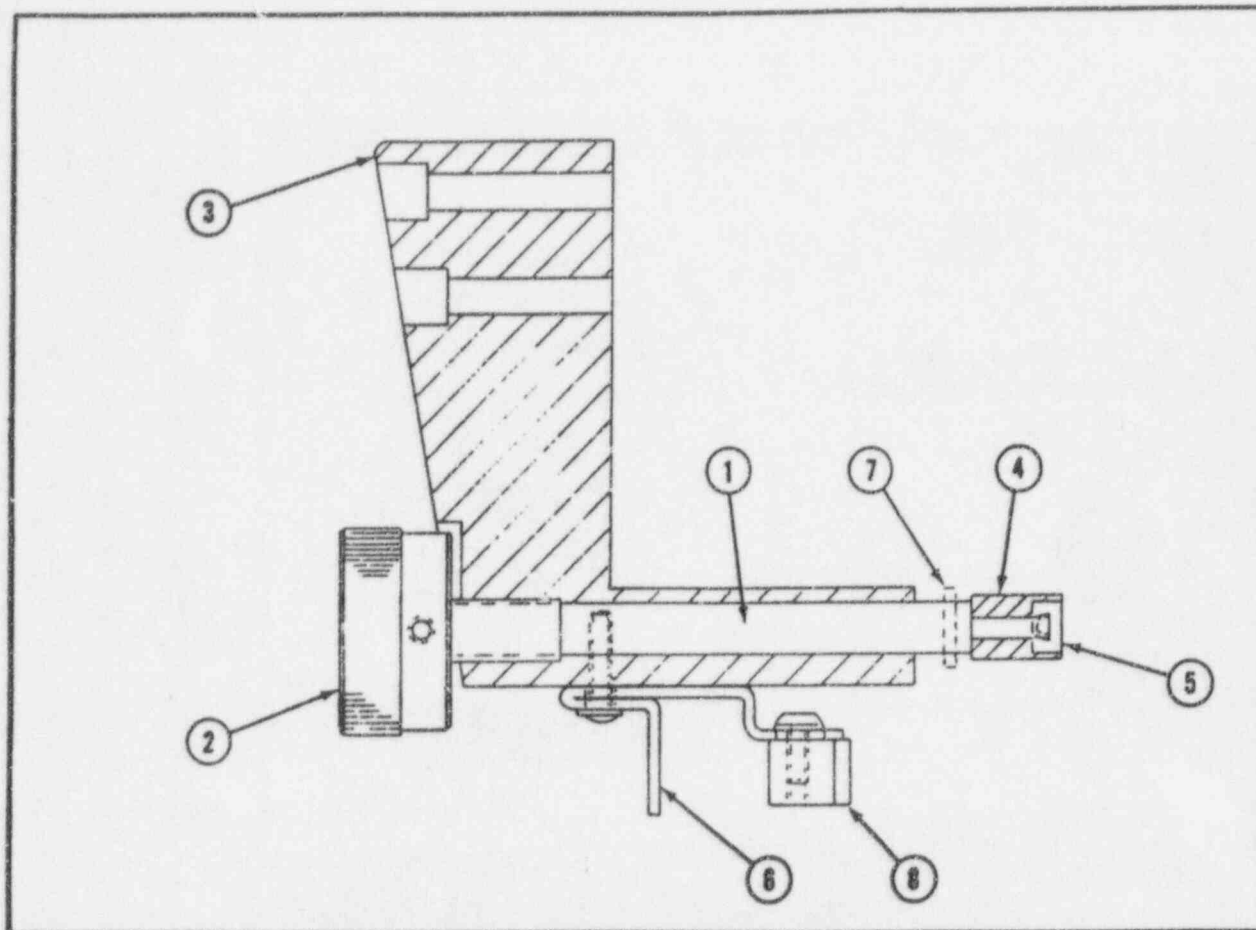


FIG. 12 - COBALT COLLIMATOR HALO SWITCH  
Part No. 181558

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
12 -	181558		Switch Assembly, Halo (See Fig. 4, Item 38)	1
1	181562		Bracket, Angle	1
2	L-2729		Switch, With Leads	1
3	T29A-16		Switch	1
4	181563		Bracket, Mounting	1
5	T14A-76		Pin, Roll, 3/32 x 1/2	1
6	T14L-75		Stud	1
7	T3A-116		Knob	1
8	T5A-93		Spring, Compression	1
9	T4-165		Plate, Nut	6
10	T9-74		Barrier, Fibre	1
11	T14A-86		Pin, Roll, 1/4 x 3/4	1
12	55972		Plate, Guide Feeler	1
13	55971		Stem, Adjustable	1



FIG. 13 - COBALT COLLIMATOR ROTATIONAL BRAKE ASSEMBLY  
Part No. 181464



19

FIG. 13 - COBALT COLLIMATOR ROTATIONAL BRAKE ASSEMBLY  
Part No. 181464

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
13 -	181464		Brake Assembly, Rotational (See Fig. 4, Item 19)	1
1	55657		Shaft, Brake	1
2	T3-61		Knob	1
3	55659A		Housing, Brake	1
4	55656		Shoe, Brake	1
5	55658		Lining, Brake Shoe	1
6	55655		Pointer	1
7	T14A-132		Pin, Roll, 1/16 x 1/2	1
8	56586		Actuator, Front Switch	1

FIG. 14 - V9 COBALT CONTROL  
 Part No. VG8D  
 DDS 1401 - V9 COBALT CONTROL  
 Part No. VG8E

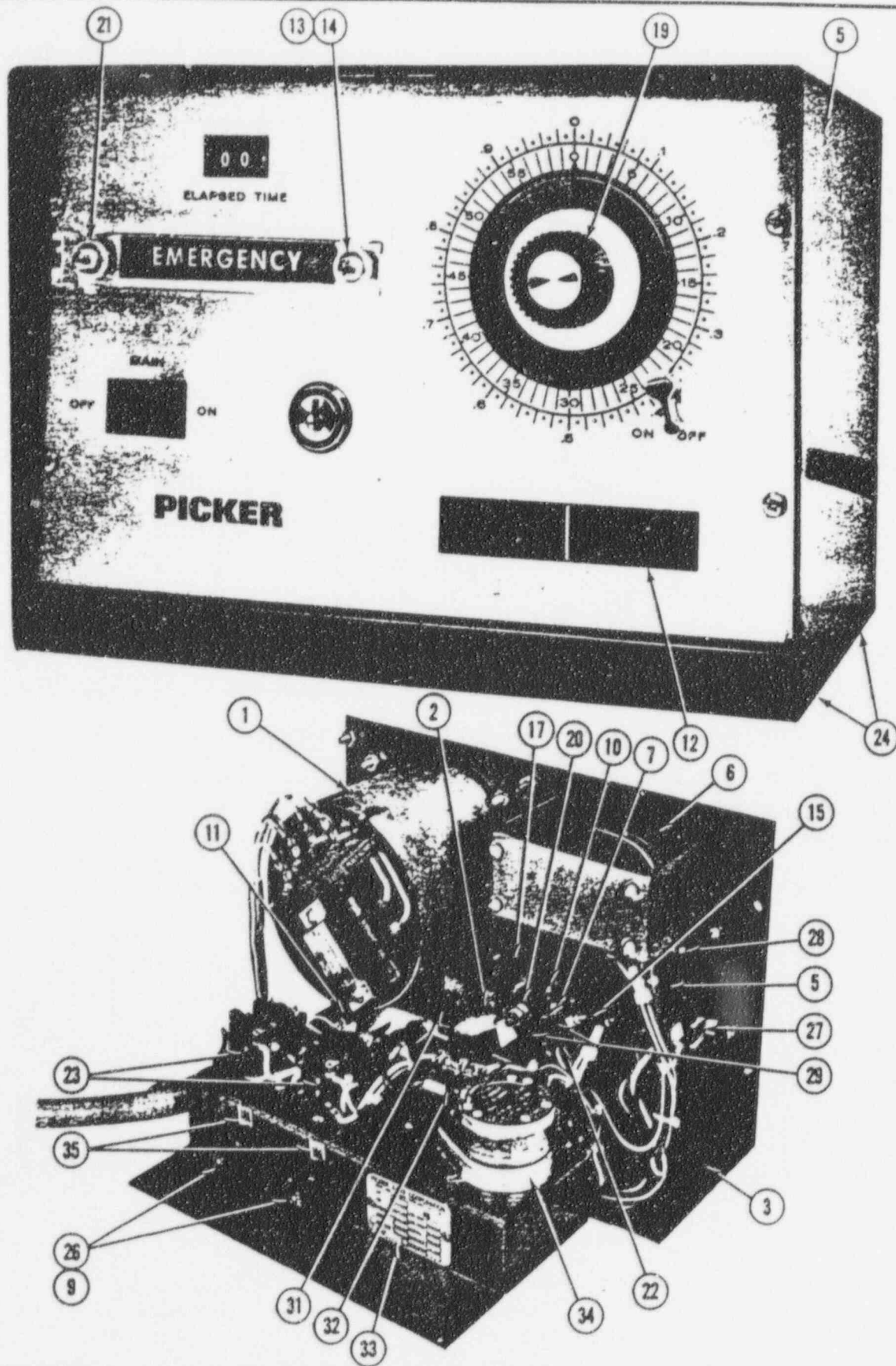


FIG. 14 - V9 COBALT CONTROL  
Part No. VG8D

H59:P

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
14 -	VG8D		Control, Cobalt, 60 Hz (See Fig. 1, Item 3)	1
1	945A		Timer, 60 Hz, L-F	1
2	14574		Bracket Assembly, Lamp	1
3	16463A		Chassis Assembly	1
4*	50314		Cabinet, Control	1
5	31358		Insulation (SW3)	1
6	34482		Timer, Back-up	1
7	34952		Actuator, Microswitch, Flat	2
8*	35088		Actuator, Microswitch, Roller	1
9	32062		Holder, Fuse	2
10	36759		Lock and Keys	1
11	37169		Sockets, Lamp	2
12	38759		Window, Shutter Indicator	1
13	38975		Bar, Exposure	1
14	38976		Strap, Cross	1
15	46536		Bracket, Key Switch	1
16*	46560		Cam, Timer	1
17	46562		Brackets, Timer	2
18*	46744A		Nameplate, Control	1
19	T3A-85		Knob	1
20	T5-433		Spring, Key Switch	1
21	T5A-185		Spring	2
22	T9-74		Spacer, Microswitch	3
23	T19A-108		Relay, D.P.D.T.	2
24	T21-140		Bumper, Rubber	4
25*	T21A-70		Grommet, Heyco	1
26	T27A-12		Fuse, 10 A, 125 Volt	2
27	T29-147		Switch, Rocker D.P.S.T.	1
28	T29A-15		Switch, Micro Snap	1
29	T29A-16		Switch, Micro S.P.D.T.	3
30*	T66A-10		Clamp, Cable	1
31	T72-8		Lamp, Mazda Bulb, 6 Watts, 120 Volts	2
32	T81A-21		Board, 10 PT. Terminal	1
33	T92-155		Plate, Rating	1
34	T93B-59		Motor, 60 Hz, 10 RPM, Syn.	1
35	T32B-8		Decal, 10 Amp	2
*Not shown.				

DIFFERENCE DATA SHEET

DDS 1401 - V9 COBALT CONTROL  
Part No. VG8E

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
14 -	VG8E		Control, Cobalt, 50 Hz (See Fig. 1, Item 3A)	1
1	945C		Timer, 50 Hz L.F.	1
36	T93B-60		Motor, 50 Hz, 10 RPM, Syn.	1

FIG. 15 - V9 COBALT FILLED STAND  
Part No. 1372C

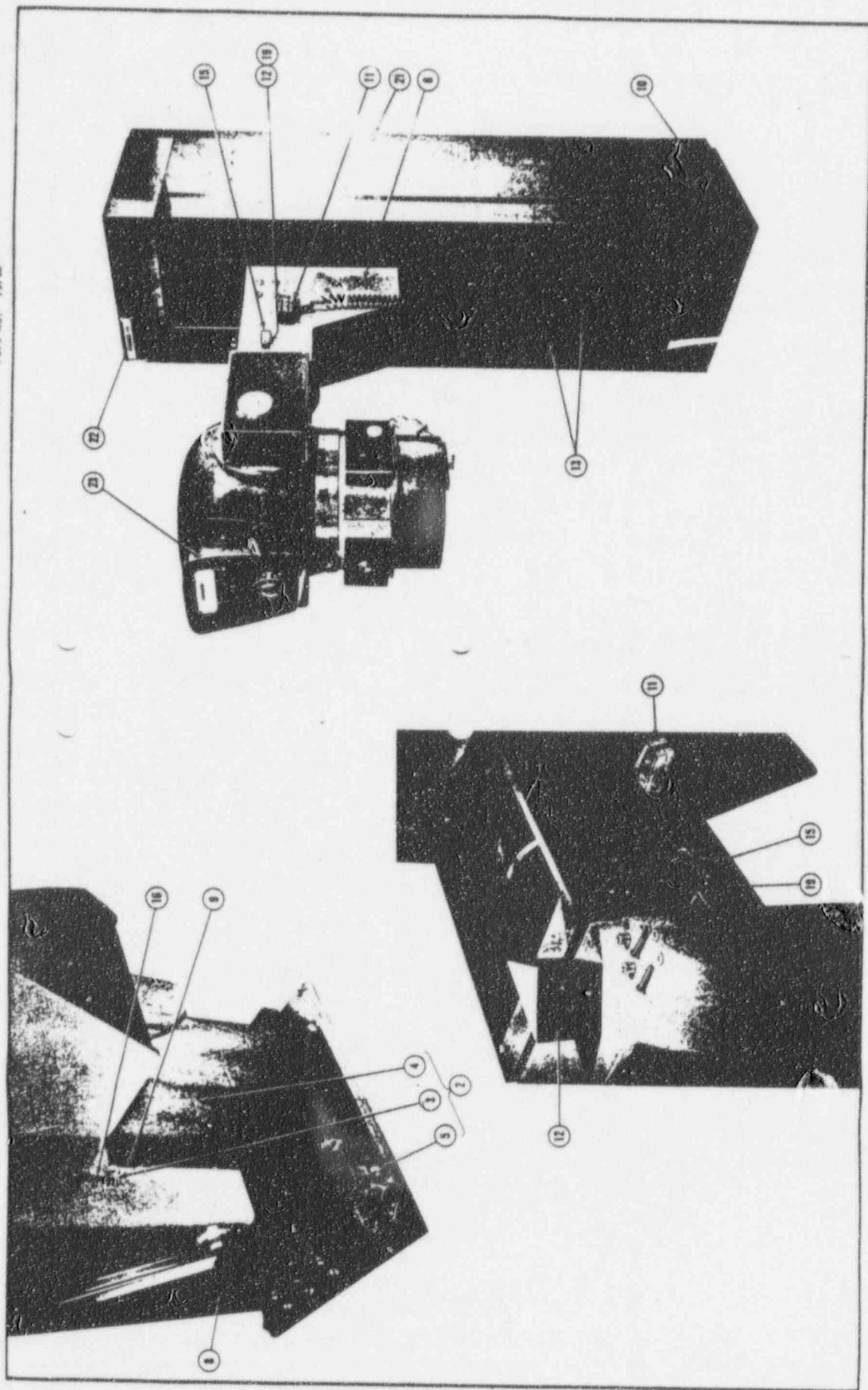


FIG. 15 - V9 COBALT FIXED STAND  
Part No. 1373E

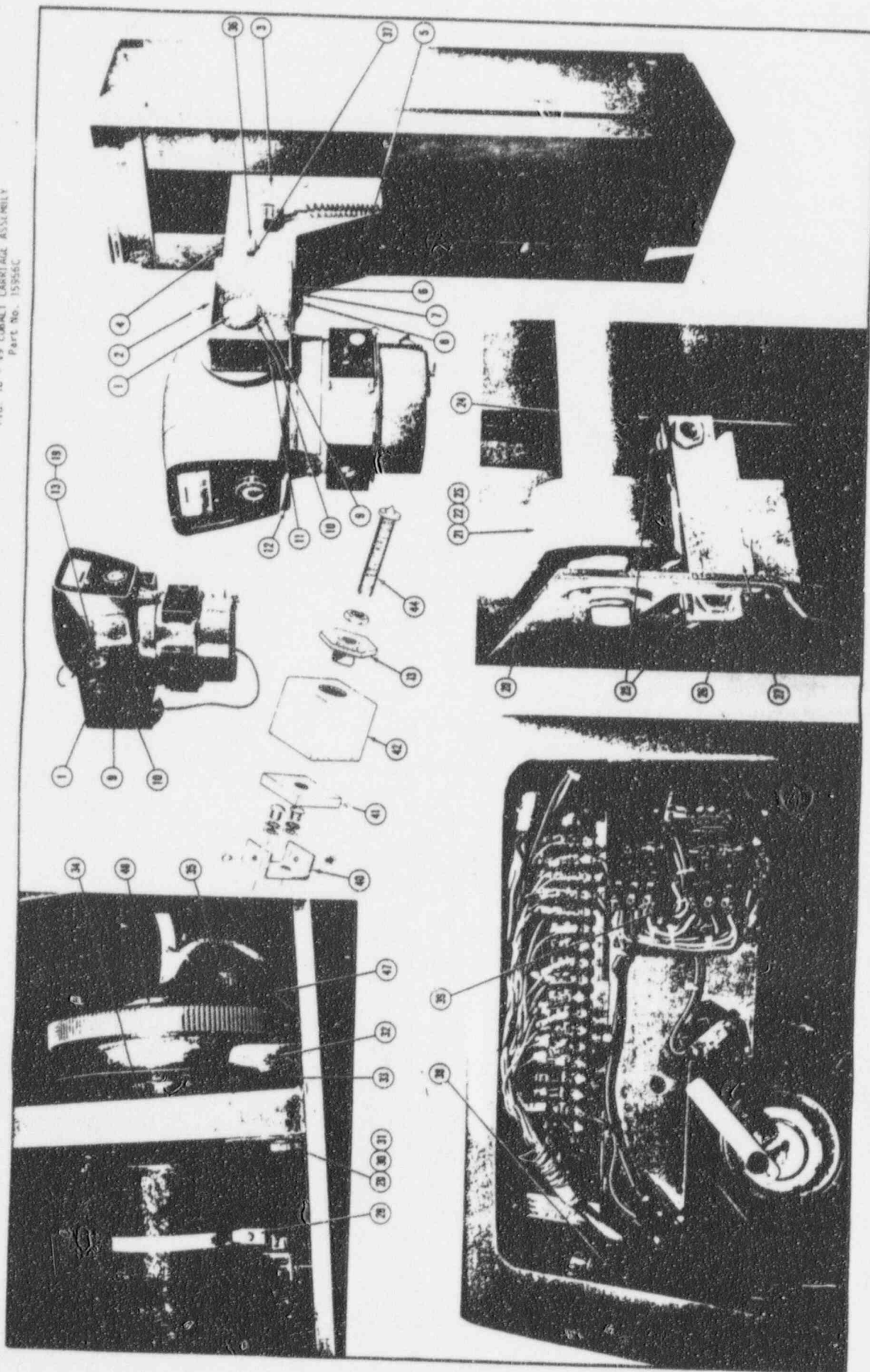
H59:P

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
15 -	1373E		Stand, V9 Fixed (See Fig. 1, Item 4)	1
1*	3719		Calculator, Cobalt	1
2	15251A		Shade Assembly	2
3	42084		Slat, Vertical Shade	1
4	42074A		Shade	1
5	42080		Roller and Bracket, Shade	1
6	15956C		Carriage Assembly, Hanger and Roller (See Fig. 16)	1
7*	15958		Drive Assembly, Vertical (See Fig. 21)	1
8	15955B		Column Assembly (See Fig. 22)	1
9	31823		Stiffener, Contact	4
10	42076A		Moulding, Trim	2
11	50825		Caddy, Pendant Switch	1
12	54134		Cover, Yoke Centering Switch	1
13	42073A		Shroud	2
14*	42090		Ballast, 50 lb. Bag	8
15	T2-480		Screw, Switch Trip	1
16	T5-446		Spring, Shade	4
17*	T10C-197		Bushing	4
18*	T26A-12		V-Belt, Vertical Drive	1
19	T29A-51		Switch, Yoke Centering	1
20*	T14L-72		Rod, Threaded, Mounting Angulation Scale	1
21	T92-176		Nameplate, Rating	1
22	T92-193		Nameplate, Picker	1
23	T92-355		Nameplate, V9	1
			*Not shown.	

23



FIG. 16 - V9 CORALIT CARRIAGE ASSEMBLY  
Part No. 15956C



PROPERTY OF FIDELITY CORPORATION  
APR 11 1961

FIG. 16 - V9 COBALT CARRIAGE ASSEMBLY  
Part No. 15956C

H59:P

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
16 -	15956C		Carriage Assembly, Hanger and Roller (See Fig. 15, Item 6)	1
1	13471C		Retainer Assembly, Angulation Scale (one on each side)	2
2	16833A		Yoke Assembly (See Fig. 17)	1
3	46855A		Support, Yoke	1
4	46856A		Plate, Yoke Support Top	1
5	46857A		Plate, Yoke Support Bottom	1
6	54135		Cover, Dust (between Yoke and Yoke Support)	1
7	54150		Scale, Partial Yoke Tilt	1
8	54151		Pointer, Scale	1
9	45020		Pointer, Angulation Scale	2
10	35829A		Scale, Yoke Angulation	2
11	54015		Cover, Yoke Arm, Right	1
12	54015A		Cover, Yoke Arm, Left	1
13	13823E		Scale Assembly, Angulation	1
14	14953		Shaft and Counterweight Assembly	1
15	36060		Pointer	1
16	36083		Face, Dial	1
17	36934		Scale, Angulation	1
18	T12-205		Bearing, Ball	1
19	181601		Housing and Window Assembly (with Retainer)	1
20	42085B		Carriage, Roller	1
21	T22-53		Retainer, Ring	4
22	35910A		Wheel, Plain Carriage	4
23	T12-144		Bearing, Carriage Wheel	4
24	T14H-66		Shaft, Carriage Roller	2
25	T12-150		Roller, Back Floor	6
26	42072		Block, Roller Mounting	3
27	15247		Plate Weldment, Roller Bracket Mounting	3
28	54168		Trip, Limit Switch	1
29	53623		Pad, Brake	4
30	54152		Retainer, Spring	2
31	T5A-256		Spring, Compression	2
32	54165		Spacer, Yoke Brake	1
33	54155		Housing, Brake	1
34	T12-328		Bearing, Rear Yoke Tube	1
35	182120		Motor Assembly	1
36	54492A		Bracket, Yoke Switch Trip Mounting	1
37	T2-490		Screw, Switch Trip	1
38	T29-98		Switch, Mercury	2
39	T81003		Control Assembly, Yoke Rotation (See Fig. 20)	1
40	54175		Bracket, Switch Mounting	1
41	T4-398		Nut Plate	1
42	181018		Bracket Assembly, Switch Trip	1
43	T11-249		Washer, Threaded	1
44	T2-480		Screw, Switch Trip	1
45*	55431		Plate, Motor Mounting	1
46*	T12-424		Bearing, Front	1
47*	T13A-235		Rod, Threaded	1
48	T22-150		Retainer, Ring	1
49*	T54-40		Ring, 2.725 Diameter	1
50*	T66B-12		Clamp, Angulation Scale	1

\*Not shown.

FIG. 17 - CORAL YOE ASSEMBLY  
Part No. 16832A

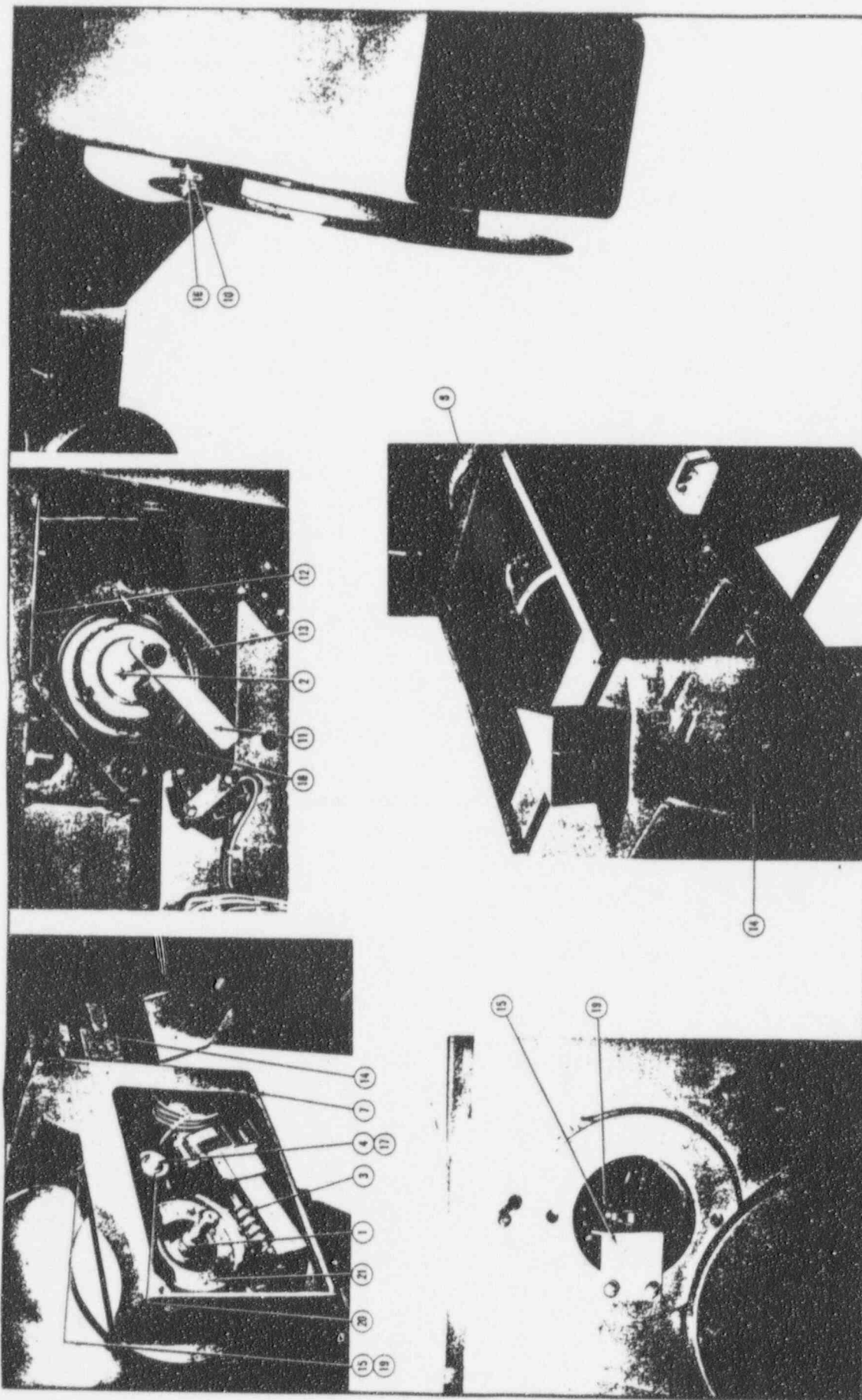


FIG. 17 - COBALT YOKE ASSEMBLY  
Part No. 16833A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
17 -	16833A		Yoke Assembly (See Fig. 16, Item 11)	1
1	180967		Trunnion Assembly, Cobalt Head (R.H.)	1
2	180968		Trunnion Assembly, Cobalt Head (L.H.)	1
3	180999		Drive Assembly, Worm (See Fig. 18)	1
4	181006		Plug Assembly, Spring Retaining	1
5*	181009		Control Assembly Head Tilt (See Fig. 19).	1
6*	181411A		Gear Assembly, Yoke and Drive	1
7	180997A		Yoke, Cobalt Head	1
8	181007A		Gear Assembly, Yoke Rotation	1
9*	53623		Pad, Brake	1
10	53628A		Disc, Brake	1
11	53677		Lever, Actuator, Limit Switch	1
12	38688		Weight, Balance	1
13	54131		Retainer, Bearing, Trunnion	2
14	54136		Bracket, Mounting, Yoke Centering Switch	1
15	54153		Bracket, Mounting, Head Centering Switch	1
16	55996		Pad, Brake (3/16" thick)	1
17	T5A-256		Spring, Compression	1
18	T12-260		Bearing, Trunnion	2
19	T29A-51		Switch, Head Centering	2
20*	T31-44		Key, Drive Gear (for Item 21 this figure)	1
21	T77C-33		Gear, Worm	1

\*Not shown.

FIG. 13 - COBALT HEAD WORM DRIVE ASSEMBLY  
Part No. 180999

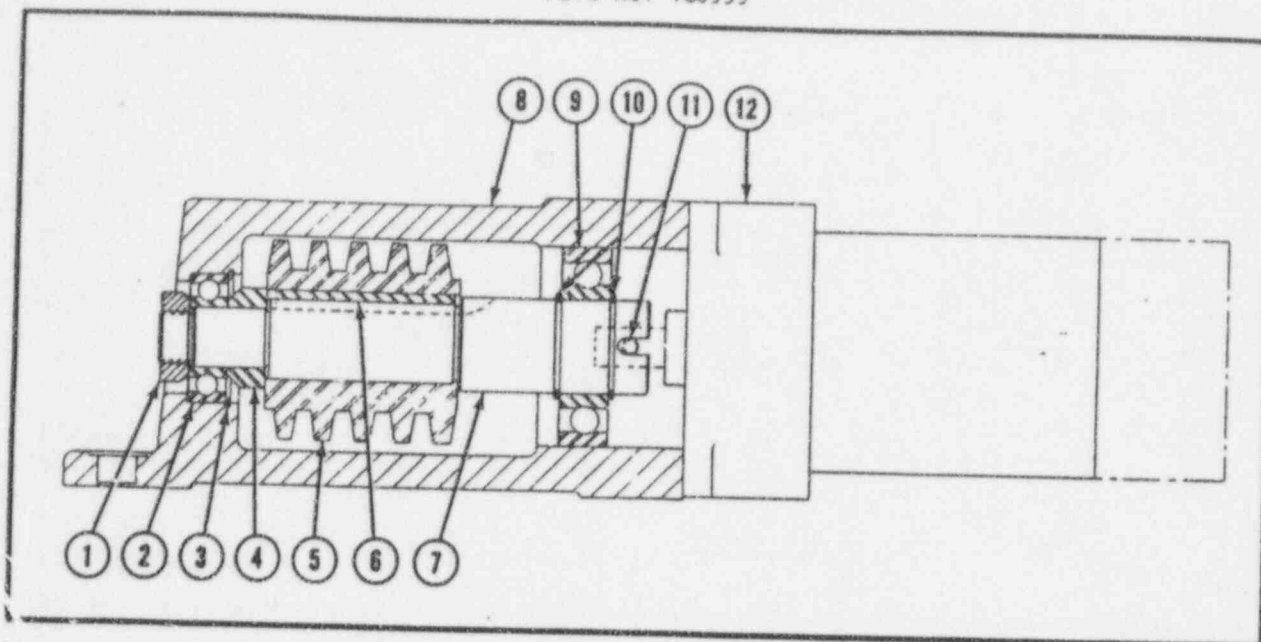
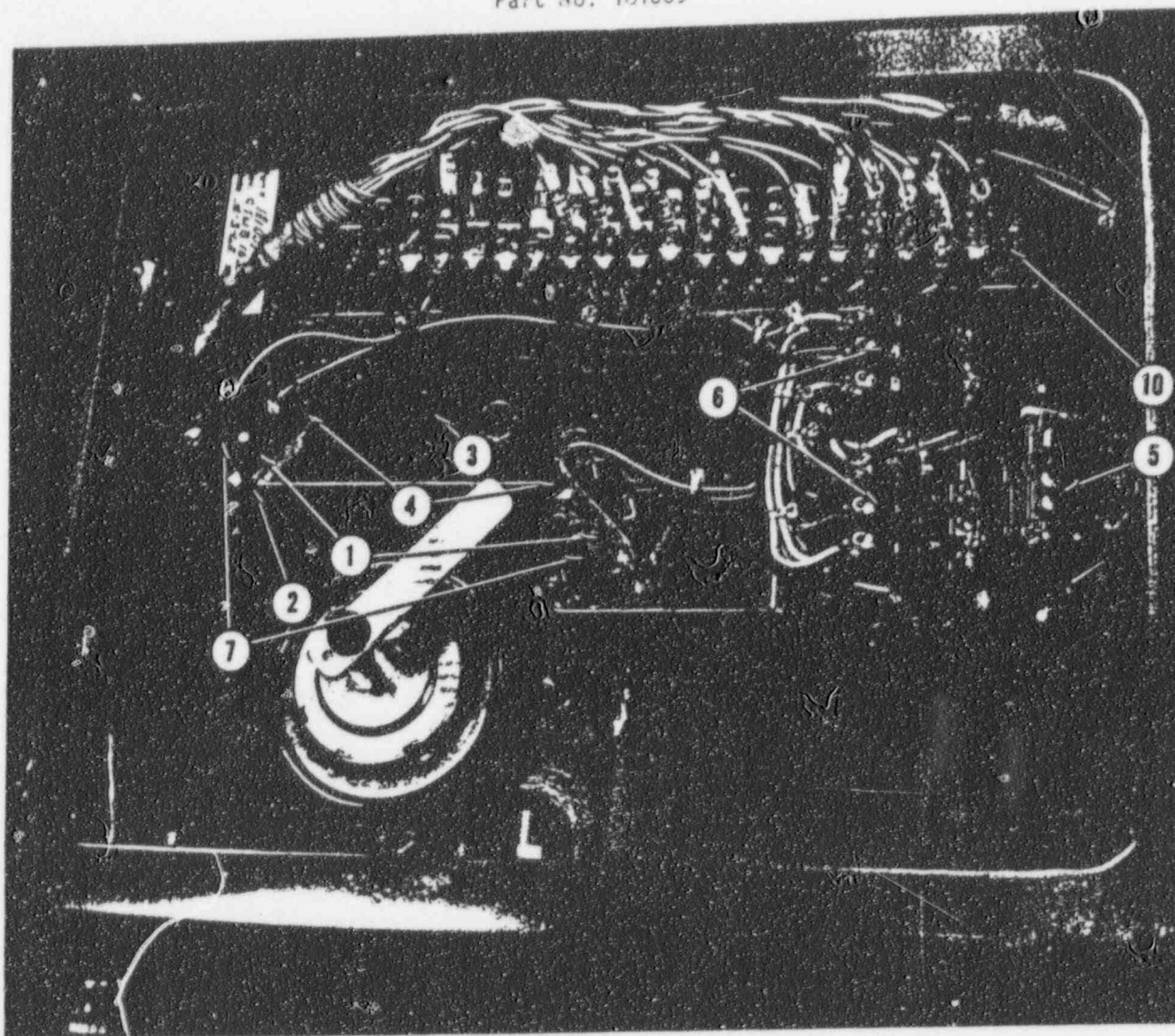


FIG. 18 - COBALT HEAD WORM DRIVE ASSEMBLY  
Part No. 180999

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
18 -	180999		Drive Assembly, Worm (See Fig. 17, Item 3)	1
1	T4-146		Nut, Worm Shaft Lock	1
2	T12-245		Bearing, Ball	1
3	T22-144		Ring, Retaining	1
4	54144		Spacer, Worm Drive Shaft	1
5	T77B-34		Gear, Worm	1
6	T31-43		Key, Worm Drive	1
7	T14C-52		Shaft, Drive	1
8	53844		Housing, Bearing	1
9	T12-156		Bearing, Ball, Single Row Radial Double Shielded	1
10	T22-52		Truarc	2
11	T14A-62		Pin, Roll 3/16	1
12	T93G-15		Motor, Power Head Tilt and Yoke Rotation	1



FIG. 19 - COBALT HEAD TILT CONTROL ASSEMBLY  
Part No. 181009



29

FIG. 19 - COBALT HEAD TILT CONTROL ASSEMBLY  
Part No. 181009

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
19 -	181009		Control Assembly, Head Tilt (See Fig. 17, Item 5)	1
1	35088		Actuator, Switch	2
2	T4-165		Plate, Nut	2
3	56683		Bracket, Relay Panel Mounting	1
4	T9-74		Barrier, Switch	2
5	T19A-130		Relay, D.P.D.T., Latch	1
6	T19A-150		Relay, D.P.D.T.	2
7	T29A-16		Switch, Micro	2
8*	32062		Post, Fuse	2
9*	T45-464		Capacitor and Bracket, 4 MF, 136 VAC	1
10	T81A-67		Strip, Terminal, 20 Point	1
11*	T27A-12		Fuse, 10 A, 250 Volt	2
*Not shown.				

FIG. 20 - V9 COBALT YOKE ROTATION CONTROL ASSEMBLY  
Part No. 181003

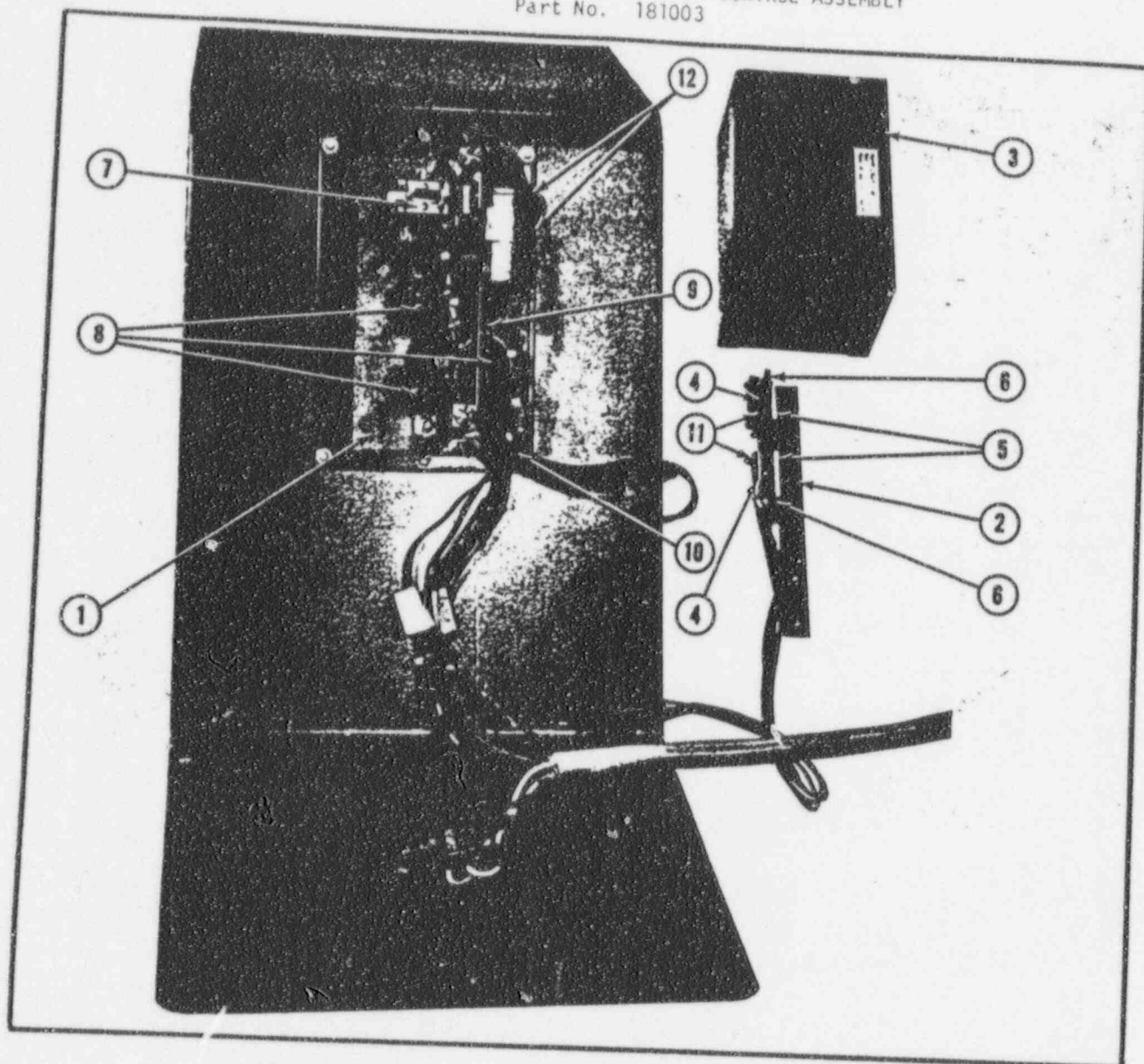
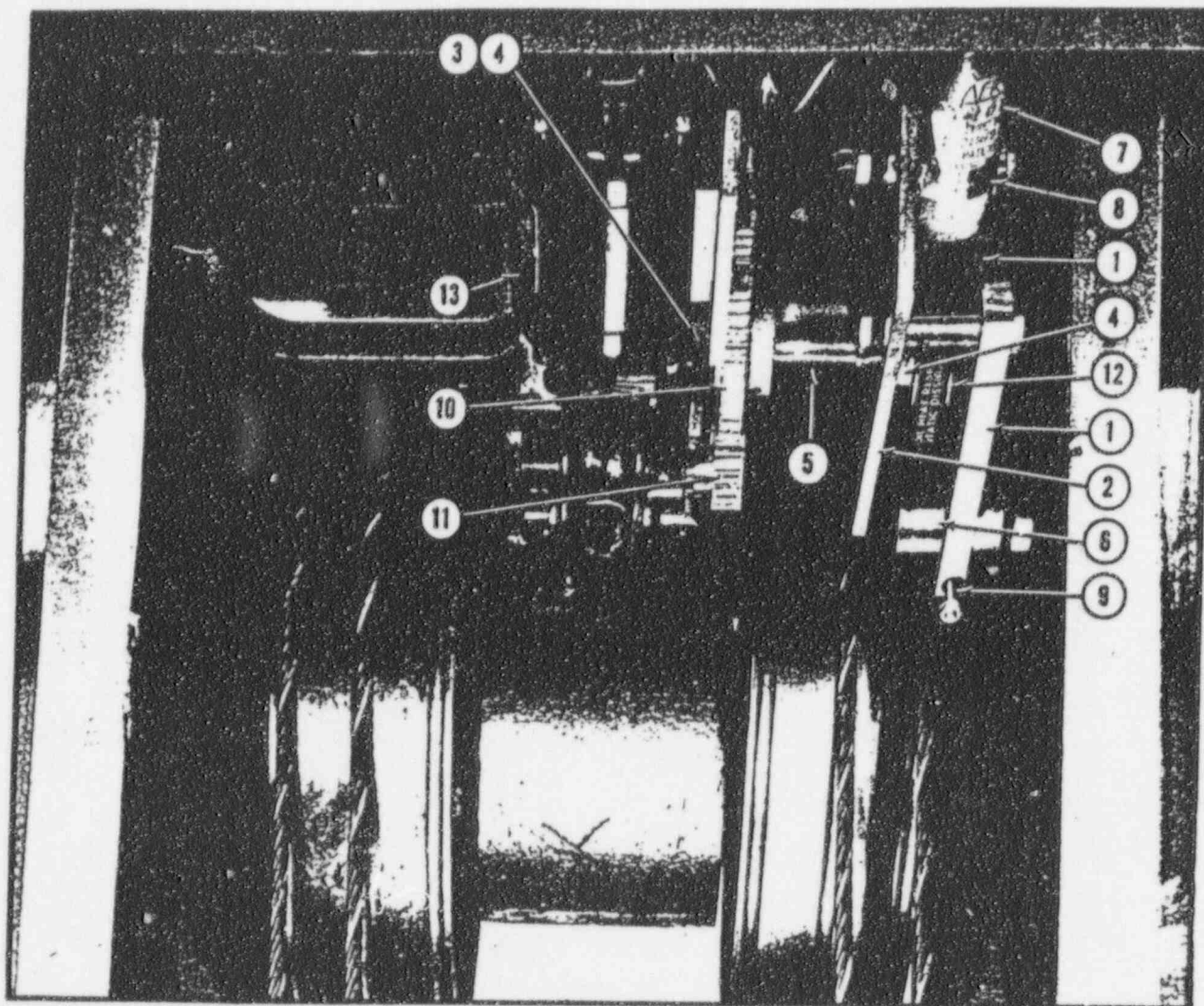


FIG. 20 - V9 COBALT YOKE ROTATION CONTROL ASSEMBLY  
Part No. 181003

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
20 -	181003		Control Assembly, Yoke Rotation (See Fig. 16, Item 39)	1
1	181004		Panel Assembly	1
2	54143		Bracket, Limit Switch	1
3	54142		Cover, Relay	1
4	34952		Actuator, Switch	1
5	T4-165		Plate, Nut	2
6	T9-74		Barrier, Switch	2
7	T19A-130		Relay, D.P.D.T., Latch	2
8	T19A-150		Relay, D.P.D.T.	1
9	T21A-69		Bushing, Snap 1/2 I.D.	3
10	T21A-75		Grommet, Rubber 1/2 I.D.	1
11	T29A-16		Switch, Micro	1
12	T45-464		Capacitor and Bracket, 4 MFD, 236 VAC	2
				1

FIG. 21 - V9 COBALT VERTICAL DRIVE ASSEMBLY  
Part No. 15958



31

FIG. 21 - V9 COBALT VERTICAL DRIVE ASSEMBLY  
Part No. 15958

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
21 -	15958		Drive Assembly, Vertical (See Fig. 15, Item 7)	1
1	50475		Bracket, Pulley, Idler	2
2	43397		Plate, Motor Mounting	1
3	T108-308		Collar, Stop	1
4	T12-253		Flange, Bearing	2
5	T14H-85		Shaft, Drive	1
6	T12-150		Bearing	2
7	T45-45		Capacitor, 10 MFD	1
8	T66A-13		Clamp, Cable	1
9	T13A-116		Stud, Threaded	1
10	T77-103		Gear, Spur (Large)	1
11	T77-172		Gear, Spur (Small)	1
12	T84-22		Pulley	1
13	T93A-8		Motor, Horizontal Drive	1
			*Not shown.	



FIG. 21 - V9 COBALT VERTICAL DRIVE ASSEMBLY  
Part No. 15958

H59:P

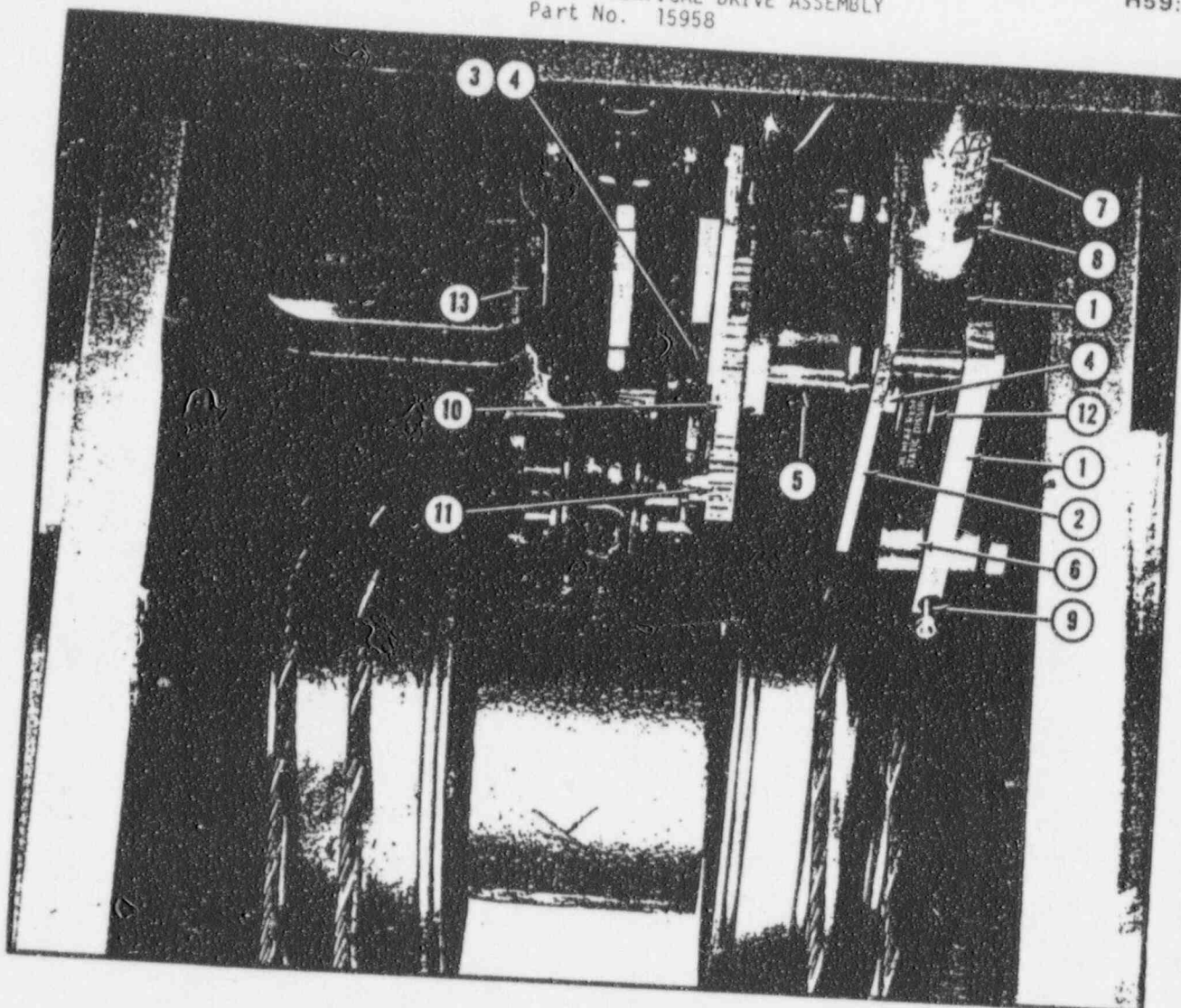


FIG. 21 - V9 COBALT VERTICAL DRIVE ASSEMBLY  
Part No. 15958

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
21 -	15958		Drive Assembly, Vertical (See Fig. 15, Item 7)	1
1	50475		Bracket, Pulley, Idler	2
2	43397		Plate, Motor Mounting	1
3	T10B-308		Collar, Stop	1
4	T12-253		Flange, Bearing	1
5	T14H-85		Shaft, Drive	2
6	T12-150		Bearing	1
7	T45-45		Capacitor, 10 MFD	2
8	T66A-13		Clamp, Cable	1
9	T13A-116		Stud, Threaded	1
10	T77-103		Gear, Spur (Large)	1
11	T77-172		Gear, Spur (Small)	1
12	T84-22		Pulley	1
13	T93A-8		Motor, Horizontal Drive	1
			*Not shown.	

FIG. 22 - V9 COBALT COLUMN ASSEMBLY  
Part No. 15955B

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
22 -	15955B		Column Assembly (See Fig. 15, Item 8)	1
1	15248		Strap Weldment, Support	1
2	154438		Bucket Assembly, Counterweight	1
3*	34959		Cushion, Rubber	1
4	42059		Sleeve, Cable	2
5	42060		Channel, Left Hand Support	1
6	42061		Plate, Lower Bearing	1
7	42062A		Plate, Upper Bearing	1
8	42067		Housing, Bearing Casting	1
9	42068		Angle, Channel Mounting	4
10	42069A		Bracket, Shroud Mounting	4
11	42078		Bracket, Carriage Stop	1
12	42086		Channel, Right Hand Support	1
13*	T98-105		Marker, Trim Strip, 14-Post	1
14	T12-234		Bearing, Main Support	2
15*	T14A-85		Pin, Roll, 3/8 x 1-3/4	2
16	T14H-67		Shaft, Main Bearing	1
17	T21-14		Bumper	2
18*	T81A-13		Strip, Terminal, 14-Post	1
19	T82-91		Support, Cable	4
			*Not shown.	



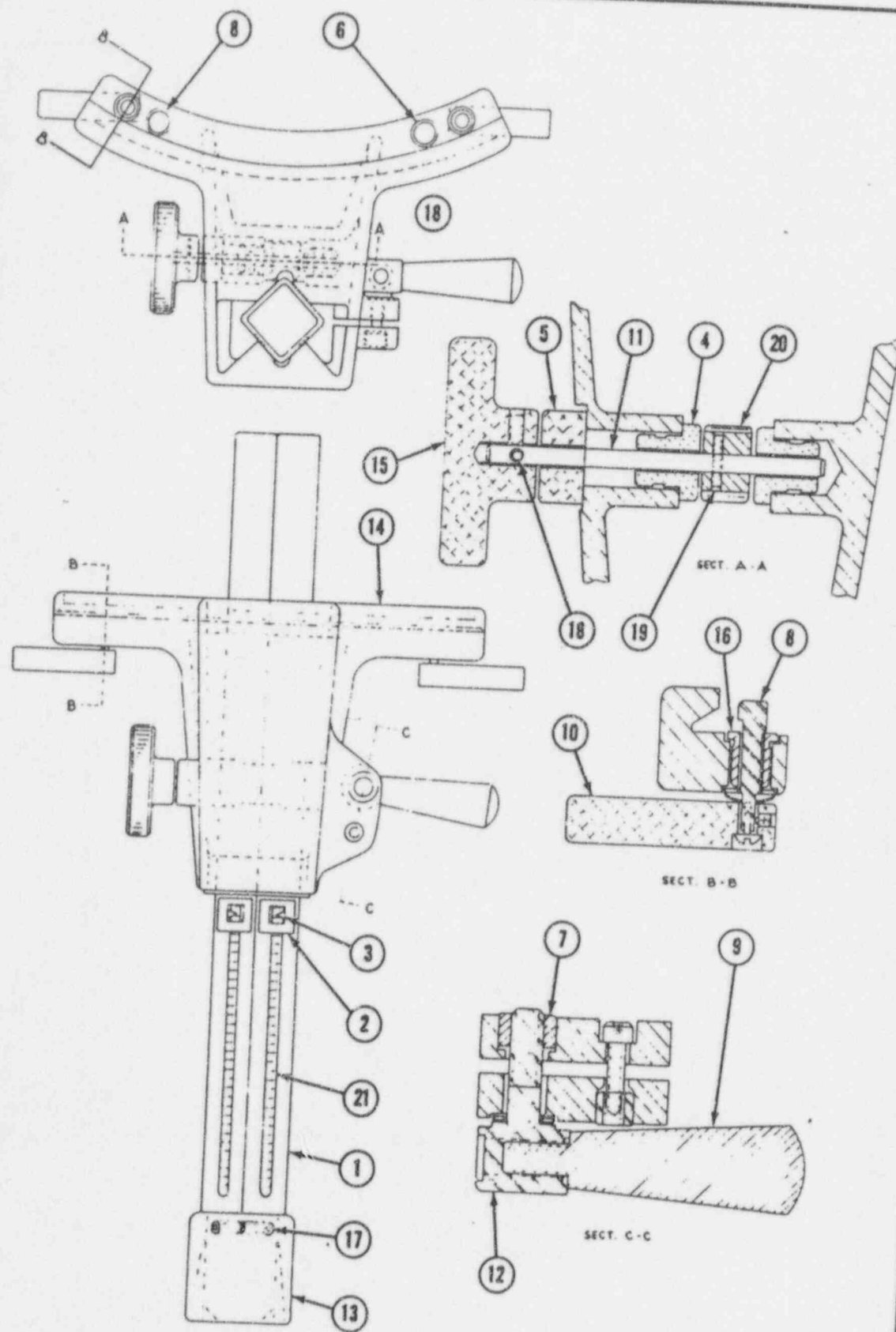
FIG. 23 - COBALT, ACCESSORY ATTACHMENT POST ASSEMBLY  
Part No. 3499E

FIG. 23 - COBALT, ACCESSORY ATTACHMENT POST ASSEMBLY  
Part No. 3499E

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
23 -	3499E		Post Assembly, Accessory Attachment (See Fig. 1, Item 5)	1
1	181481		Tube Assembly, Drive	1
2	181478		Bracket Assembly, Pointer	1
3	20816		Pointer	2
4	55663		Bushing, Eccentric	2
5	55664		Spacer, Drive Knob	1
6	55665		Pad, Nylon	2
7	55667		Clamp, Knurled Insert	1
8	55668		Clamp, Eccentric	2
9	55670		Handle, Clamp	1
10	55671		Handle, Clamp, Eccentric	2
11	55672		Shaft, Drive Wheel	1
12	55673		Bolt, Clamp	1
13	55674		Collar, Tapered	1
14	55360A		Post, Accessory Mounting	1
15	T3-62		Knob, Clamp	1
16	T108-574		Bushing	2
17	T14A-86		Pin, Roll, 1/4 x 3/4	2
18	T14A-122		Pin, Roll, 1/8 x 1	1
19	T14A-113		Pin, Roll, 1/8 x 3/8	1
20	T77-323		Gear, Drive	1
21	T32-489		Scale, "0"CM to 20CM	2

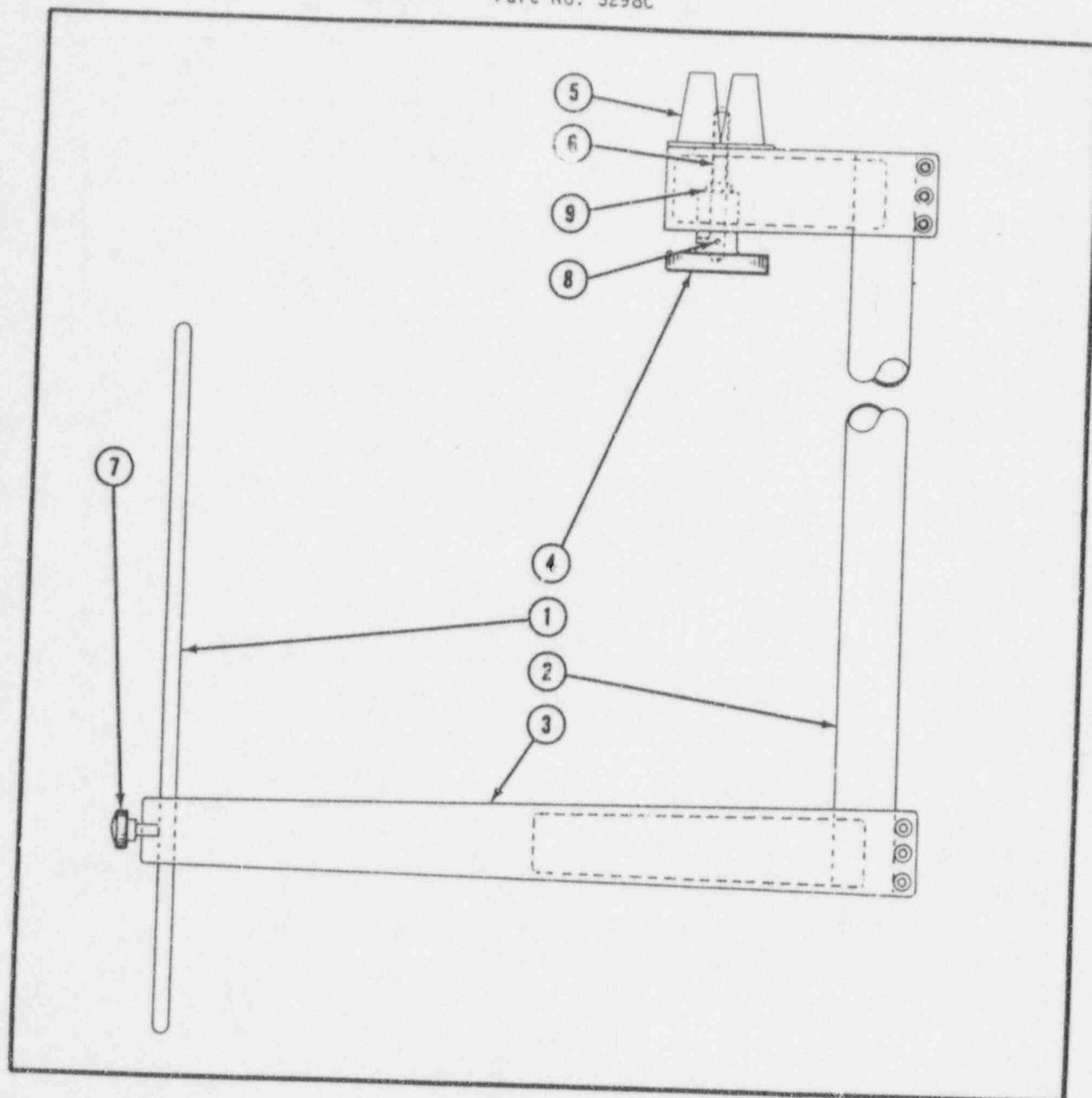
FIG. 24 - COBALT, BACKPOINTER ASSEMBLY  
Part No. 3298CFIG. 24 - COBALT, BACKPOINTER ASSEMBLY  
Part No. 3298C

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
24 -	3298C		Backpointer Assembly (See Fig. 1, Item 7)	1
1	39057		Rod, Pointer	1
2	50623		Support, Tube	1
3	55545A		Arm, Backpointer	1
4	T3-155		Knob, Clamp	1
5	55542A		Backpointer, Upper Arm	1
6	T13-395		Shaft, Clamp Knob	1
7	T2J-66		Screw, Thumb	1
8	T14A-122		Pin, Roll, 1/8 x 1	1
9	T22-22		Ring, Retaining, Truarc, 3/8 Shaft	1

FIG. 25 - COBALT, BEAM DIRECTING PIN-AND-ARC ASSEMBLY  
Part No. 3500C

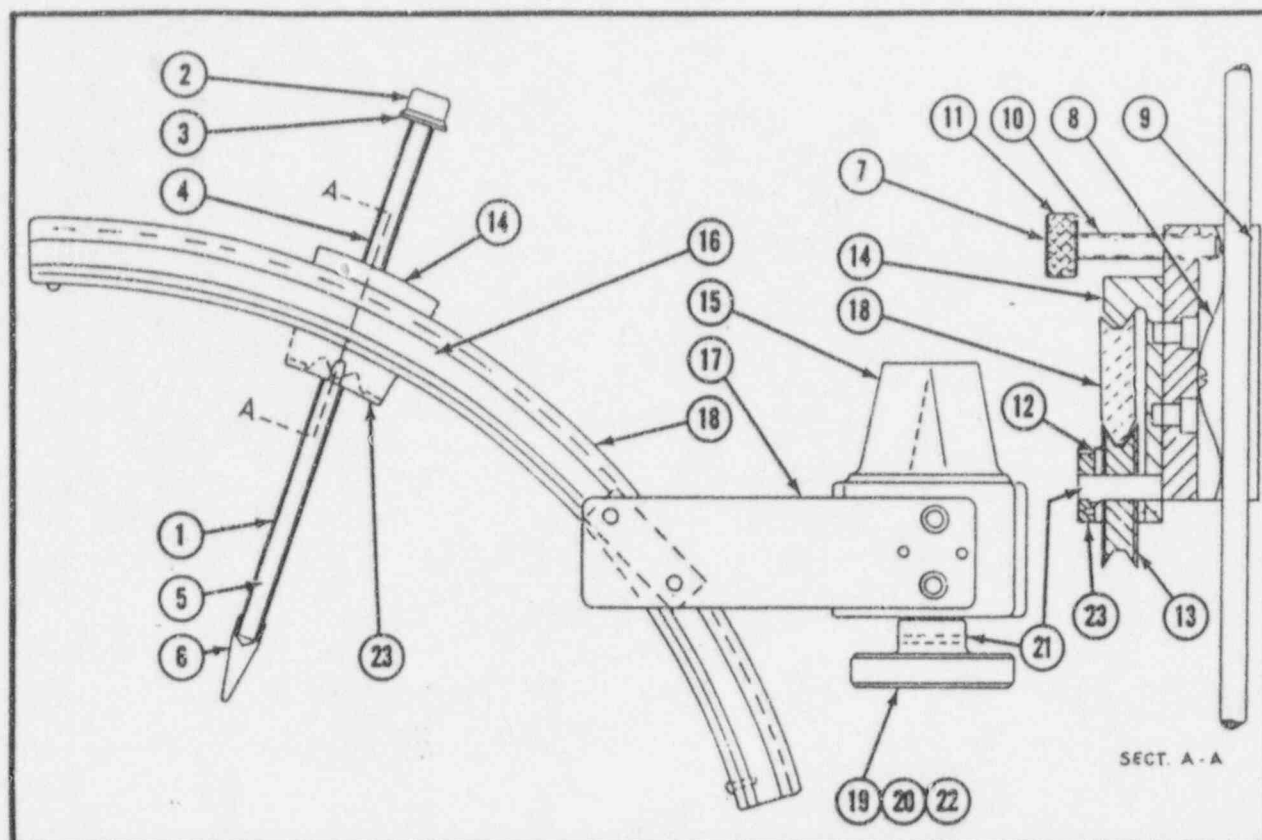


FIG. 25 - COBALT, BEAM DIRECTING PIN-AND-ARC ASSEMBLY  
Part No. 3500C

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
25 -	3500C		Pin-and-Arc, Beam Directing (See Fig. 1, Item 8)	1
1	14361A		Pin Assembly	1
2	39055		Level, Circular	1
3	39081		Flange, Level Mounting	1
4	55680		Pin	1
5	55894		Scale	1
6	39627		Cap, Pointer	1
7	14396		Bushing Assembly, Pin	1
8	T5-455		Spring, Pin Bushing	1
9	38942		Bushing, Pin	1
10	T10C-389		Spacer	1
11	T2J-37		Screw, Thumb	1
12	20816		Pointer, Index	1
13	39088		Wheel, Thumb	1
14	39090		Arc, Cursor	1
15	55543A		Block, Mounting	1
16	55666		Scale, Arc	1
17	56494		Plate, Arc Mounting	1
18	56729A		Arc	1
19	T3-155		Knob, Clamp	1
20	T13-395		Shaft, Clamp Knob	1
21	T14-927		Pin, 3/16 x 5/8	1
22	T14A-122		Pin, Roll 1/8 x 1	1
23	T5-453		Spring, Pressure	1

FIG. 26 - COBALT, WEDGES AND COMPENSATOR ASSEMBLIES

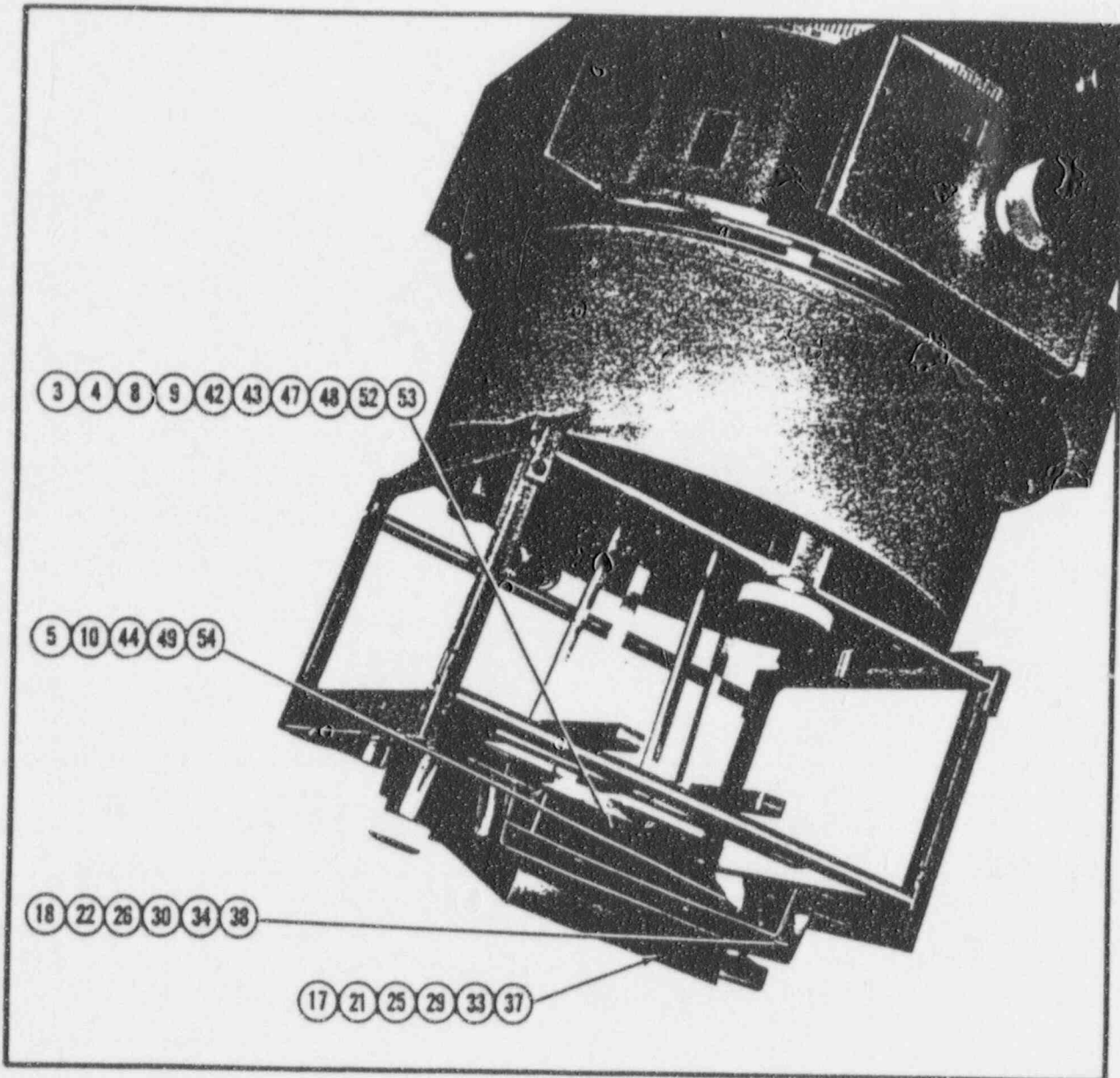


FIG. 26 - COBALT, WEDGES AND COMPENSATOR ASSEMBLIES

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
26 -	---		Wedges and Compensator Assemblies (See Fig. 1, Items 9, 10 and 11)	
1*	3021		Filter, Lead Wedge (45°) (See Fig. 1, Item 9)	1
2*	181651		Wedge Assembly, Lead (45°) 8°-14'	1
3	55614		Wedge, 8°-14', Lead (stamped "W1")	1
4	55624		Cover, Wedge	1
5	55611		Plate, Wedge Mounting	1
6*	T32-476		Decal	1
			*Not shown.	



FIG. 26 - COBALT, WEDGES AND COMPENSATOR ASSEMBLIES  
(continued)

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
26 -	---	(continued)		
7*	181651C		Wedge Assembly, Lead (45°) 6°-41'	1
8	55617		Wedge (45°), 6°-41' (stamped "W4")	1
9	55620		Cover, Wedge	1
10	55612		Plate, Wedge Mounting	1
11*	T32-479		Decal	1
12*	181858		Curve Set, Wedge Filter (45°)	1
13*	181858B		Curve Set, Wedge Filter (45°)	1
14*	181858E		Curve Set, Wedge Filter (45°)	1
15*	3021A		Compensator Assembly, Oblique (See Fig. 1, Item 10)	1
16*	181652		Compensator Assembly, Brass (45°)	1
17	55628		Compensator (45°) 10°-11' (stamped "C1")	1
18	55626		Plate, Compensator Mounting	1
19*	T32-481		Decal	1
20*	181652A		Compensator Assembly, Brass (45°)	1
21	55629		Compensator (45°) 8°-38' (stamped "C2")	1
22	55626		Plate, Compensator Mounting	1
23*	T32-482		Decal	1
24*	181652B		Compensator Assembly, Brass (30°)	1
25	55630		Compensator (30°) 6°-8' (stamped "C3")	1
26	55626		Plate, Compensator Mounting	1
27*	T32-483		Decal	1
28*	181652C		Compensator Assembly, Brass (30°)	1
29	55631		Compensator (30°) 5°-12' (stamped "C4")	1
30	55626		Plate, Compensator Mounting	1
31*	T32-484		Decal	1
32*	181652D		Compensator Assembly, Brass (30°)	1
33	55632		Compensator (30°) 4°-12' (stamped "C5")	1
34	55627		Plate, Compensator Mounting	1
35*	T32-485		Decal	1
36*	181652E		Compensator Assembly, Brass (45°)	1
37	55633		Compensator (45°) 7°-18' (stamped "C6")	1
38	55627		Plate, Compensator Mounting	1
39*	T32-486		Decal	1
40*	3021B		Filter, Lead Wedge (60°) (See Fig. 1, Item 11)	1
41*	181651A		Wedge Assembly, Lead (60°) 13°-58'	1
42	55615		Wedge, (60°) 13°-58' (stamped "W2")	1
43	55623		Cover, Wedge	1
44	55611		Plate, Wedge Mounting	1
45*	T32-477		Decal	1
46*	181651B		Wedge Assembly, Lead (60°) 15°-28'	1
47	55616		Wedge, (60°) 15°-28' (stamped "W3")	1
48	55620		Cover, Wedge	1
49	55611		Plate, Wedge Mounting	1
50*	T32-478		Decal	1
51*	181651D		Wedge Assembly, Lead (60°) 11°-32'	1
52	55618		Wedge (60°) 11°-32' (stamped "W5")	1
53	55622		Cover, Wedge	1
54	55612		Plate, Wedge Mounting	1
55*	T32-480		Decal	1
*Not Shown				

FIG. 27 - COBALT, WALL MOUNTED LIGHTS  
Part No. 3595C

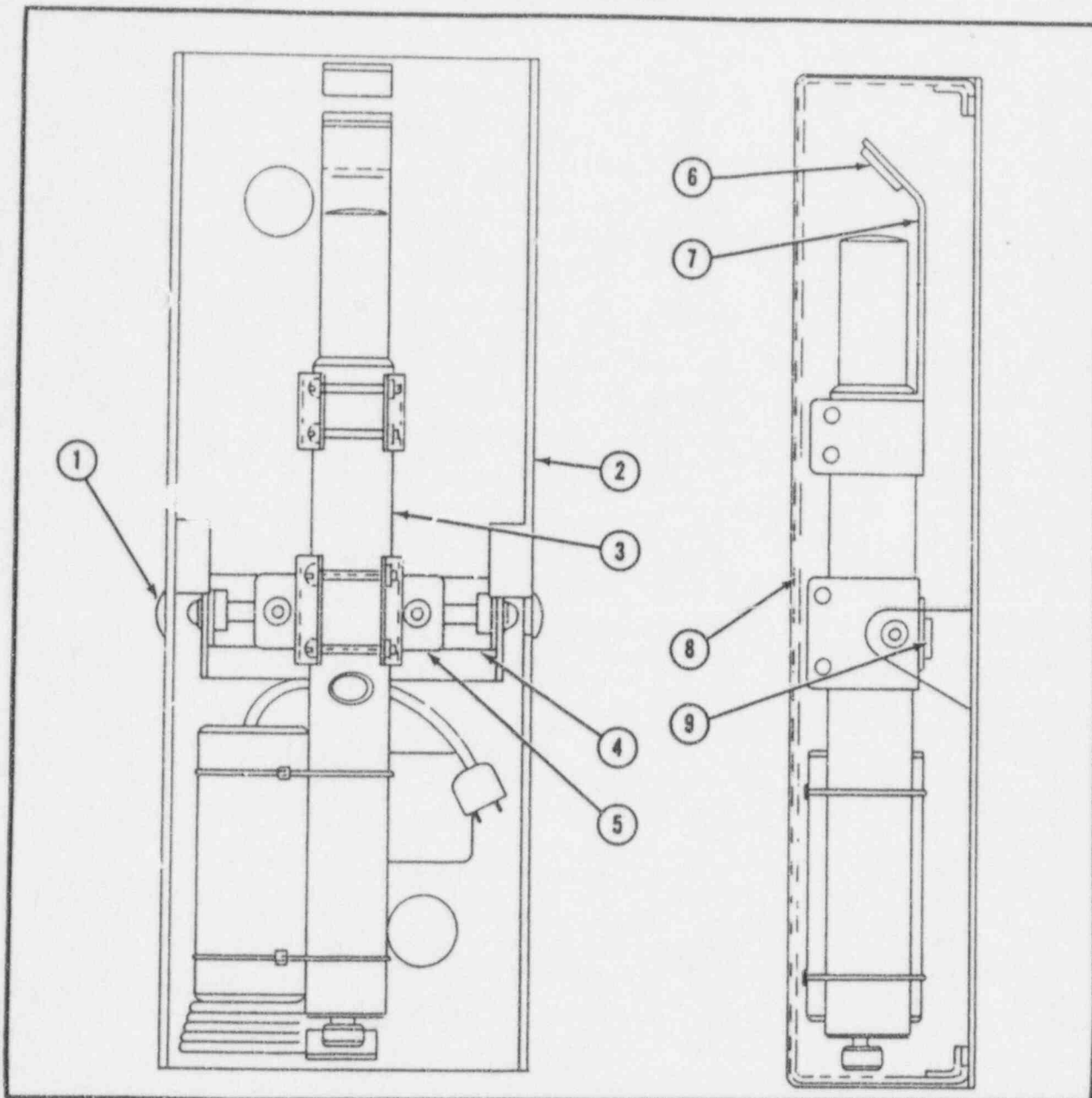
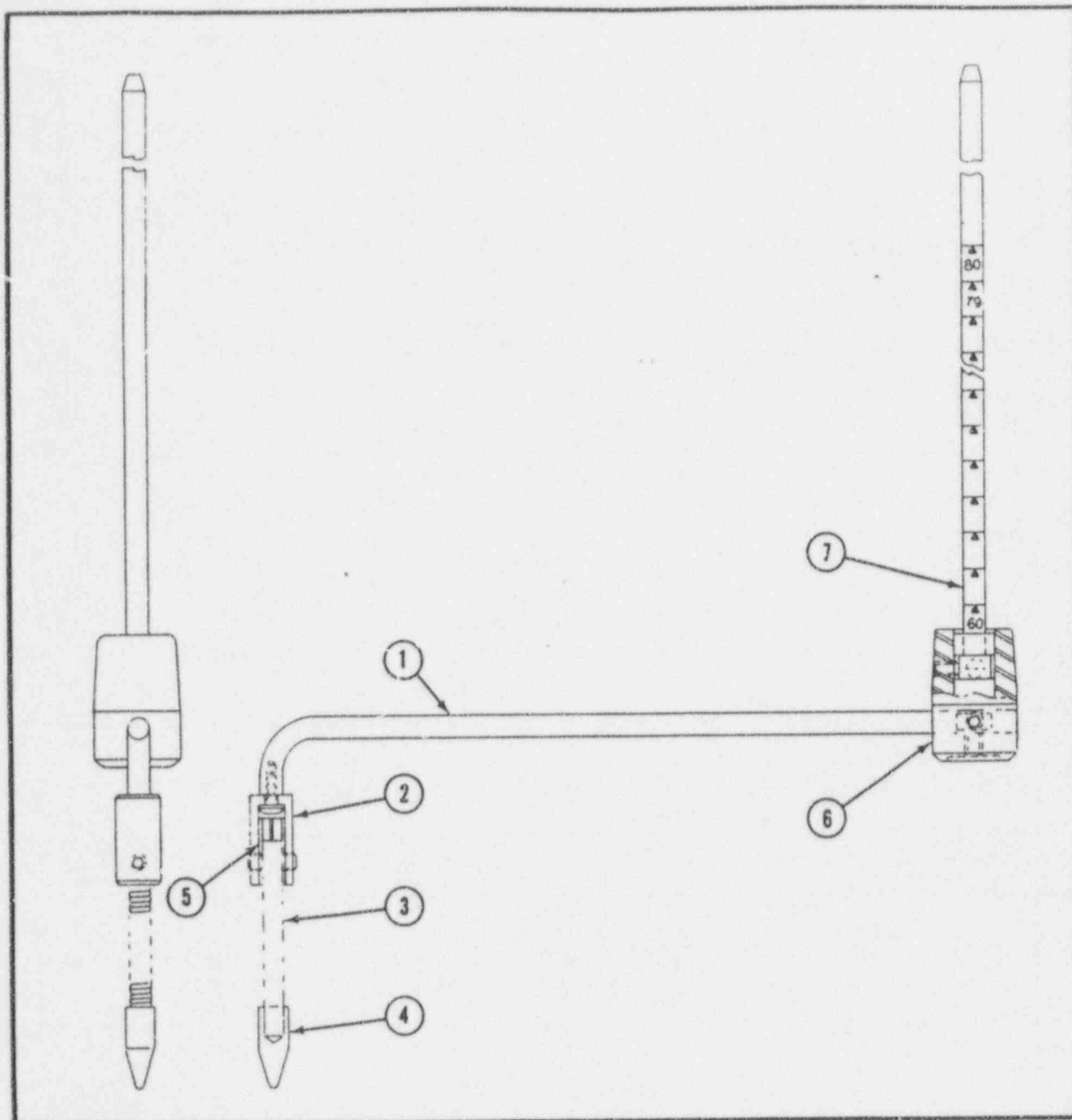


FIG. 27 - COBALT, WALL MOUNTED LIGHTS  
Part No. 3595C

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
27 -	3595C	Lights, Wall Mounted Position (See Fig. 1, Item 12)		Ref.
1	T30-140		Button, Plug	2
2	181637		Container, Light	1
3	44557		Pointer, Spot Light	1
4	181626		Bracket, Adj.	1
5	181635		Bracket, Mounting	1
6	T87A-20		Mirror	1
7	46874		Support, Mirror	1
8	56100		Cover, Box	1
9	56096		Plate, Nut	1

FIG. 28 - COBALT, FRONT-FINAL POINTER ASSEMBLY  
Part No. 181560



41

FIG. 28 - COBALT, FRONT-FINAL POINTER ASSEMBLY  
Part No. 181560

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
28 -	181560		Pointer Assembly, Front-Final (See Fig. 1, Item 14)	Ref.
1	55925		Arm, Pointer	1
2	55926		Bushing, Adapter	1
3	T5-664		Spring	1
4	55927		Tip, Pointer	1
5	55928		Bushing, Split	1
6	55962		Adapter, Arm-to-Pointer	1
7	181586		Arm Assembly, Scale	1

FIG. 29 - COBALT, SCALE POINTER MOUNTING ASSEMBLY  
Part No. 181564

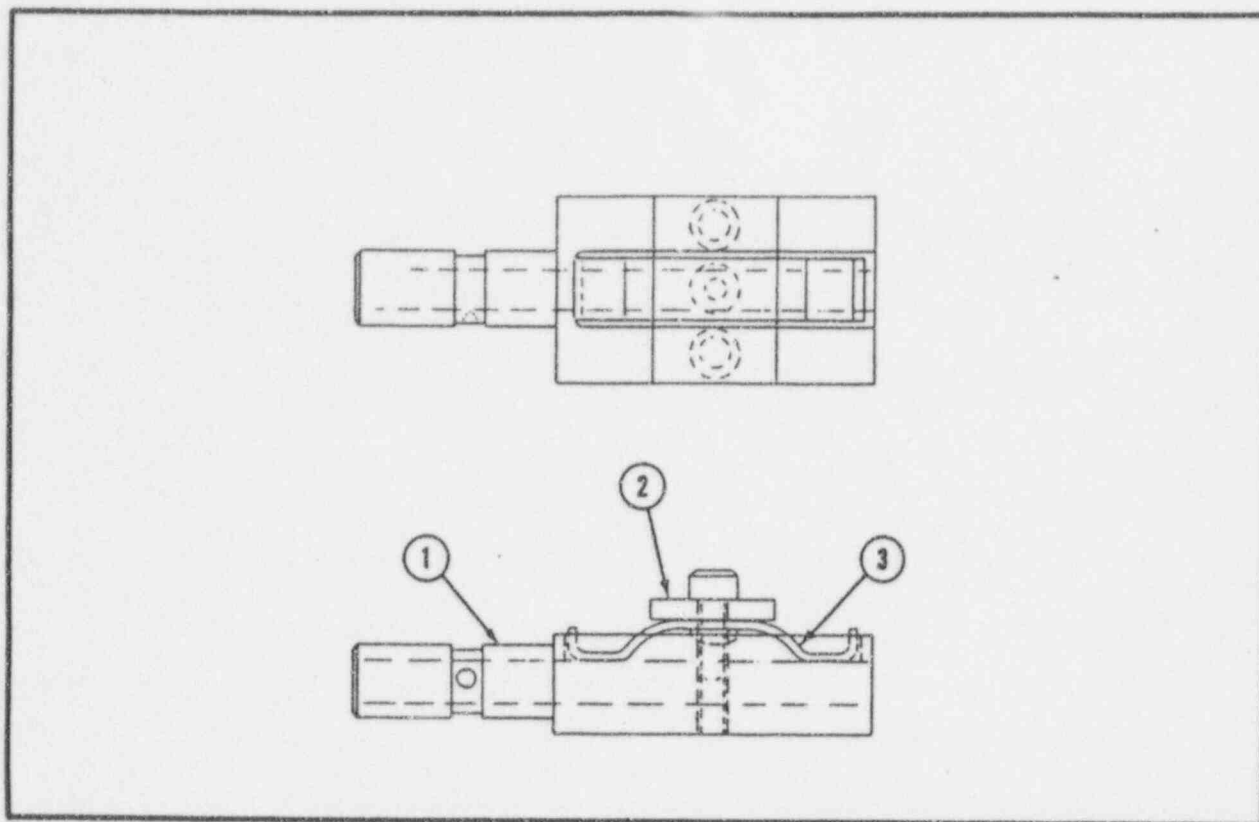
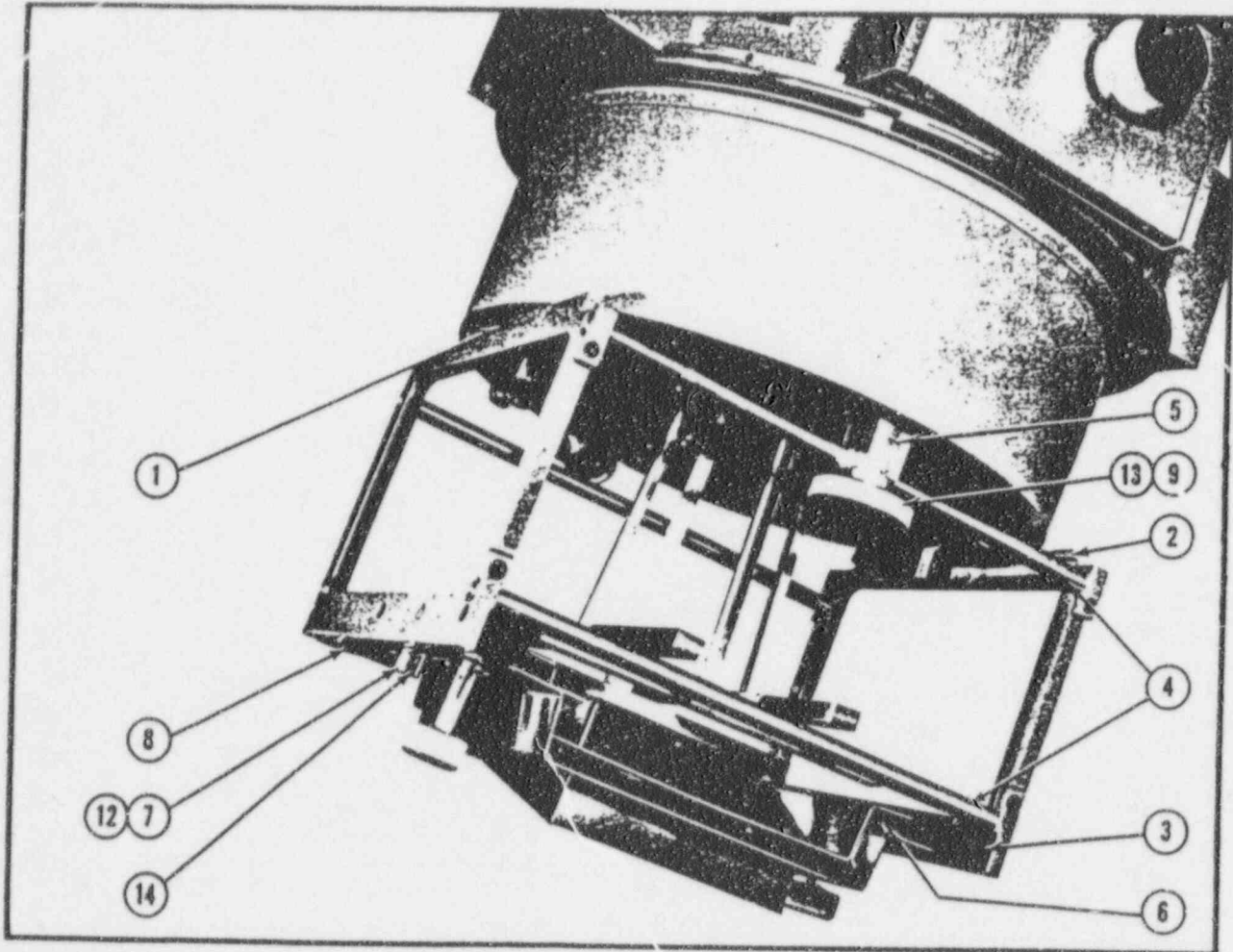


FIG. 29 - COBALT, SCALE POINTER MOUNTING ASSEMBLY  
Part No. 181564

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
29 -	181564		Mounting Assembly, Scale Pointer (See Fig. 1, Item 15)	1
1	181764		Pointer Assembly, Sleeve	1
2	T4-426		Nut Plate	1
3	T5-665		Spring, Pressure	1

FIG. 30 - COBALT, ACCESSORY MOUNTING PLATFORM ASSEMBLY  
Part No. 3754A

H59:P



43

FIG. 30 - COBALT, ACCESSORY MOUNTING PLATFORM ASSEMBLY  
Part No. 3754A

FIG & ITEM	PART NO.	1 2 3 4 5	DESCRIPTION	QTY
30 -	3754A		Platform Assembly, Accessory Mounting (See Fig. 1, Item 19)	Ref.
1	55654		Side Plate, Platform	1
2	55654A		Side Plate, Platform	1
3	55653		End Plate, Platform	2
4	55650		Bar, Connecting	4
5	55651		Block, Tie-Down	1
6	55652		Nose, Accessory Clamp	2
7	55648		Screw, Accessory Clamp	2
8	55649		Handle, Accessory Clamp	2
9	T13-396		Stud, Clamp	1
10*	T22-165		Truarc, 1/4" Shaft	2
11*	T14A-122		Pin, Roll, 1/8 x 1	2
12	T2-516		Plunger, Spring 10-32 x 9/16	2
13	T3-155		Knob, Clamp	1
14	T14A-148		Pin, Dowel (3/16 x 5/8)	2
*Not shown.				



# ADVANCED MEDICAL SYSTEMS OPERATING PROCEDURE

## SOURCE INSTALLATION AND EXCHANGE PROCEDURES USING CATALOG 3320-3320 AR LOADING AND EXCHANGE CONTAINERS AT AUTHORIZED THIRD PARTY FACILITIES

ISP-18 Rev. 1/95

Page 1 of 24

- 1.0 PURPOSE: To provide a procedure for the safe transfer or exchange of high output Cobalt 60 sealed sources at authorized third party facilities.
- 2.0 PRECAUTIONS AND LIMITATIONS:
- 2.1 This procedure is applicable to source transfers or exchanges performed at customer sites on a variety of Picker and AMS manufactured teletherapy/radiography equipment.
  - 2.2 This procedure requires two (2) individuals, a Class 1 Service Engineer and an assistant. The Class 1 Service Engineer has been specifically approved by the NRC to perform this procedure. The person assisting must be agreeable to the task and have received Part 19.12 training for this procedure.
  - 2.3 Sources should be exchanged only by, or in the physical presence of, persons specifically licensed by the NRC or an agreement state to perform these operations.
  - 2.4 An individual licensed to perform source exchanges may perform only those operations described in the procedures.

---

Prepared by: Robert Meschter

Approved by: *R Meschter*

Date: 1-24-95

---

- 2.5 The person making the exchange is obligated to refuse to make an exchange should any condition or action present a situation wherein the exchange cannot be made within the limitations of these procedures.
- 2.6 Prior to the commencement of the operations outlined in this procedure, the licensee for whom the exchange is being performed will relinquish control over the use of, and the keys for, the equipment and its Controlled Areas to the licensed person performing the exchange. At such time as the source has been exchanged, and it has been determined by the licensed person performing the exchange that the equipment is in safe operating condition, control of the equipment and Controlled Areas will be returned to the licensee.
- 2.7 At certain times during this procedure (specifically during the actual source transfer), the Class 1 Service Engineer will be alone in the room. During these periods, it is important that communication between the engineer and assistant be maintained.
  - a. Visual communication may be possible by utilizing the closed circuit television equipment that is often installed in the room.
  - b. Audio communication may be possible by utilizing an intercom system.

### 3.0 INSTRUCTIONS:

#### 3.1 Equipment Required

- 3.1.1 The following equipment is either shipped with the 3320/3320AR exchange container or hand carried to the job site:

- 1 - Audible Detector
- 1 - Victoreen 491 (or equivalent) survey meter
- 1 - Nuclear Associates Minimonitor II (or equivalent) survey meter
- 2 - 200mR Pocket Dosimeters
- 2 - 5R Pocket Dosimeters
- 1 - Dosimeter Charger
- 1 - Drawer "T" Handle
- 2 - Pair Disposable Gloves
- 1 - Pushrod Extension
- 1 - Swivel for Pushrod Extension
- 1 - Spring Loaded Pushrod Support

- 1 - Brass Head to Container Adapter
- 1 - Service Manual for specific unit
- 1 - Cable hoist, hand ratchet type (1/2 ton capacity minimum)
- 1 - Sling
- Generous supply of paper towels, plastic bags and masking tape
- Hand tools, as required
- Hardware, as required
- Shipping tags, labels and placards, as required

3.1.2 The following additional equipment is shipped only as needed:

- 1 - Hanger pull
- 1 - Collimator Lifting Fixture, service tools
- 1 - Head Tilting Wrench
- 1 - Head Bearing Locking Screws
- 1 - 1/2" Impact Wrench

### 3.2 Inspection and Source Exchange Container

NOTE: This procedure is to be followed once the source exchange container (SEC) has been removed from the shipping overpack.

3.2.1 Check the container for any signs of mishandling or damage.

- a. If any damage is noted, immediately check for radiation leakage and contamination as outlined in Step 3.2.2.
- b. If determined to be safe, take whatever action is necessary to repair the damage.
- c. If the damage presents a safety hazard, call the Chairman of the Isotope Committee or the Radiation Safety Officer (RSO) for advice or assistance.

3.2.2 Perform a radiation survey of the container to determine if any point reads more than ten (10) mR/hr at one (1) meter.

- a. If any point exceeds 10mR/hr at 1 meter, something is wrong.
- b. Proceed carefully to find the cause, avoiding exposure to high radiation levels.

- c. If the radiation level on the surface of the container is more than one (1) R/hr at any point, do not, under any circumstances, proceed without consulting with the Chairman of the Isotope Committee and/or the RSO.

- 3.2.3 Remove the bottom plate, the drawer cover plate and the top cover plate. Next, lift out the plug in the top cavity, wet smear the plug and replace the plug.

CAUTION: Keep away from the open top cavity as a highly collimated beam of radiation (10-100R/hr) is emitted when the plug is removed.

- 3.2.4 If any wet smear, after drying, indicates greater than 200 cpm above background, notify the RSO before proceeding.

- 3.2.5 Verify that the container is level and the bottom most part of the skid is between 11-3/4 inches and 12 inches above the floor.

### 3.3 Preparation of Unit for Source Exchange

- 3.3.1 Over the years, Picker and AMS have manufactured a variety of equipment involving various designs of source heads, collimators and stands, making available a large number of combinations. Refer to the appropriate manual for the unit being worked on. This procedure will deal with the handling of individual components.

- 3.3.2 Lock source shutter mechanism (shutter wheel) in the "beam off" position. See appropriate unit manual for locking instructions.

- 3.3.3 Remove the collimator (performing wet smear checks as indicated).

CAUTION: Removing a collimator creates an imbalance in the unit. Take precautions as outlined in the appropriate unit manual.

a. 3313 Series

This collimator weighs about 500 pounds. It should be maneuvered onto a soft pad on the floor or onto a "dolly" capable of handling the weight. The dust shield is part of the machine head, so no preliminary contamination check is necessary before removing.

b. 3347 Series

Take a wet smear of the periphery of the collimator bearing ring before removing. This collimator can be installed or removed in either one piece (200 lbs.) or in two pieces (100 lbs. each).

c. 3706 Series and 183435 Collimator

The collimator (but not the collimator bearing ring) may be removed before contamination check is made.

Perform a wet smear contamination check of the periphery of the collimator bearing ring before removing.

3.4 Prepare Machine Heads

3.4.1 Model #581, #581A, #581B Heads.

- a. After collimator removal, pierce a small hole in the port dust shield through which a cotton swab stick can pass.
- b. Take a wet smear contamination check.
- c. Remove the dust shield and lead port block.
- d. Insert the proper "head to source exchange container" adapter.



3.4.2 Model #583, #583A, #583B, #590, #590A and #590B Heads.

- a. Remove "saddle" (where applicable) and take a wet smear of the exposed surface of the source wheel.
- b. Place the appropriate "head to container" adapter on the container.

3.4.3 Model #590C, D, E, F, G and 182972A Heads.

CAUTION: Radiation leakage may be several R/hr on the bottom surface of the head when the collimator bearing ring is removed.

- a. Insert the brass head-to-container adapter into the doughnut, align the center hole and secure together.
- b. Immediately after the removal of the collimator and bearing ring, mount the doughnut to the bottom of the head. This will reduce the radiation leakage greatly and help to offset the imbalance condition.

### 3.5 Maneuver Head to Mate with Source Exchange Container

3.5.1 Model C-5000 and V-2000 Vertical-Spring Counterbalance Units.

- a. Lock the yoke and head tilt movements. The stand will operate electrically and manually in the unbalanced condition.
- b. Maneuver exchange container under head and lower head electrically until it is close to mating. Manually lower head until mated.

3.5.2 Model V-3000, V-4, V-8, V-9, V-10,000 - Vertical Weight Counterbalanced Units.

- a. These units are delicately balanced and the head will rapidly rise to its upper limit if the collimator is removed without a restraining device. To prevent this rise, attach a cable hoist to the right side of the unit.

- b. Remove the shrouds from the stand and then remove one of the 1/2-13 bolts holding the side columns to the base plate.
- c. Using a longer 1/2-13 bolt, bolt the special sling provided in the kit to the column with the bolt through both loops in the ends of the sling.
- d. Electrically lower the head as far as it will go.
- e. Connect a cable hoist on the right hand side (viewing from the front) of the column between the sling and the top edge of the head support hanger.
- f. Pull up on the hoist until it is snug.
- g. The collimator may now be removed.
- h. The head may be raised and lowered to mate with the container by using the cable hoist.

3.5.3 Model C-1000, C-2000, C-3000 Rotational - Magnetic Clutch Drive Units.

- a. The magnetic clutch on the C-arm drive on these units will safely hold the C-arm in the vertical position after the collimator has been removed.
- b. Engage the magnetic clutch.
- c. Have assistant lend his weight to balance C-arm. Momentarily releasing magnetic clutch, rotate the C-arm so that the head is in the 12 o'clock position. Re-engage clutch.
- d. Attach the appropriate "Head Tilting Wrench".
- e. Remove the shroud from the left foot of the unit and attach cable hoist between left foot and C-arm behind head.
- f. Have assistant maintain head tilting wrench horizontal. Unlock head bearing ring or yoke brake, drive or lock.

- g. Take up on cable hoist lowering head to about 9 o'clock position. Maneuver container under head, insert proper adapter and mate.

3.5.4 Model C-4, C-8, C-9, C-10,000 and C-12 Rotational Chain or gear Driven Units.

- a. These units can be maneuvered electrically after the collimator has been removed. Move unit in short arcs, adjusting head each time to keep bottom surface of head horizontal. Care must be taken not to damage yoke motor during mating operation. Move slowly.
- b. Secure the head to the container.

3.5.5 Model C-10,000 Rotational - Chain or Gear Driven - Fixed Yoke.

- a. The head must be removed from this unit to mate it with the container.
- b. With the head at the 6 o'clock position, secure the yoke to hinge brackets on each side of the bed frame with chains or cable hoist. This is to keep the unit in "O" position. Using the special collimator lifting fixture and a gantry, remove the collimator and set aside on a soft pad.
- c. Take a wet smear.
- d. Mount special head lifting fixture to flat surface of head. Attach gantry hoist.
- e. Remove head mounting bolts and index pins.
- f. Lift head out of yoke and set on floor.
- g. Attach lifting ears. Remove lifting fixture. Rotate head 180 degrees so that flat side is down.
- h. Fix ears so head will not rotate. Lift head, insert proper adapter, and mate to container.

3.5.6 Cyclops Hydraulic Mobile and Jib Crane Stands.

- a. These units can be maneuvered electrically in the unbalanced (collimator off) condition.
- b. Mate head to container using proper head to container adapter.
- c. Secure the head to the container.

3.5.7 Fixed Head Rotational Magnetic Clutch Drive.

- a. Remove the stand covers from one side. The head will be at 5 o'clock or 7 o'clock during this operation. If at 5 o'clock, remove left hand covers. If at 7 o'clock, remove the right hand covers.
- b. Check the stand to floor mounting bolts for tightness. If they are not tight, the unit could tip over during this procedure.
- c. Remove shutter motor access cover from above and behind the head.
- d. Remove the transformer and the cover and disconnect it from the terminal board.
- e. Remove all the wires coming up from the slip rings to the terminal board.
- f. Remove the stainless trim covers from the back of the head and disconnect the wires from the mercury switches and distance localizer assembly.
- g. Construct a wood cradle to hold the head.
- h. Swing the head around to the 5 o'clock position and position the head in the cradle (using padding to protect paint). Set the wheels of the dolly so that it can be pulled straight out away from the stand after the head is unbolted.

- i. Place a 4,000 lb. come-along hook into the top of the C-arm access hole. The other hook of the come-along is fastened to the outside of the left toe. If the 7 o'clock position of the head allows more room for this procedure, the come-along is fastened to the right toe.
- j. Take up on the come-along until the head rests firmly in the cradle. The come-along will prevent the barrier from swinging down once the head is removed.
- k. Remove the allen screws holding the head to the ring to separate the head from the stand. When loosening the last two bolts, watch to see if the come-along tension is right. This is done by watching to see that the C-arm barrier are rigid and that the head is snug in the cradle.
- l. In addition to the bolts that hold the head to the C-arm, there are two 3/8 inch centering pins holding the head. Use two screwdrivers to separate the head and C-arm.
- m. The head is now pulled away from the C-arm. Pull from the dolly and not from the head or cradle. Pull the dolly straight out, or the motor assembly will be damaged. Move to an area out of the swing of the C-arm and barrier.
- n. Replace the fixed head mounting ring with the rotating head mounting bearing ring and remount head. The unit can now be treated as a standard C-2000 unit with rotating head.
- o. After the source exchange is completed, reverse the procedure, and remount the fixed head mounting ring.



3.6 Source Exchange Procedure Using Model 3320 AR Exchange Container

3.6.1 Perform and record a radiation leakage measurement on the surface of the top of the head. Mark the location for future reference.

3.6.2 Remove the 1/4-20 screw and square brass insert holding the bottom end of the pushrod in position. Install the pushrod extension onto the lower end of the pushrod by using a 10-32 x 1" socket head cap screw. Test for free movement of the pushrod by turning. If any binding is noticed, the screw holding the pushrod extension to pushrod is either not in far enough or is too long. The pushrod should have about 2" free vertical movement.

3.6.3 Insert the shaft of the "T" handle into the coil spring and screw this assembly all the way into the plunger, then back it out two (2) full turns. Mark the lower side of the drawer. When exchange is complete, this mark should be uppermost.

CAUTION: Do not loosen the drawer stop and pull out the drawer at this time, as this will greatly increase the radiation leakage above the container.

3.6.4 Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.

3.6.5 Remove the shutter lock.

3.6.6 At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

3.6.7 Loosen drawer stop screw.

CAUTION: Do not remove entirely.

3.6.8 Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

3.6.9 Gently push the "T" handle in as far as it will go.

3.6.10 Raise the pushrod gently until it can be felt that the source is up against the plunger tongue. Maintain this raised position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. Lower pushrod.

3.6.11 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

3.6.12 Call to assistant to electrically open the shutter of the therapy head. The timer must be set at 30 minutes or more so that the shutter will not close during the exchange.

3.6.13 Gently raise the pushrod as far as it will travel, rotate it until its pins seat in the holes of the source capsule. (The swivel may be used for this.)

NOTE: If the pushrod will not engage the source, the shutter wheel is not in proper alignment. In this event, lower the pushrod and have the assistant close the shutter. Verify that room radiation levels are safe. Have the assistant come into the room, with the control key, and position himself above the therapy head. From this position, as directed by the source exchanger, he can manually open the shutter and adjust the stop when the pushrod engages the source.

CAUTION: The assistant should be warned to keep all portions of his body above the head to container junction.

3.6.14 Keeping a firm upward pressure on the pushrod, unscrew the old source.

- a. If the old source is tight and will not unscrew with one hand pressure, place the spring loaded pushrod holder and the swivel between the pushrod and the floor.
- b. Adjust spring pressure so that it takes both hands to lift it off the floor when in place under the pushrod and swivel. This frees both hands for loosening the old source.
- c. If the source is still unmovable, a pipe wrench may be used on the pushrod.

NOTE: An impact wrench may also be utilized to break the source free. However, it should not be used to unscrew the source from the shutter.

3.6.15 After the source has been loosened, remove the pushrod holder again hold in place by hand. Unscrew source at least five (5) complete turns.

3.6.16 Turning the pushrod slightly, gently lower the pushrod to its bottom most position.

- a. If the source is completely loose and follows the pushrod down into the container, a noticeable flash of radiation will be detected by watching the gamma survey meter as the source passes the joint between the head and the container.
- b. In addition, an audible signal will be heard from the audible detector.
- c. If no "flash" is noticed, the source did not follow the pushrod down, and the operation of unscrewing and lowering should be repeated until successfully completed.

- 3.5.17 With two hands, gently push the drawer in until the scribe line is just visible.
- a. Unscrew the "T" handle two (2) full turns and release the new source from the plunger.
  - b. Lower pushrod to bottom most position (approximately 2" protruding from container).

- 3.6.18 Gently push the drawer into the innermost position. If necessary to close drawer, remove the pushrod extension.

NOTE: If pushrod pins are no longer in old source pinholes, the drawer will not close. Rotate pushrod to correct.

- a. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- b. Both sources are now safely stored in the exchange container and the radiation background should not be more than 20mR/hr at one (1) meter from the surface. Verify this with the survey meter.

- 3.6.19 Have the assistant close the shutter. Take possession of the shutter key.

- 3.6.20 Verify that the source has been removed from the head by surveying the top of the head.

- 3.6.21 If a Five Year Inspection and Preventive Maintenance is to be performed, proceed to perform the head and shutter related items at this time.

- 3.6.22 Once the head is reassembled, verify that the shutter mechanism is operating properly, then proceed to install the source.

3.6.23 Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector on this same position.

3.6.24 At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

3.6.25 Loosen drawer stop screw.

CAUTION: Do not remove entirely.

3.6.26 Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

3.6.27 Gently push the "T" handle in as far as it will go.

3.6.28 Re-install pushrod extension and raise the gently until it can be felt that the new source is up against the plunger tongue. Maintain this raised position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. Lower the pushrod and old source.



- 3.6.29 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

- 3.6.30 Rotate drawer 180 degrees in whichever direction it will turn (it will only turn in one direction). This puts the new source in the upper position.

- 3.6.31 Reach up with both hands and gently push drawer in until the scribed line is just visible.

- 3.6.32 Loosen "T" handle two (2) complete turns.

- 3.6.33 Raise the pushrod gently until it can be felt that the old source is up against the plunger tongue. Maintain this position and tighten the "T" handle until it stops. The spring tension of the "T" handle will hold the source in the plunger tongue. At this point, both the old and new sources are in the drawer plunger tongue.

- 3.6.34 Reach up with both hands and gently pull drawer out until it stops.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

- 3.6.35 Rotate drawer 180 degrees in whichever direction it will turn (it will only turn in one direction). This returns the new source to the bottom position.

- 3.6.36 Again reach up with both hands and gently push drawer in until the scribed line is just visible. This places the new source over the pushrod so that it may now be removed from the drawer plunger tongue. At this point, the mark that was put on the drawer when the exchange was started should again be in the original position.

3.6.37 Raise the pushrod gently until it touches the source in the drawer tongue. Rotate pushrod until the pins seat.

a. While holding the pushrod in this position, loosen the "T" handle two (2) complete turns. The source will then be released and will follow the pushrod down when it is lowered.

b. Lower the pushrod. Again tighten the "T" handle to the limit. The new source is now resting on the pushrod.

3.6.38 Reach up with both hands and gently pull drawer out until it stops. Do not rotate drawer 180 degrees.

CAUTION: If drawer does not stop before 4-1/2 inch withdrawal, something is wrong and the drawer must be pushed back in.

3.6.39 Have assistant open the shutter.

3.6.40 The path to the shutter wheel is now clear for the new source. Gently raise the pushrod until the new source touches the shutter wheel. A flash of radiation will again be noticed on the meter as the source passes the joint between the head and the container. Maintaining a firm upward pressure, turn the pushrod in a tightening direction until the source has turned at least three and a half turns and becomes as tight as possible using one hand on the pushrod cross handle. Now lower the pushrod to the bottom most position. There should be no flash of radiation noticeable on the meter if the source is threaded in the shutter wheel.

3.6.41 Have assistant close the shutter. The radiation level showing on the survey meter should drop considerably when the shutter is closed.

- 3.6.42 Reach up with both hands and gently rotate the drawer 180 degrees in whichever direction it will turn. This puts the old source in the bottom position. Now push the drawer inward until the scribe line is just visible.
- 3.6.43 Lift the pushrod gently until it touches the source in the drawer tongue.
- a. While holding the pushrod in this position, loosen the "T" handle two (2) complete turns. The source will then be released and will follow the pushrod down when it is lowered.
  - b. Lower the pushrod.
- 3.6.44 Gently push the drawer into its innermost position. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- 3.6.45 Remove the 10-32 x 1" cap head screw holding the pushrod extension to the pushrod. Raise the pushrod and insert 1/4-20 hex head screw and brass block. This secures the pushrod in its shipping position.
- 3.6.46 Attach the shutter locking bar.
- 3.6.47 Take possession of shutter operating key.
- 3.6.48 Perform a radiation leakage survey at the top surface of the head as previously marked. If the sources have been properly exchanged, this reading should be higher than the original reading.
- 3.6.49 Unmate the head from the container.
- CAUTION: Keep body as far as possible from the open top cavity. The radiation levels in this area may be 10 to 100R/hr.
- 3.6.50 Remove adapter and insert plug into the container cavity.

- 3.6.51 Reinstall collimator to head.
- 3.6.52 Perform Beam Off Head Leakage Survey using appropriate data sheet. The average leakage shall not be greater than 2mR/hr at one (1) meter from the source, with no single spot exceeding 10mR/hr.
- 3.6.53 Complete the Five Year Inspection and PM.

### 3.7 Source Exchange Procedure for 3320 and 3320B Containers

NOTE: The Model 3320 container has only one source cavity and can be used only for loading and unloading a source.

The Model 3320B container is to be used for removing or loading a single Cesium source only.

The Picker Model 3320 and 3320 AR containers are easily converted to Model 3320B containers by replacing the Cobalt pushrod with a Cesium pushrod.

- 3.7.1 Inspect shipping container as per Step 3.2.
- 3.7.2 Prepare Model 592 machine head for source transfer.
  - a. Remove beam defining device (cone) per instructions in Section 8 of Picker Manual T55-226.
  - b. Perform a wet smear contamination check of the inner most diaphragm of the "cone" holder.
  - c. Lock the head in the upright position by using the lever on the right hand trunnion (see Figure 3, Manual T55-226).
  - d. Remove the decorative covers.

- e. Remove cone holder (see Figure 8, Manual T55-266).

CAUTION: When cone holder is removed, the radiation leakage will increase in this area to as much as 300mR/hr. Do not stand or place hands unnecessarily close to this area.

- f. Perform a wet smear contamination check of exposed section of shutter wheel.

- g. Install head to container adapter.

3.7.3 Remove the shipping container top cavity plug.

3.7.4 Move the shipping container under the head.

3.7.5 Lower the head, maneuvering the container so that the head to container adapter enters the container top cavity. Lower until firmly seated. Secure machine head to exchange container.

3.7.6 Evacuate the room and turn source to "ON" position to make sure shutter works electrically. Close shutter.

3.7.7 Source Removal.

- a. Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.

- b. Remove the shutter lock.

- c. At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.



NOTE:

The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

- d. Loosen drawer stop screw.

CAUTION: Do not remove entirely.

- e. Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

- f. Raise pushrod until it touches shutter wheel, then lower about 1/2 inch.
- g. Have assistant open the shutter and note the meter reading.
- h. Raise pushrod until it touches the source.
- i. Rotate until it engages the source.
- j. Keeping firm upward pressure, rotate the pushrod to unscrew right hand threaded source, three and a half turns (3-1/2) or more.
- k. If the old source is tight and will not unscrew with one hand pressure, place the spring loaded pushrod holder and the swivel between the pushrod and the floor.

- l. Adjust spring pressure so that it takes both hands to lift it off the floor when in place under the pushrod and swivel. This frees both hands for loosening the old source.
- m. If the source is still unmovable, a pipe wrench may be used on the pushrod.

NOTE: An impact wrench may also be utilized to break the source free. However, it should not be used to unscrew the source from the shutter.

- n. Lower pushrod and source, noting the flash of radiation, indicated by the meter, as the source passes the point between the head and the container. When the source lowers into the container, the radiation level will drop significantly. If the level does not drop, it means the source has not been removed and lowered into the container. The removal sequence should be continued until the source is in the safe position in the container.
- o. Push the drawer into the container and secure drawer stop. Check the area with a survey meter to ensure all is safe.
- p. Unmate the machine head and container and insert lead plug into the container top cavity.
- q. Check the source cavity in head for contamination.
- r. Move the container a safe distance from the work area and proceed with repairs or maintenance on the head.

#### 3.7.8 Source installation.

- a. Remate head and container.

- b. Place a Minimonitor II gamma survey meter (or equivalent) on the floor within easy view, about two (2) feet from the container. Set to X10 scale (full scale 100mR/hr). Place an audible detector at this same position.
- c. Remove the shutter lock.
- d. At this point, give the shutter operating key to the assistant and have him and all non-assisting personnel leave the room. The assistant should take a survey meter with him in case an emergency entrance is necessary.

NOTE: The following operations to be performed by the Source Engineer should be done from the supine position with the body kept as close to the casters of the exchange container as is possible. At no time should any part of the body, except the hands and the forearms, be raised above the bottom edge of the source drawer.

- e. Loosen drawer stop screw.

CAUTION: Do not remove entirely.

- f. Pull the drawer out to scribed line (approximately 1/4 inch beyond the indexing groove). Twist drawer slightly to verify that the safety bolt is in place in the drawer groove.

CAUTION: If safety bolt is not in proper place, the drawer could be inadvertently removed and the source exposed.

- g. Have assistant open the shutter.

NOTE:

The path to the shutter wheel is now clear for the new source. Gently raise the pushrod until the new source touches the shutter wheel. A flash of radiation will again be noticed on the meter as the source passes the joint between the head and the container. Maintaining a firm upward pressure, turn the pushrod in a tightening direction until the source has turned at least three and a half turns and becomes as tight as possible using one hand on the pushrod cross handle. Now lower the pushrod to the bottom most position. There should be no flash of radiation noticeable on the meter if the source is threaded in the shutter wheel.

- h. Have assistant close the shutter. The radiation level showing on the survey meter should drop considerably when the shutter is closed.
- i. Gently push the drawer into its inner most position.
- j. Slip the drawer stop over the end of the drawer and tighten the screw holding it in place.
- k. Unmate the head from the container.

**CAUTION:** Keep body as far as possible from the open top cavity. The radiation levels in this area may be 10 to 100R/hr.

- l. Remove adapter.
- m. Reinstall cone assembly head.
- n. Perform Beam Off Head Leakage Survey using appropriate data sheet. The average leakage shall not be greater than 2mR/hr at one (1) meter from the source, with no single spot exceeding 10mR/hr.
- o. Complete the Five Year Inspection and PM.

# ADVANCED MEDICAL SYSTEMS OPERATING PROCEDURE

## RADIATION WORK PERMITS

ISP-29 Rev. 01/95

Page 1 of 6

1.0 PURPOSE: To provide instructions to personnel needed to prepare and use Radiation Work Permits (RWP). Radiation Work Permits are an integral part of AMS ALARA Program.

### 2.0 PRECAUTIONS AND LIMITATIONS:

- 2.1 Radiation Work Permits are written to inform workers of the radiological conditions and controls associated with work within Restricted Areas.
- 2.2 Each individual is responsible for following the RWP and keeping track of their dose.
- 2.3 The RSO or designee is responsible for ensuring that all Radiation Work Permits are prepared in accordance with this procedure.

### 3.0 INSTRUCTIONS:

#### 3.1 Types of RWPs

- 3.1.1 Job Specific RWP - This type RWP is to be used for all entries into Radiation Areas, Contamination Areas and for all work in Controlled Areas that involves radioactive materials. These RWPs will be prepared for each job and will be terminated immediately following the completion of the work.

---

Prepared by: Robert Meschter

Approved by: *R Meschter*

Date: 1-24-95

---



- 3.1.2 Extended RWP - This type RWP is to be used for all entries into Restricted Areas that do not require a job specific RWP. This type RWP may also be used for repetitive jobs such as routine surveys, training, etc. These RWPs will be terminated at one (1) year intervals or sooner if radiological conditions change such that additional controls are needed.

### 3.2 Initiating a Radiation Work Permit

- 3.2.1 Any employee wishing to enter a Restricted Area of the facility should ensure that the entry is covered by a current RWP. If not, the employee can initiate an RWP by completing the Description and Location of Work section of the RWP, Form ISP-29B, and submit the RWP to the RSO or designee for completion and possible approval.
- 3.2.2 The RSO or designee will complete the RWP, including the ALARA review, and activate the permit by signing and dating the form. Each RWP will be consecutively numbered and entered in the RWP Tracking Log, Form ISP-29A.
- 3.2.3 Each person who enters an area under an RWP must read and sign the RWP Sign In Sheet, Form ISP-29C. Each person signing this sheet acknowledges that they have read and understand the RWP requirements and precautions.

### 3.3 Use of a Radiation Work Permit

- 3.3.1 Prior to entering the area, workers shall:
- a. Read and understand the RWP.
  - b. When appropriate, receive a prejob briefing from the RSO or designee.
  - c. Obtain radiation safety job coverage, if required.
  - d. Ensure sufficient exposure is available for the job.
  - e. Ensure they have met all the necessary precautions and have obtained the needed protective clothing and devices for the job.

3.3.2 During work, workers should:

- a. Periodically read their self reading pocket dosimeter unless exposure is being tracked by timekeeping methods.
- b. Wear protective clothing and devices properly.
- c. Maintain exposures ALARA.
- d. Stop work and exit the area if radiological conditions change significantly from those outlined in the RWP.

3.3.3 When exiting the area/job site, workers should:

- a. Leave the area in a clean and uncluttered condition by removing all tools and materials from the job site.
- b. Use proper techniques to minimize the spread of contamination, including proper removal of protective clothing and proper use of step-off pads.
- c. Perform a whole body frisk for personal contamination, paying particular attention to those areas of the body that could most likely become contaminated (hands, feet, face, knees, etc.).
- d. Report any personal contamination or unusual exposures to the RSO or designee.

3.4 RWP Termination

3.4.1 RWPs will be terminated by the RSO or designee:

- a. Upon completion of work.
- b. Upon expiration of the RWP.
- c. If the scope of work has significantly changed.
- d. If the radiological conditions have significantly changed.

## ISP-29A

ISP-29A

REVIEWED BY RSO: \_\_\_\_\_ DATE: \_\_\_\_\_

REVIEWED BY RSO: \_\_\_\_\_ DATE: \_\_\_\_\_

## RADIATION WORK PERMIT

ISP-29B

PERMIT NO.: \_\_\_\_\_  
EXPIRATION DATE: \_\_\_\_\_

JOB SPECIFIC - EXTENDED (CIRCLE)

DESCRIPTION AND LOCATION OF WORK: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### SURVEY INFORMATION

GENERAL AREA DOSE RATES (MR/HR): \_\_\_\_\_  
MAXIMUM ACCESSIBLE DOSE RATES (MR/HR): 2 \_\_\_\_\_  
REMOVABLE CONTAMINATION LEVELS (DPM/100CM<sup>2</sup>): \_\_\_\_\_

### ALARA REVIEW

ESTIMATED TOTAL DOSE: \_\_\_\_\_ ACTUAL TOTAL DOSE: \_\_\_\_\_  
PREJOB BRIEFING POSTJOB BRIEFING PERFORMED BY: \_\_\_\_\_  
DOSE REDUCTION TECHNIQUES TO BE EMPLOYED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### DOSIMETRY REQUIREMENTS

\_\_\_\_ TLD/FILM BADGE \_\_\_\_ FINGER RING \_\_\_\_ SRPD(200MR) \_\_\_\_ SRPD(1R) \_\_\_\_ SRPD(5R)  
\_\_\_\_ OTHER-SPECIFY: \_\_\_\_\_

### PROTECTIVE EQUIPMENT

\_\_\_\_ COVERALLS \_\_\_\_ LABCOAT \_\_\_\_ HOOD \_\_\_\_ RUBBER GLOVES \_\_\_\_ BOOTIES \_\_\_\_ RUBBERS  
\_\_\_\_ RESPIRATOR \_\_\_\_ TAPED SEAMS \_\_\_\_ RADIATION SAFETY COVERAGE \_\_\_\_ AIR SAMPLE  
OTHER PRECAUTIONS AND SPECIAL INSTRUCTIONS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

AUTHORIZED BY: \_\_\_\_\_

TERMINATED BY: \_\_\_\_\_







ALARON CORPORATION

THIS PROPOSAL RECEIVED BY  
FAX FEB 13, 1995.

SEE FEB 13, 1995 FOR  
COMPLETE PACKAGE.

CL019535

January 26, 1995

Mr. David Cesar  
Advanced Medical Systems, Inc.  
121 North Eagle Street  
Geneva, Ohio 44041  
(216) 466-4671

RE: ALARON PROPOSAL AR-MS-129426R1

Dear Mr. Cesar,

ALARON is pleased to resubmit to you the enclosed proposal. The proposal was developed based on information provided by and services requested of Mr. Bob Meschter. As you requested we have provided two options in the proposal.

If you have any questions, please do not hesitate to call me.

Sincerely,

Bradley S. Well, RRPT  
Manager, Field Services

cc: L. Sears  
J. Taylor  
File

B/25