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Docket No. 030-06870

Atomic Energy of Canada Limited
ATTN: J. T. Slobodian
Regulatory Affairs
413 March Road
P. O. Box 13500
Kanata, Ontario, Canada K2K1X8

Gentlemen:

Your application for Amendment No. 37 to the above referenced license contained an Operator's Manual for the Theratron 780-C which is copyrighted. All material submitted in support of license applications is reproduced in microform, and filed on our Document Control System (DCS). Copyrighted material cannot be so copied without the express permission of the copyright holder. (Proprietary information is generally not copied onto the DCS.) It is important that all material relevant to an application be available on the DCS. You have the following options:

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3. If it is impossible to furnish required information in any other way, and irreparable harm would result from public disclosure of the copyrighted material, a small amount of copyrighted material can be accepted as part of an application, and withheld from disclosure.

With respect to the Operator's Manual for the Theratron 780-C, please furnish either permission to copy or an explanation of why the material should be withheld. At the same time, please inform us of your decision on how you plan to handle this problem in the future.

Sincerely,

Original Signed By:
Laurence F. Friedman, Ph.D.

John E. Glenn, Ph. D., Chief
Nuclear Materials Safety Section B
Division of Nuclear Materials
Safety and Safeguards

"OFFICIAL RECORD COPY"

ML 10

THERATRON 780-C

OPERATOR'S MANUAL

NOVEMBER 1984
EDITION 1
Stock Number 2M003442

AECL MEDICAL
413 MARCH ROAD, P.O. BOX 13500,
KANATA, ONTARIO, CANADA, K2K 1X8
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RECORD OF REVISIONS

EDITION NO.	ISSUE DATE	PAGE NO.
	NOTE	
	The portions of the text affected by the changes are indicated by vertical lines in the outer margins of the pages.	
1	November 1984	Original Issue

UNIT DATA SHEET

This data sheet to be completed by installer and retained in this manual.

1. FACILITY:

   NAME: _____

   ADDRESS: _____
   _____
   _____

2. MODEL: T780-C

   PRODUCT NUMBER: G8500

   SERIAL NO.: _____

   DATE ACCEPTED BY CUSTOMER: _____

3. UNIT TYPE:

   BEAMSTOPPER ☐ PENDULUM ☐

   POTENTIOMETER ON UNIT:

   YES ☐ NO ☐

   TABLE:

   23 ☐ 27 ☐

   POTENTIOMETER ON TABLE:

   YES ☐ NO ☐

   TABLE TOP:

   SOLID TOP ☐ OPEN-SECTION ☐

   HAND CONTROL MOUNTING:

   OVERHEAD ☐ TABLE ☐

UNIT DATA SHEET (continued)

SPECIAL FACTORY MODIFICATIONS:

_____

_____

_____

4. RETROFIT KITS INSTALLED:

To be completed by installer.

Description and Number	Date	By

IMPORTANT NOTICE

Information contained in this manual is subject to change without notice.

Atomic Energy of Canada Limited, Medical Division (AECL MEDICAL), assumes no responsibility for the use or misuse of the equipment. Since AECL MEDICAL cannot control use of this equipment, they shall not be responsible for personal injury or damage resulting therefrom. The customer is advised to operate and maintain the equipment in accordance with the instructions contained herein, to observe all cautions and warnings, and to consult appropriate Local, State and Federal regulations.

AECL MEDICAL makes no warranty, either expressed or implied, including but not limited to any implied warranties of merchantability and fitness for a particular purpose, regarding this material and makes such materials available solely on an 'as-is' basis. In no event shall AECL MEDICAL be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of this material and the sole and exclusive liability to AECL MEDICAL shall not exceed the purchase price of this material. Moreover, AECL MEDICAL shall not be liable for any claim of any kind whatsoever against the user of this material by any other party.

DEFINITIONS

Warnings, cautions and notes are included in this manual as a means of bringing certain matters to the operator's attention.

WARNING

A WARNING is a statement describing known situations which could result in injury or death of personnel.

CAUTION

A CAUTION is a statement describing known situations which could result in equipment damage.

NOTE

A NOTE provides additional information about situations known to require special attention.

Various organizations and individuals are referred to in this manual.

COMPETENT AUTHORITY

A COMPETENT AUTHORITY is any regulatory organization having jurisdiction over the installation, operation and maintenance of the device, including its standard options and accessories.

LICENSEE

The LICENSEE is the person held responsible by the competent authority for the installation, operation and maintenance of the device, including its standard options and accessories.

AECL MEDICAL

AECL MEDICAL is Atomic Energy of Canada Limited, Medical Division, Kanata, Ontario, Canada.

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PART 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

The Theratron 780-C is a complete cobalt-60 teletherapy unit. It consists of a cobalt-60 source, rotating gantry and head assembly, adjustable collimator, treatment table, hand control and control console (Fig. 1.1 and 1.2).

During patient set-up, all system motions (Fig. 1.3) are controlled from the hand control in the treatment room or from unit mounted controls.

The control console is located outside the treatment room. In addition to a panel for entering treatment parameters, it features alarm and interlock systems. A keyswitch controls the power supply to the unit.

The Theratron 780-C may be operated in the following treatment modes:

- Fixed Therapy
- Rotation (moving beam) Therapy
- Skip Therapy
- Arc Therapy.

A brief description of the Theratron 780-C follows; controls are described in detail in Part 3.

1.1.1 Source

The source is a quantity of the metallic radioisotope, cobalt 60, sealed inside two stainless-steel capsules (one inside the other). Typically, the source is about 2.0 cm diameter by 1 cm to 3 cm long. The cobalt-60 atoms continuously and spontaneously "decay" to become nickel-60 atoms while emitting gamma radiation. This process has a "half life" of 5.26 years.

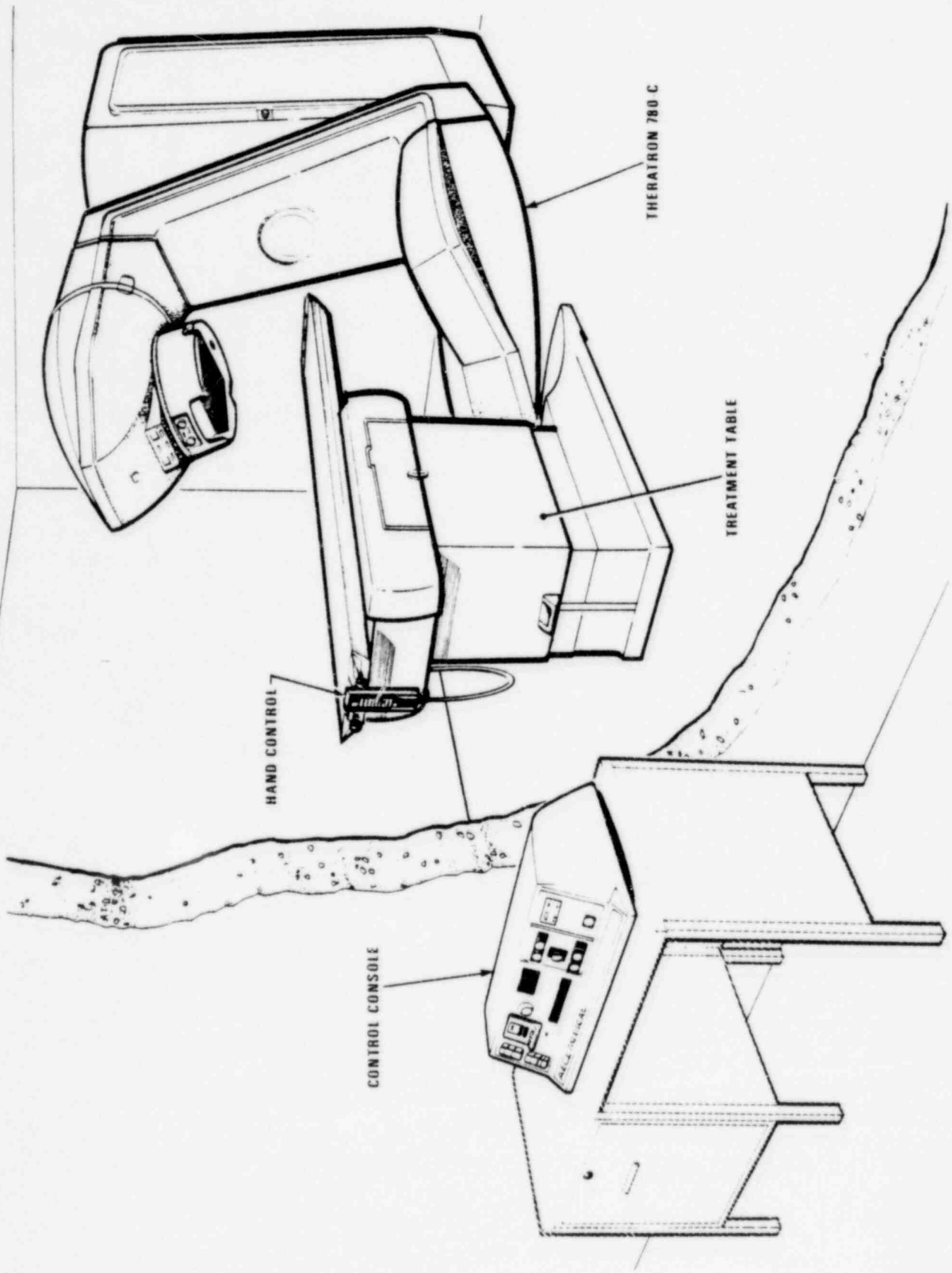

Fig. 1.1. Theratron 780-C System

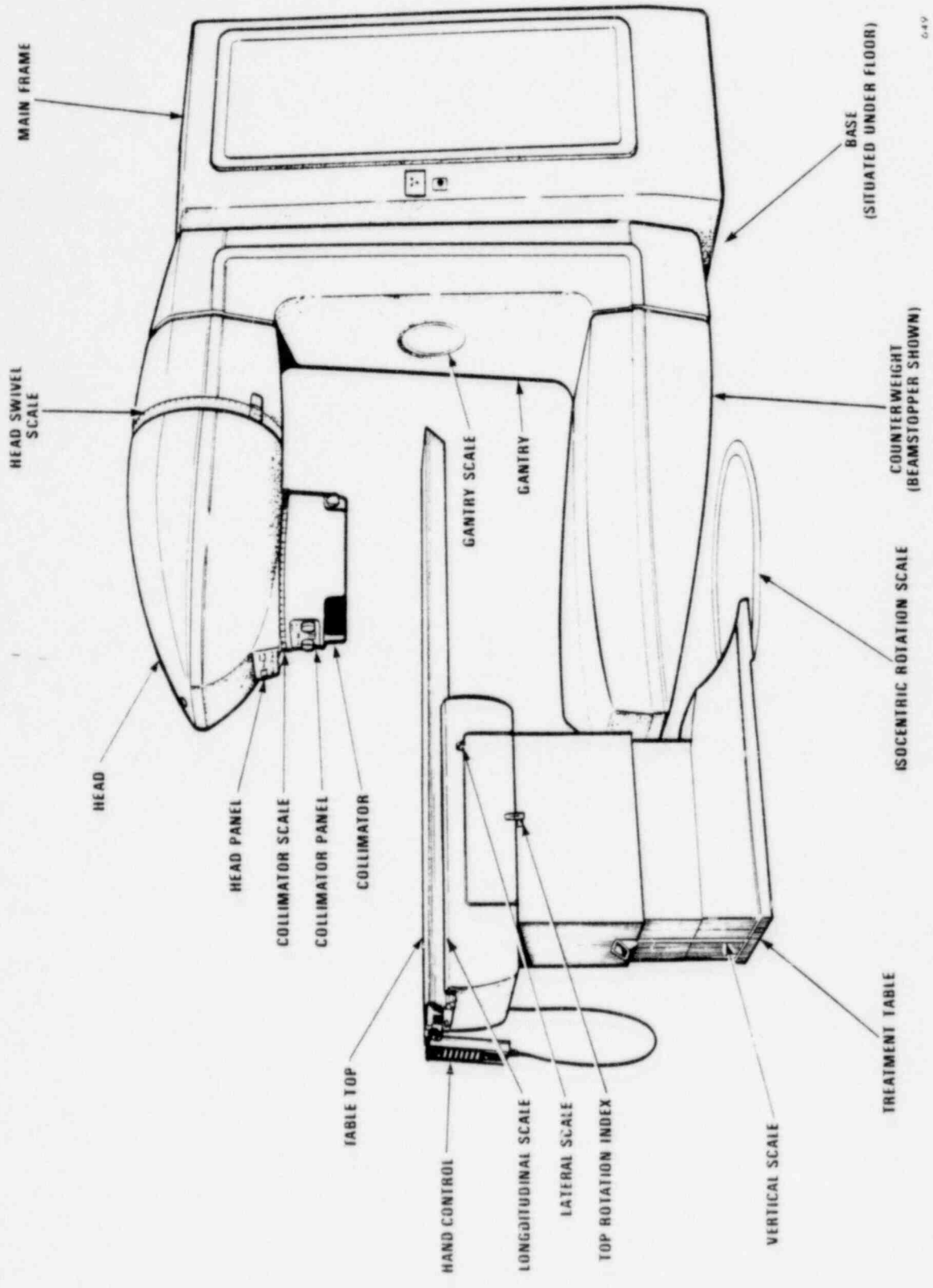

Fig. 1.2. Theratron 780-C Nomenclature

1.1.2 Head

The source is contained in a movable source drawer, which slides along a horizontal tube in the head. When the source is changed, the drawer is returned to the factory and a new drawer, complete with a new source, is inserted.

The head is a steel shell filled with a lead and uranium shield. At the source fully exposed position the shield has a conical opening, which contains the collimator. The source drawer is moved along the tube between the fully exposed and fully shielded positions by the piston of an air cylinder.

The air cylinder is controlled by two air valves which, under normal use conditions, do not permit the source to remain in the fully exposed position when the electrical power is cut off. If either, or both, of the valves should fail, the valves will return the source to the fully shielded position or will depressurize the system so that the source can be returned manually. The valves are operated by the treatment control system.

An auxiliary lock is provided to secure the source in the fully shielded position while the unit is shut down.

The head is mounted on bearings which allow it to swivel through an angle of 180 degrees in either direction from the HEADLOCK position. This motion can be locked when the collimator is pointing at the isocentre to assure isocentric accuracy.

1.1.3 Collimator

The collimator consists of two pairs of movable shields, called leaves. Each pair of leaves is aligned parallel, square and symmetrical about the collimator axis of rotation. Trimmers, with their distal edge 45 cm from the source, are attached to the leaves, they provide rectangular fields ranging from 5 cm square to 35 cm square at 80 cm from the source. In addition, 55 cm accessory trimmers, which provide an improved penumbra, are available.

The collimator is mounted on a precision bearing which permits 360 degree collimator rotation while providing accurate collimator alignment with the isocentre at all gantry angles.

Provision is made on the collimator for the mounting of various accessories.

1.1.4 Field Lamp and Optical Distance Indicator

When the source is in the fully shielded position, a lamp on the front of the source drawer projects an image of the collimator trimmers, which corresponds with the radiation field size, onto the treatment surface. The center of the beam is indicated by a shadow of the intersection of two cross-wires in the collimator.

An optical distance indicator, mounted on the rear of the collimator, projects a scale onto the treatment surface. The scale reading, at its intersection with the cross-wire image, is the distance of the treatment surface from the front face of the source.

1.1.5 Counterweights

The head is counterbalanced by a weight at the opposite end of the rotating gantry. The counterweight is either a lead-filled beamstopper, or a pendulum-style counterbalance. The beamstopper is normally used where the treatment room wall thickness will not adequately absorb the direct exit beam in all directions. It absorbs much of the primary beam and radiation scattered from the patient.

1.1.6 Mainframe, Gantry and Base

The mainframe contains the gantry rotation drive system, the air compressor and storage tank, the main electrical panel and the control system printed circuit board cardfile. These are all accessible through large panels on the sides of the mainframe.

The gantry rotation drive will accelerate the gantry quickly to the desired speed and will brake the gantry to a rapid stop under normal operating conditions.

The entire unit is mounted on a steel base below floor level. This supports, and aligns, the mainframe and the table.

1.1.7 Table

The table is supported by the base frame and has five motions:

a. Isocentric rotation, about an axis through the isocenter

b. Table vertical

c. Top rotation, about an axis through the vertical column

d. Lateral

e. Longitudinal

Either Table 23, in which all motions are motorized, or Table 27, in which top rotation and table vertical are motorized and the remaining motions are manually operated, is installed.

The table is fitted with either a solid top or open section top. The solid top is designed for rotational treatment and has a thin steel skin over a foamed plastic core. The open section top is similar except that it has two cranks which form an opening. Because the cranks and their bearings effectively block the radiation beam, this top is best suited for fixed treatments. The cranks may be rotated 180 degrees to alter the position of the open section. The open section is fitted with a nylon mesh frame for patient support.

Two accessory support clamps are built into the handles at each end of the top.

1.1.8 Covers

Flame resistant thermoplastic covers enclose most of the unit and part of the table. The covers will withstand light impacts with little or no damage but may be permanently deformed by heavy loads or impacts or by temperatures exceeding 120 degrees Celsius (250 degrees Fahrenheit). The covers are not affected by most chemicals but they will be stained or damaged by chemicals containing some solvents, e.g., Acetone and Methyl Ethyl Ketone (MEK).

1.2 APPLICABLE DOCUMENTS

a. National Council on Radiation Protection and Measurements, Publication 33, Medical X-ray and Gamma Ray Protection for Energies up to 10 MeV - Equipment Design and Use (NCRP Publications, P.O. Box 4867, Washington, D.C., 20008, U.S.A.).

b. International Commission on Radiological Protection, Publication 15, Protection Against Ionizing Radiation from External Sources (Maxwell House, Fairview Park, Elmsford, New York, 10523, U.S.A., or Pergammon Press Limited, Headington Hill Hall, Oxford, Britain).

c. Isodose Charts as per International Commission on Radiation Units, Report 10(d) Clinical Dosimetry, or the U.S. National Bureau of Standards Handbook 87.

d. International Atomic Energy Authority, Technical Report Series 8, Single Field Isodose Charts for High Energy Radiation.

e. Atomic Energy of Canada Limited (AECL), Medical Division, Specification GS8500.

f. International Commission on Radiation Units and Measurements, ICRU Report 18, Specification of High Activity Gamma-ray Sources.

1.3 SPECIFICATIONS

The following system specifications are provided for operator guidance.

1.3.1 Radiation Beam

a. Source Capacity

The unit cobalt-60 source capacity is guaranteed at a minimum of 175 Rmm-ICRU. Each unit ordered with an AECL MEDICAL cobalt-60 source with output exceeding 175 Rmm-ICRU will have a guaranteed capacity of 200 Rmm-ICRU, at no additional charge.

b. Field Accuracy

The differences between the optical field, radiation field, and the indicated field size do not exceed ±0.25 cm at 80 cm from the face of the source.

c. Isocentric Accuracy

The isocenter is defined as the center of the sphere through which passes the axis of collimator rotation at any angle of gantry rotation when the headlock is engaged. The radius of this sphere does not exceed 0.1 cm.

The isocenter is 80 ±0.1 cm from the active face of the source.

The centerline of table isocentric rotation, with the top at the isocenter, passes within 0.1 cm of the isocenter.

d. Field Size

Table 1.1 shows the field size ranges at 80 cm from the front surface of the source for the available trimmer bars.

Table 1.1. Field Sizes

TRIMMER BARS (SDD-cm)*	FIELD SIZE RANGE AT 80 cm SAD	
	MINIMUM (cm sq)	MAXIMUM (cm sq)
	not more than	not less than
45	5.0	35.0
55	4.0	34.0

*Source to definer distance, cm.

1.3.2 Shielding

a. Leakage

Total radiation leakage does not exceed that permitted by the requirements of the International Commission on Radiological Protection, ICRP Publication 15 and National Council on Radiation Protection and Measurements Report No. 33 and 34.

b. Collimator Transmission

Collimator transmission does not exceed 2 percent of the useful beam exposure rate.

c. Beamstopper

With the headlock engaged at 0 degrees, the beamstopper will absorb an average of 99.7 percent of the primary beam, and up to 35 degrees of scattered radiation from the isocenter regardless of collimator setting.

1.3.3 Unit Motions

Refer to Table 1.2 and Fig. 1.3.

1.3.4 Table Motions

Refer to Table 1.3 and 1.4 and to Fig. 1.3.

Table 1.2. Unit Motions

MOTION	RANGE	MAXIMUM SPEED	INDICATION	CONTROL
Gantry	continuous 360 degrees	1 rpm	a circular scale in the center of the gantry and a digital readout in the control console	from the hand control or control console
Head swivel	±180 degrees	0.5 rpm	head scale	from the hand control
Collimator rotation	±180 degrees	1.3 rpm	collimator scale	head control panel
Collimator X and Y	(ref. section 1.3.1d)	approximately 15 sec for full opening	digital readouts on collimator control panel	collimator control panel

Table 1.3. Table 23 Motions

MOTION	RANGE	MAXIMUM SPEED	INDICATION	CONTROL
Isocentric rotation	±110 degrees about isocenter	0.5 rpm	floor scale	from the hand control
Table vertical	0 to 39 cm below isocenter	0.6 cm/s	scale indicating distance below isocenter	from the hand control
Top rotation	±182 degrees about vertical column	1 rpm	pointers to indicate zero position	from the hand control
Lateral	±20 cm	5 cm/s	scale	from the hand control
Longitudinal	78 cm	5 cm/s	scale	from the hand control

Table 1.4. Table 27 Motions

MOTION	RANGE	MAXIMUM SPEED	INDICATION	CONTROL
Isocentric rotation	±130 degrees about isocenter	manual	pointers to indicate zero position	foot-operated lock
Table vertical	0 to 39 cm below isocenter	0.6 cm/s	scale indicating distance below isocenter	from the hand control
Top rotation	±182 degrees about vertical column	1 rpm	pointers to indicate zero position	from the hand control
Lateral	±20 cm	manual	scale	locking levers on both ends of table
Longitudinal	78 cm	manual	scale	locking levers on both sides of table

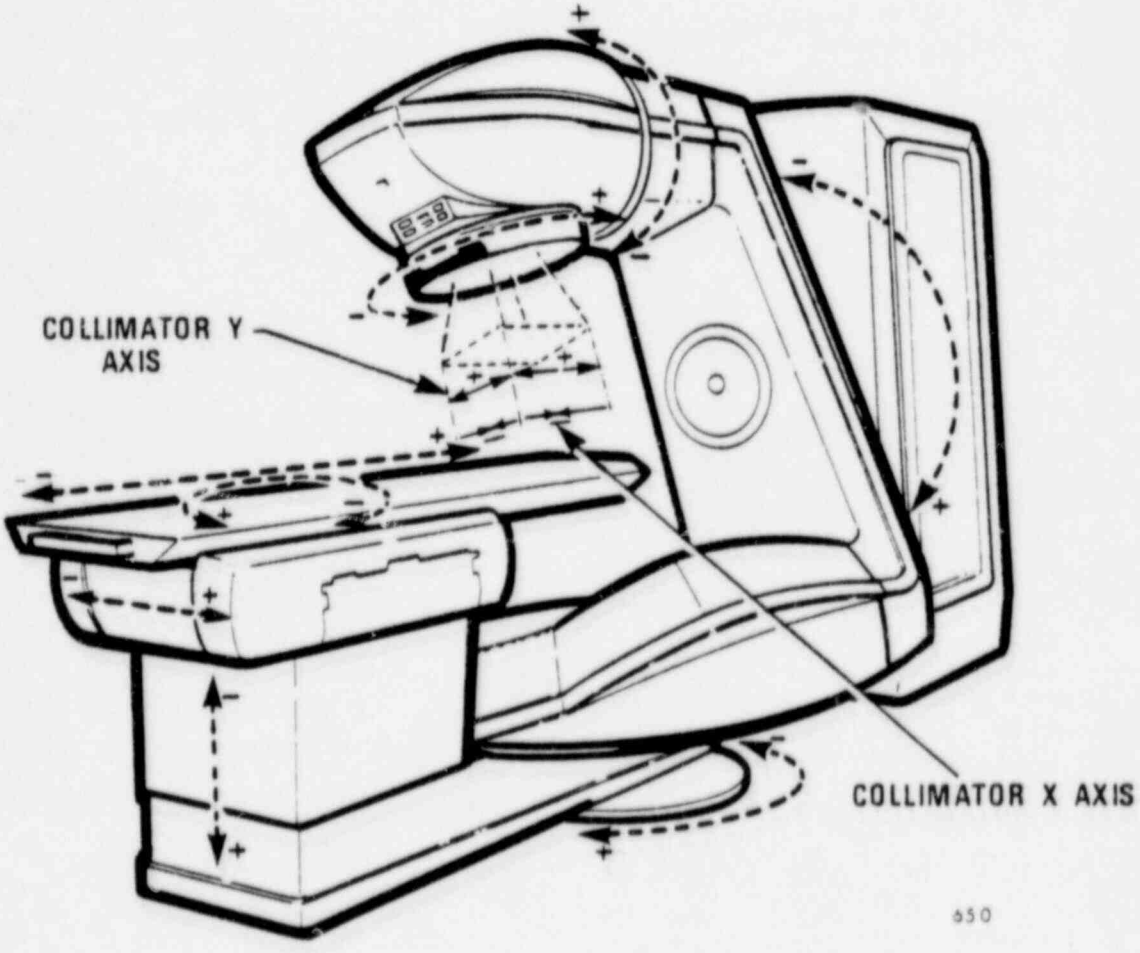

Fig. 1.3. Unit Motions

1.3.5 Treatment Timer

SET TIME range - 0.01 to 20.99 minutes.

PRIMARY and SECONDARY TIMER display ranges - 0 to 99.99 minutes.

Display resolution for all displays - 0.01 minutes.

Timing accuracy - better than ±0.01 minutes for the first segment of a treatment and ±0.00$\bar{1}$ minutes for each additional treatment segment.

1.3.6 Power Requirement

Electrical power required is 115 or 230V ac ±10 percent, single phase, 1.5kVA approximately, 50 or 60 Hz.

1.3.7 Load Capacity

The static load capacity of the table is 136 kg (300 lb).

The static load capacity of the beamshaping trays is 20 kg (44 lb).

1.3.8 Source

Cobalt-60 source characteristics are given in Table 1.5.

Table 1.5. Cobalt-60 Data

Radiations
Beta 1.478 (weak), 0.318 (1.00)
Gamma 1.333 MeV (1.00), 1.1733 MeV (1.00)
Gamma output
1.30 Roentgens per hour at one meter per Curie
Half life 5.26 years

Decay Characteristics

YEARS	MONTHS											
	0	1	2	3	4	5	6	7	8	9	10	11
0	-	0.9891	0.9783	0.9676	0.9570	0.9466	0.9362	0.9260	0.9159	0.9059	0.8960	0.8862
1	0.8766	0.8670	0.8575	0.8482	0.8389	0.8297	0.8207	0.8117	0.8028	0.7941	0.7854	0.7768
2	0.7684	0.7600	0.7517	0.7435	0.7353	0.7273	0.7194	0.7115	0.7037	0.6961	0.6885	0.6809
3	0.6735	0.6662	0.6589	0.6517	0.6446	0.6375	0.6306	0.6237	0.6169	0.6101	0.6035	0.5969
4	0.5904	0.5839	0.5775	0.5712	0.5650	0.5588	0.5527	0.5467	0.5407	0.5348	0.5290	0.5232
5	0.5175	0.5118	0.5063	0.5007	0.4953	0.4898	0.4845	0.4792	0.4740	0.4688	0.4637	0.4586
6	0.4536	0.4487	0.4438	0.4389	0.4341	0.4294	0.4247	0.4201	0.4155	0.4190	0.4064	0.4020
7	0.3976	0.3933	0.3890	0.3847	0.3805	0.3764	0.3723	0.3682	0.3642	0.3602	0.3563	0.3524
8	0.3485	0.3447	0.3410	0.3372	0.3336	0.3299	0.3263	0.3228	0.3192	0.3157	0.3123	0.3089
9	0.3055	0.3022	0.2989	0.2956	0.2924	0.2892	0.2860	0.2829	0.2798	0.2768	0.2737	0.2708
10	0.2678	0.2649	0.2620	0.2591	0.2563	0.2535	0.2507	0.2480	0.2453	0.2426	0.2400	0.2373
11	0.2347	0.2322	0.2296	0.2271	0.2247	0.2222	0.2198	0.2174	0.2150	0.2127	0.2103	0.2080
12	0.2058	0.2035	0.2013	0.1991	0.1969	0.1948	0.1926	0.1905	0.1885	0.1864	0.1844	0.1824
13	0.1804	0.1784	0.1764	0.1745	0.1726	0.1707	0.1689	0.1670	0.1652	0.1634	0.1616	0.1598
14	0.1581	0.1564	0.1547	0.1530	0.1513	0.1497	0.1480	0.1464	0.1448	0.1432	0.1417	0.1401
15	0.1386	0.1371	0.1356	0.1341	0.1326	0.1312	0.1297	0.1283	0.1269	0.1255	0.1242	0.1228
16	0.1215	0.1201	0.1188	0.1175	0.1163	0.1150	0.1137	0.1125	0.1113	0.1100	0.1088	0.1077

POST IN A PROMINENT POSITION CLOSE TO THE TELETHERAPY UNIT CONTROL CONSOLE

WARNING

ANY ATTEMPT TO ADULTERATE THE APPROVED DESIGN OR THE MECHANICAL/PNEUMATIC/ELECTRICAL SYSTEMS OF THIS DEVICE, INCLUDING ITS STANDARD OPTIONS AND ACCESSORIES, MAY PROVE HAZARDOUS TO PERSONNEL AS WELL AS CAUSE INJURY TO A PATIENT OR EXTENSIVE DAMAGE TO THE DEVICE.

FAILURE TO PERFORM THE SAFETY CHECKS AND PREVENTIVE MAINTENANCE PROGRAMME, AS DESCRIBED IN THIS INSTRUCTION MANUAL, MAY CAUSE THE DEVICE, INCLUDING ITS STANDARD OPTIONS AND ACCESSORIES, TO BECOME HAZARDOUS TO PERSONNEL, CAUSE INJURY TO A PATIENT OR DAMAGE TO THE DEVICE.

THE LICENSEE IS RESPONSIBLE FOR ENSURING THAT THE DEVICE, INCLUDING ITS STANDARD OPTIONS AND ACCESSORIES, IS OPERATED AND MAINTAINED IN ACCORDANCE WITH THE REQUIREMENTS OF THE COMPETENT AUTHORITY.

Atomic Energy of Canada Limited
Radiochemical Company
413 March Road
P.O. Box 13500, Kanata, Ontario
Canada K2K 1X8

POST IN A PROMINENT POSITION CLOSE TO THE TELETHERAPY UNIT CONTROL CONSOLE

IMPORTANT

AECL MODELS
6, 8, 60, 80, 76, 78, 765, 780, 780 CTS, AND 780CC
TELETHERAPY UNITS

IF THE DRAWER FAILS TO CLOSE, PROCEED AS FOLLOWS:

1. Remove the patient from the treatment room.
2. The drawer return emergency T-bar, which is supplied with the unit and located at the control station, should be placed over the beam condition indicating rod. Forward pressure on the source drawer with the T-Bar will push the drawer backwards and into the safe position.

NOTE:

1. The amber coloured portion of the emergency T-bar must be entirely inside the front head cover before the source is in the fully safe position. This will reduce external radiation fields to normal levels and allow repairs to be made to the drawer.
   The front portion of the T-bar is painted red and the source can be considered relatively safe if no red marking appears outside the front cover.
2. Licensing authorities in some countries stipulate additional emergency procedures. Operating personnel should familiarize themselves with these requirements prior to operation of this equipment.

FOR EMERGENCY SERVICE
TELEPHONE:

_____

Atomic Energy of Canada Limited
Radiochemical Company
413 March Road
P.O. Box 13500, Kanata, Ontario
Canada K2K 1X8

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POST IN A PROMINENT POSITION CLOSE TO THE TELETHERAPY UNIT CONTROL CONSOLE

IMPORTANT

TO ALL "USERS" OF TELETHERAPY EQUIPMENT MANUFACTURED BY ATOMIC ENERGY OF CANADA LIMITED

1. The operating manuals provided with this teletherapy equipment constitute part of the labelling for the device.
2. The equipment should not be used unless the operating manuals are available in the control area for operator use.
3. The equipment should be used by authorized operators only.
4. The operator is responsible for performing the safety check procedures described in the operating manuals.
5. The prescribed safety check procedures should be performed each time the equipment is started up.
6. If a malfunction is detected during a safety check procedure then the equipment should not be used for set-up or treatment until the malfunction has been corrected.
7. Only qualified technicians should be permitted to make adjustments to the equipment.

FOR SERVICE CONTACT:

_____

Atomic Energy of Canada Limited
Radiochemical Company
413 March Road
P.O. Box 13500, Kanata, Ontario
Canada K2K 1X8

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PART 2

POTENTIAL HAZARDS

2.1 GENERAL

Potential hazards are associated with the operation of any radiation teletherapy equipment. While many features have been incorporated into the Theratron 780-C to minimize those hazards, the ultimate responsibility for the safe operation of the unit lies with the operator. The unit must be operated with due care, having regard for the associated hazards.

This part includes:

- A discussion of the potential hazards.
- Requirements for operator training and qualifications.
- A description of the alarms, indicators and interlocks incorporated into the Theratron 780-C to minimize the potential hazards.
- Recommended emergency procedures.

The warning and information cards provided in this manual must be posted in a prominent position close to the control console.

All enquiries relating to the operation of this unit should be directed to:

Atomic Energy of Canada
Medical Division
P.O. Box 13500
Kanata, Ontario
K2K 1X8

Tel. (613) 592-2790
Cable Nemota/Telex 053-4162

2.2.2 Laser Radiation

The optional alignment lasers pose a potential hazard to eye tissue. The following precautions must be observed:

a. Patients must not be allowed to look directly into the laser beam. Be sure WARNING labels are prominently placed near the alignment lasers.

b. The lasers should only be turned on during actual patient setup. They must be turned off at all other times.

c. Do not attempt to modify the lasers.

2.2.3 Collision

The probability of an accidental collision between the unit, table, and patient may be minimized by:

a. Not bypassing the interlocks provided or otherwise modifying the unit.

b. Following the Operating Procedures given in Part 4 of this manual, paying particular attention to the included warnings.

2.2.4 Electrical Shock

To avoid potential hazards posed by high electrical voltages in the system, the operator should observe the following precautions:

a. Do not modify the unit.

b. Do not remove protective covers or expose components normally accessible only to maintenance personnel.

2.3 OPERATOR TRAINING AND QUALIFICATION

Each person operating the Theratron 780-C must:

a. Be approved by the competent authority.

2.2 HAZARDS

The potential hazards are:

a. Radioactive materials and radiations

b. Laser radiation (if patient alignment lasers are installed)

c. Collision

d. Electrical shock

2.2.1 Radioactive Materials and Radiations

Because of its energy level and intensity, the beam is potentially hazardous to both patient and operator. The probability of an unwanted exposure to radiation or dispersal of radioactive material may be minimized by observing the following precautions:

a. Ensure patient set-up is precise to deliver the prescribed dose to the prescribed treatment area.

b. Permit only the patient to stay in the treatment room when the radiation beam is on.

c. Ensure all personnel working in the radiation area wear authorized radiation monitoring devices.

d. Do not bypass the interlocks provided or otherwise modify the equipment.

e. Follow the operating and maintenance instructions given in this manual, paying particular attention to the included warnings.

f. Perform routine contamination tests for radioactive materials.

b. Strictly comply with proper operating procedures (Part 4).

c. Be aware of the correct procedure in the event of an emergency (section 2.5).

d. Not modify the unit unless modifications are authorized by Atomic Energy of Canada and approved by the competent authority.

e. Ensure that the unit is maintained in proper operating condition by:
   (1) regular testing of the unit (Part 4),
   (2) a regular preventive maintenance program (Part 6),
   (3) correcting all malfunctions before resuming clinical operations.

f. Be aware of hazards associated with direct, scattered and leakage radiation.

The operators should comply with the recommendations contained in applicable documents a and b (section 1.2).

2.4 ALARMS, INDICATORS AND INTERLOCKS

Various alarm and interlock systems have been incorporated into the Theratron 780-C to minimize the hazards normally associated with the use of radiation teletherapy equipment. They are categorized as follows:

a. Source Drawer Systems

b. Treatment Interlock Systems

c. Unit Motion Systems

d. Emergency Stop System

2.4.1 Source Drawer System

Green and red lamps on the front of the head covers and on the console control panel indicate source position, when the power keyswitch is turned on, as follows:

a. Source fully shielded - green BEAM OFF lamps illuminated, red BEAM ON lamps extinguished.

b. Source in transit - green BEAM OFF and red BEAM ON lamps illuminated.

c. Source fully exposed - green BEAM OFF lamps extinguished, red BEAM ON lamp illuminated.

A red tipped beam-on indicator rod, connected directly to the front of the source drawer, protrudes from the front of the head cover when the source is near, or in, the fully exposed position. When the rod is visible, high radiation fields are present. If the rod is not visible but the BEAM ON lamp is illuminated, radiation fields will be substantially below the source fully exposed level but may be sufficiently high that personnel should not unnecessarily remain adjacent to the unit.

The source drawer remains in, or is automatically returned to, the fully shielded position when a power failure occurs.

If the source drawer to driver cylinder main linkage fails, an auxiliary coupling is automatically engaged to return the source to a location very close to the fully shielded position and to prevent further operation.

A T-bar is provided for manually returning the source to the fully shielded position if the drawer mechanism fails to operate.

2.4.2 Treatment Interlock Systems

The following treatment interlocks are provided. Each interlock system must be in the defined state before a treatment can be started. If the state of any interlock system (except source drawer and treatment timer) is changed during treatment, treatment will be automatically terminated.

a. Door - The treatment room door must be closed. (The door switch is to be provided by the owner.)

b. Headlock - If a FIXED treatment mode is selected, the head may be locked or unlocked. If ARC, SKIP or ROT is selected, the head must be locked.

c. Off shield - The head must not be directing the beam through a predetermined angle of limited room shielding. Mercury switches in the treatment head are adjusted to the required angle during unit installation. When the head is locked on beamstopper units, the gantry may be in any position.

d. Treat mode - One of the four treatment modes (ARC, SKIP, ROT or FIXED) must be selected. For rotary treatments a direction must also be selected. Mode selection is cleared automatically at the termination of a treatment.

e. Treat angle - None of the four treatment angles selected must equal or exceed 360 degrees.

f. Air pressure - The pressure in the compressed air storage tank must not be less than 30 psig. This ensures that the source cannot be moved to, or remain in, the fully exposed position unless there is a sufficient air reserve to return it to the fully shielded position.

g. Source drawer - The drawer must be in the fully shielded position before a treatment can be started. This prevents the unit from being used if the primary source drawer coupling fails.

h. Timer - The treatment timer relays must not be in the beam on condition (e.g., the timer must not display Un.P).

j. Wedge filter - This interlock is optional. If it is installed, the wedge filter must have been confirmed.

2.4.3 Unit Motion Systems

Limit switches are provided on the head swivel, collimator and table motions. Mechanical stops are fitted to back up all limit switches.

Bars are provided to retain the collimator in place should its rotation bearing collapse.

A motion interlock prevents the gantry from being rotated through the sector 115 to 245 degrees when the headlock is not engaged. This reduces the probability of the collimator hitting the treatment room floor.

A motion interlock prevents the gantry from being rotated during treatment when the headlock is not engaged.

Treatment mode (ARC, SKIP, ROT, FIX) switches on the console control panel are self-cancelling at the end of each treatment. Gantry rotation during treatment can occur only when selected by the operator prior to the start of the treatment.

A SIMULATE momentary-action pushbutton on the hand control permits the operator to simulate ARC, SKIP and ROT treatments during setup with the source in its fully shielded position.

All unit motions are equipped with auxiliary devices to interrupt the supply of power to the drive motors as follows:

a. Collimator X, Y and Rotation - Momentary-action enabler switches, between the driver circuits and the motors, directly interrupt the supply of power to the motors unless they are depressed.

b. Head Swivel and All Table Motions - Solid-state relays interrupt the supply of power to the driver circuits unless a momentary-action enabler switch is depressed on the hand control.

c. Gantry Rotation - A solid-state relay interrupts the supply of power to the driver circuit unless:
   (1) a momentary-action enabler switch on the hand control is depressed, or
   (2) a rotary treatment (including direction) is selected and either the treatment switch is in the TREAT position or the control panel SET UP button is depressed.

A crank is supplied for lowering the table top during a loss of electrical power.

2.4.4 Emergency Stop System

EMERGENCY pushbuttons are located on the control panel, the hand control and the unit mainframe. When operated, all motions stop and the source will return to, or remain in, the fully shielded position.

2.5 EMERGENCY PROCEDURES

Emergency procedures are recommended for the following situations:

a. Fire

b. Unwanted Unit Motion

c. Unwanted Beam-on

d. Unwanted Radiation Exposure

These procedures should be practiced regularly so that each person associated with the unit is familiar with the location and use of emergency controls and equipment.

2.5.1 Fire

If a fire occurs:

a. Remove patient from treatment room.

b. Activate room or building FIRE ALARM.

c. Turn off control console keyswitch.

d. Turn off ac power disconnect switch outside teletherapy room.

e. Use a fire extinguisher of type approved for electrical fires.

f. Discontinue use of the unit until a thorough inspection has been made by AECL MEDICAL or their accredited Representative and necessary repairs completed.

2.5.2 Unwanted Unit Motion

If any unwanted unit motion occurs, during either set-up or treatment:

a. Depress any EMERGENCY STOP pushbutton. EMERGENCY STOP pushbuttons are located on:
   (1) each side of mainframe
   (2) hand control
   (3) control console.

b. Unit motions may also be stopped by:
   (1) Turning the keyswitch to OFF.
   (2) Switching off the power supply at the main disconnect (isolating) switch. This should switch off the main power supply to the console and to the unit. (In some clinics there may be two switches; one inside and one outside the room.)

c. Discontinue use of the unit. Notify the Licensee and AECL MEDICAL or their accredited Representative.

2.5.3 Unwanted Beam-on

If the control system does not terminate the exposure at the end of the preset treatment time, perform the following steps in a calm manner:

a. For the Operator

   (1) Open the treatment room door.

   (2) Enter the treatment room but avoid exposure to the treatment beam.

   (3) Remove the patient from the room.

   (4) Close the door.

   (5) Turn off the keyswitch at the control console.

   (6) Immediately notify the radiation protection officer and the Licensee.

b. For the Radiation Protection Officer

(1) Obtain a portable survey meter; check to see that it is functioning properly.

(2) Open the treatment room door a few inches.

(3) Stand behind the door and insert the survey meter into the door opening to determine if high radiation levels are present.

(4) Open the door and observe the front of the head, if the red tip of the source drawer position indicator rod is visible, high radiation fields will be present in the treatment zone and adjoining areas.

(5) Obtain the emergency T-bar from its location at the control console. Enter the room but avoid exposure to the treatment beam.

(6) Insert the end of the T-bar over the red indicator rod and through the head cover. If the indicator rod is not visible, insert the T-bar through the cover opening until it is felt to engage the indicator rod (Fig. 2.1).

(7) Apply firm pressure to the T-bar and push the source back into the fully shielded position. Align the hole in the T-bar with the hole in the cover and insert the locking pin.

(8) Close and secure the treatment room door. Post a sign warning people not to enter.

(9) Immediately notify the Licensee, the competent authority and AECL MEDICAL or their accredited Representative.

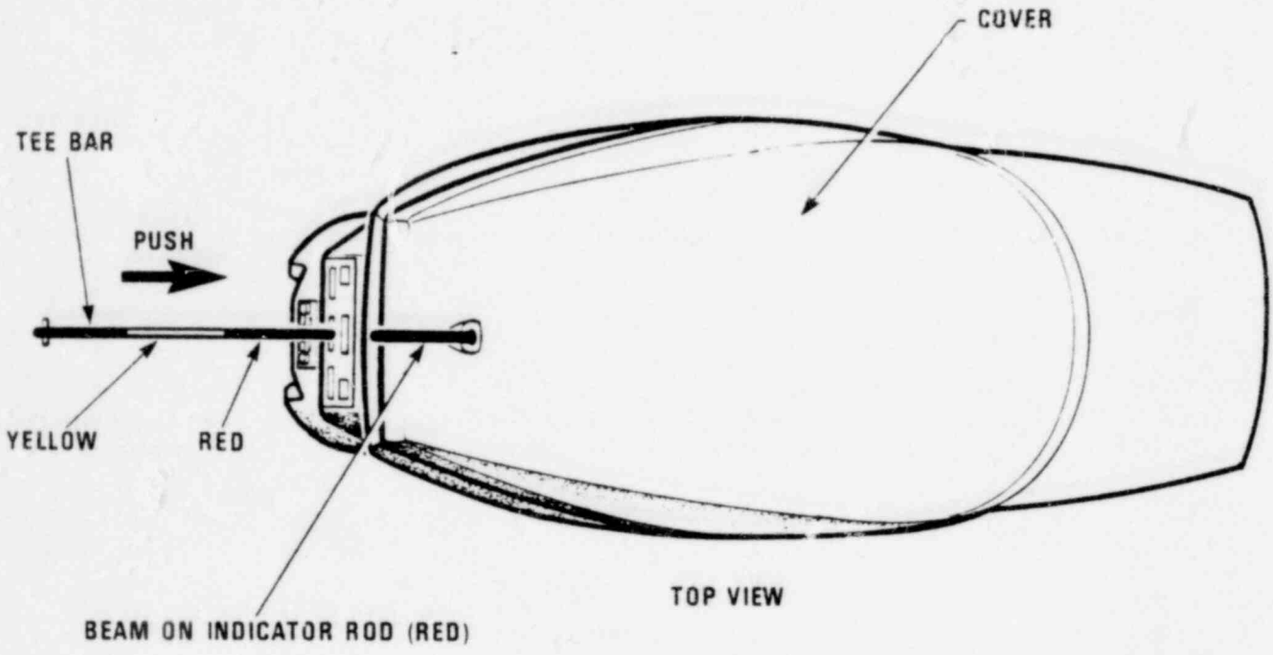


Fig. 2.1. Source Drawer T-bar

NOTES

1. When the yellow colored portion of the T-bar is entirely inside the head cover, the source is in the fully shielded position, external radiation fields are at normal levels and repairs can be carried out.
   If the amber colored portion of the T-bar is visible and the red colored portion is entirely inside the cover, the radiation fields can be considered to be at a relatively safe level. However, they must be monitored as repair work proceeds.

2. Competent authorities in some countries stipulate additional emergency procedures. The operator must be familiar with these procedures before operating this equipment.

(10) If the source remains in the fully exposed position for a protracted time, check radiation levels in all areas adjacent to the treatment room, including any areas above or below, and prevent unauthorized persons from entering any area where a high radiation field exists.

(11) Write a complete description of the incident. Include names and addresses of any persons involved and estimate the length of time each person was exposed to radiation. Indicate whether this was direct or indirect radiation.

NOTE

Although this procedure must be practiced with the source in the fully shielded position, it should be simulated as accurately as is possible.

2.5.4 Unwanted Radiation Exposure

The treatment facility is responsible for defining emergency procedures for the care of persons who have received an unwanted radiation exposure.

2.6 RADIATION CONTROL

The Licensee is responsible for ensuring that the Theratron 780-C is operated and maintained in accordance with the requirements of the competent authority.

PART 3

CONTROLS AND INDICATORS

3.1 GENERAL

Controls and indicators are categorized as follows:

- Control Console
- Unit Mounted Controls
- Table Mounted Controls
- Hand Controls

3.2 CONTROL CONSOLE

The control console (Fig. 3.1) is located outside the treatment room. Controls and indicators are grouped into four panels:

a. Power Control

b. Treatment Control

c. Wedge Filter Interlock

d. Interlock Status

3.2.1 Power Control Panel (Fig. 3.2)

a. Power Keyswitch

The keyswitch has three positions labelled OFF, ON, START. When turned from OFF to ON, the equipment is in its emergency state; power is not immediately supplied to the motor drive and source drawer drive circuits. To start the system, either the keyswitch is turned to START or the unit mounted RESTART POWER pushbutton (section 3.3.3b) is depressed.

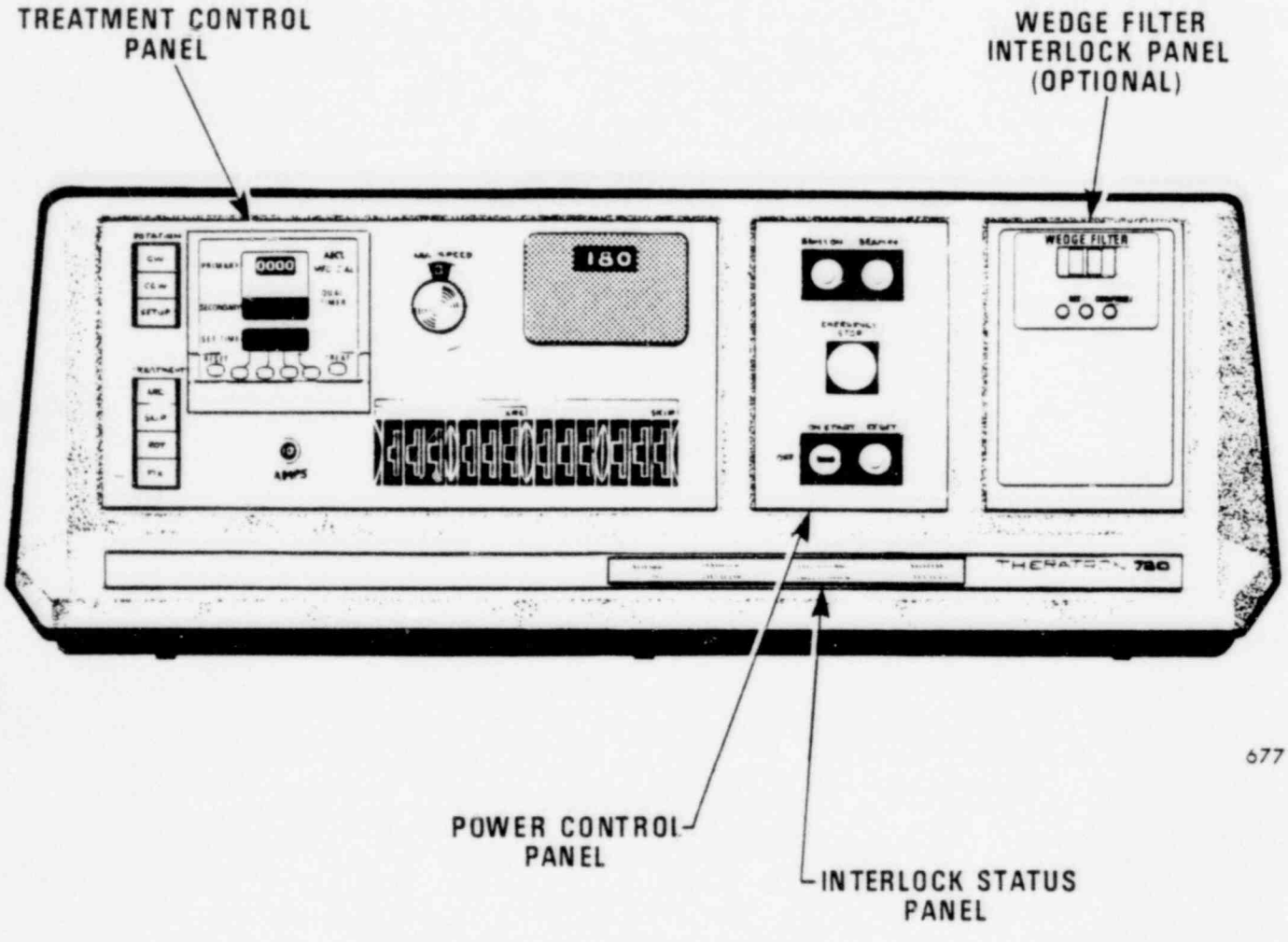


Fig. 3.1. Control Console

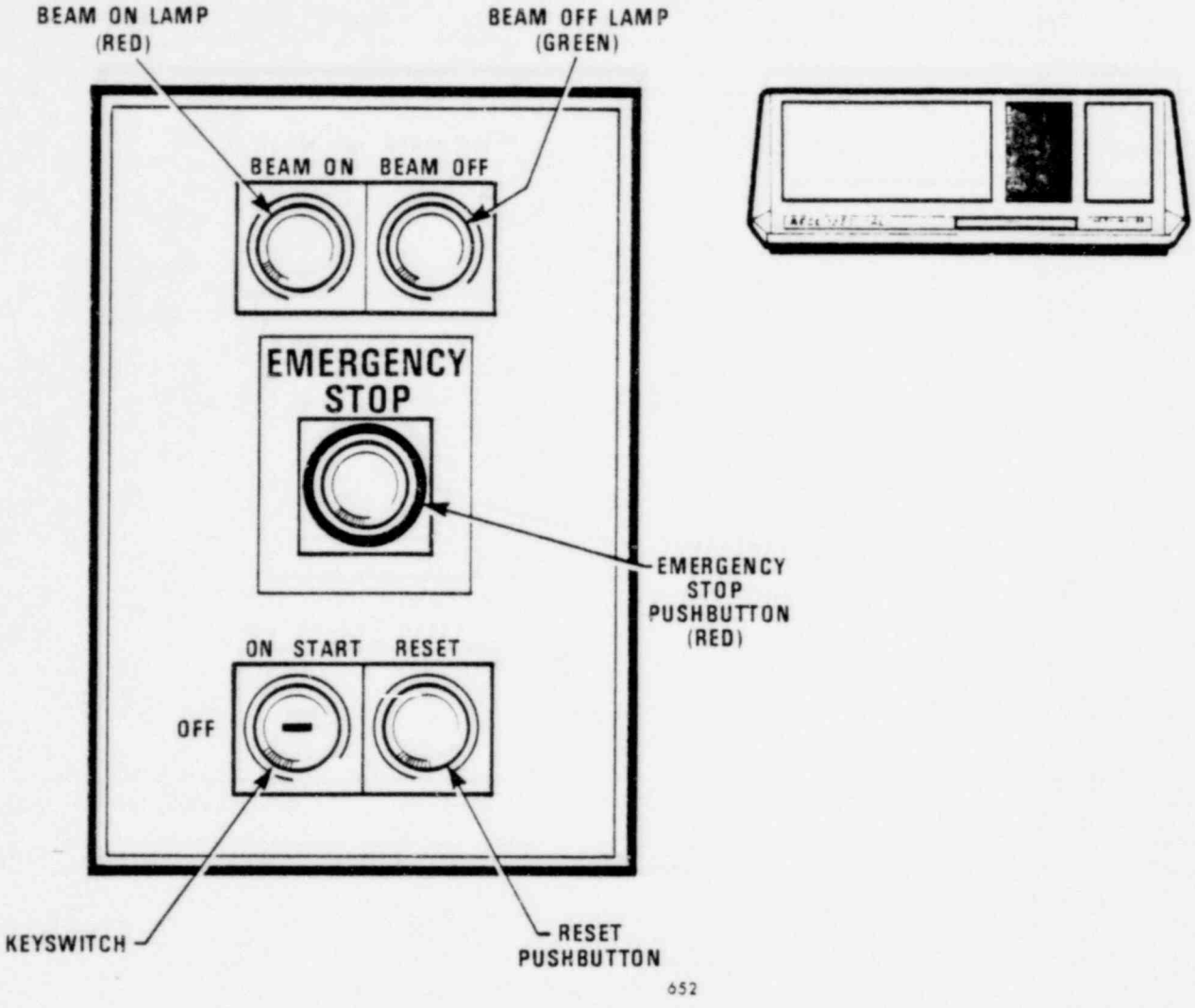


Fig. 3.2. Power Control Panel

Alarms sound at the control console and in the treatment room while the key or the RESTART POWER pushbutton is held against its spring restoring force.

WARNING

If the alarms continue to sound when the key and pushbutton are released, the emergency circuit may not operate when an EMERGENCY pushbutton is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

b. Reset

Before starting treatment, the RESET pushbutton is depressed to arm the treatment circuit after all interlock systems are in the defined state. If the status of

any interlocked system changes during treatment (e.g., if a control is altered), treatment will be terminated and the RESET pushbutton comes on. The RESET pushbutton will also illuminate automatically at the end of a treatment.

c. Emergency

Pressing this red latching pushbutton places the unit in its emergency state. All motions will stop and the source will return to, or remain in, the fully shielded position. This pushbutton is illuminated when any emergency pushbutton is in its latched state. It is unlatched by rotating it counterclockwise.

d. Beam On

This red lamp is illuminated when the source is in any location other than the fully shielded position.

e. Beam Off

This green lamp is illuminated when the source is in any location other than the fully exposed position.

NOTE

When the source is in transit between fully shielded and fully exposed positions, both BEAM OFF and BEAM ON lamps are illuminated.

3.2.2 Treatment Control Panel (Fig. 3.3)

a. Treatment Mode

A vertical bank of four self-cancelling, illuminating pushbuttons is provided for treatment mode selection:

(1) ARC - a yellow pushbutton for treatment within a selected sector of rotation. The gantry will arc clockwise and counterclockwise while the beam remains on.

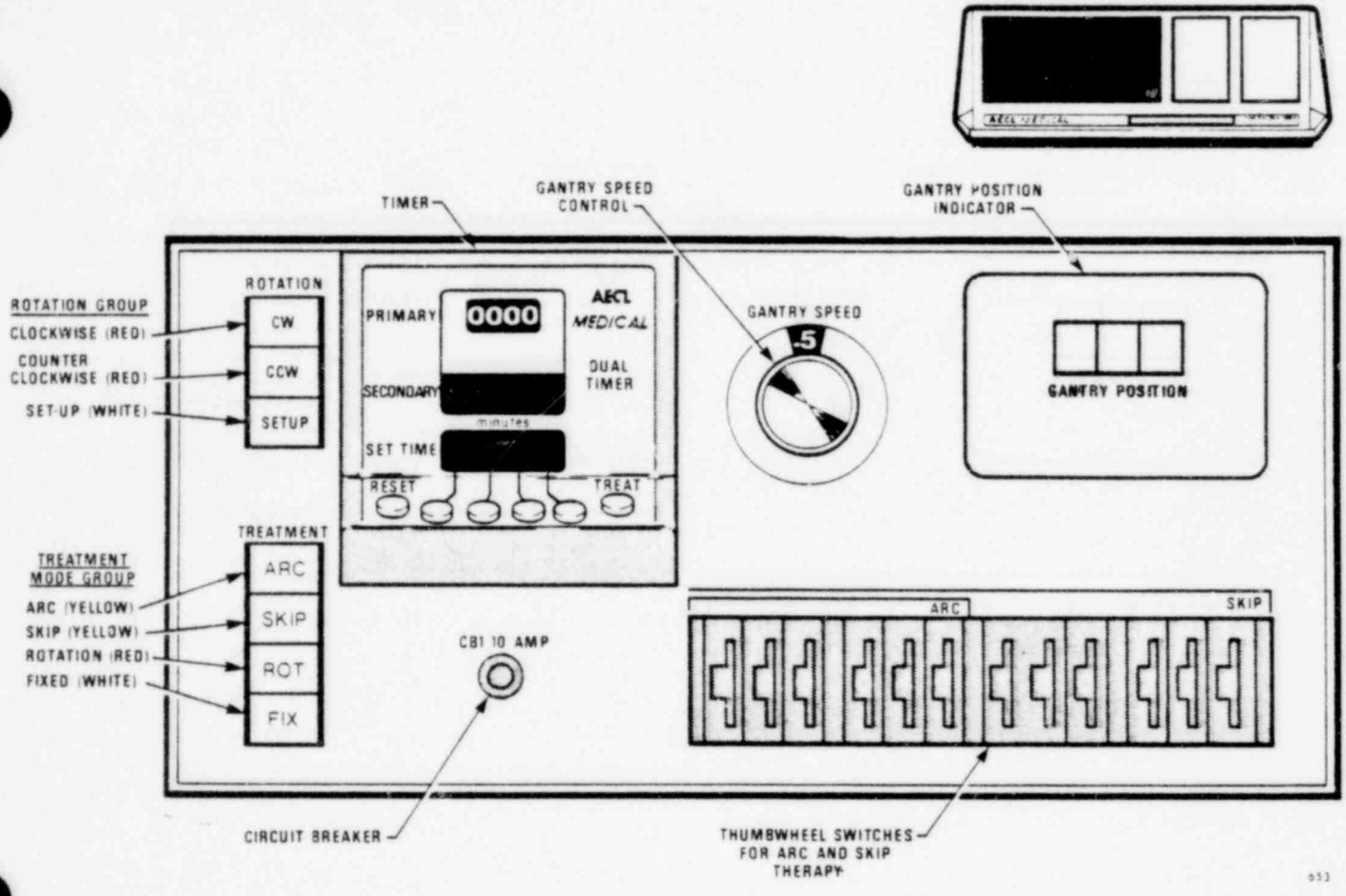


Fig. 3.3. Treatment Control Panel

(2) SKIP - a yellow pushbutton for treatment within two defined sectors of rotation. The gantry will rotate continuously as the beam goes on and off.

(3) ROT - a red pushbutton for rotary treatment. The gantry will rotate continuously while the beam remains on.

(4) FIX - a white pushbutton for fixed treatment at any preset gantry angle.

NOTE

These pushbuttons are self-cancelling so that the required mode must be selected before each treatment starts.

b. Rotation

A vertical bank of three illuminating pushbuttons, this controls movement as follows:

(1) CW - a red pushbutton for selection of clockwise gantry rotation (interlocked with CCW).

(2) CCW - a red pushbutton for selection of counterclockwise gantry rotation (interlocked with CW).

(3) SET UP - a white, momentary-action pushbutton which causes the gantry to rotate at the selected speed. This pushbutton is used during patient set-up. The beam will not be turned on.

c. Gantry Speed Control

This rotary knob control regulates gantry rotation speed during treatment and when the SET UP control is used. Speed is continuously variable from 0 to 1 rpm. Graduations in 10 increments from 0 to 1 are provided.

d. Gantry Position Readout

A three digit display of gantry position with a range of 0 to 359 degrees.

e. Arc and Skip Mode Angles

These angles are controlled by four groups of three thumbwheel switches. The first two groups are used to establish the angular limits of ARC treatments. All four groups are used to establish the angular limits of SKIP treatments (i.e., two SKIP treatment sectors are available). For both treatment modes, the beam will turn on in the sector occupied by the gantry at the start of the treatment.

f. Timer

The following controls and indicators are provided on the timer front panel:

(1) SET TIME Display

This display indicates the prescribed treatment time entered using the SET TIME pushbuttons. It also shows certain timer and therapy unit conditions by flashing various messages alternately with the set time.

(2) PRIMARY Display

This display counts up to show the accumulated treatment time. When PRIMARY time equals SET TIME, the timer will automatically terminate treatment.

Time is accumulated whenever the source is in the fully exposed position (see Fig. 3.4). At the end of treatment the PRIMARY display may be showing a slightly higher reading than the SET TIME display. This is caused by the source drawer system requiring a small amount of time to start moving the source away from its fully exposed position after the timer initiates termination of the treatment. The PRIMARY display reading rather than the SET TIME display reading is the true indicator of actual treatment time.

This display is mechanical so that it retains treatment time in the event of an electrical power supply failure.

(3) SECONDARY Display

This display counts up to show the accumulated treatment time. If the PRIMARY timer fails to terminate the treatment, the SECONDARY time will automatically terminate the treatment when SECONDARY time exceeds SET TIME by a small preset interval.

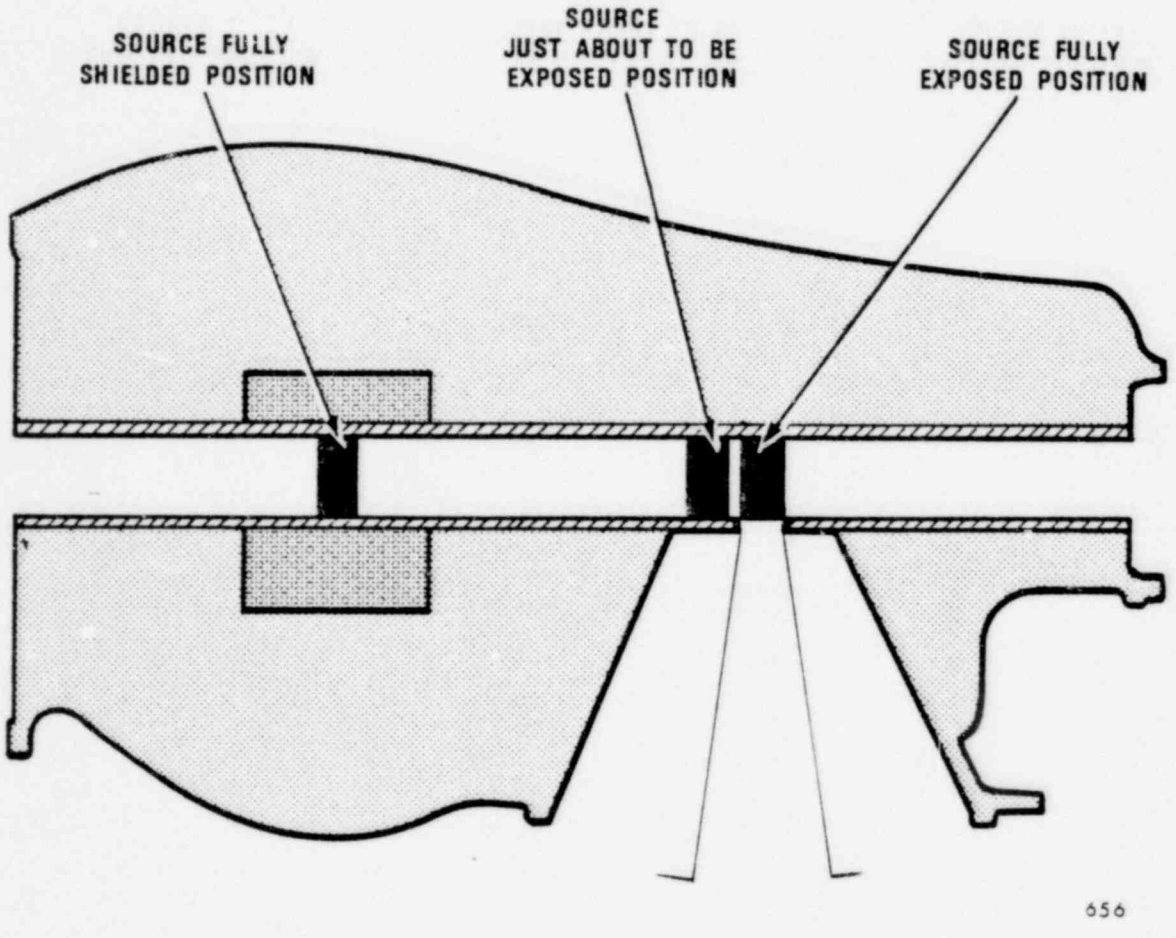


Fig. 3.4. Source Positions

Time is accumulated whenever the source is at or between the positions at which it is just about to be exposed and at which it is fully exposed. At the end of treatment, SECONDARY time is always greater than PRIMARY time by the time it takes the source to move from the just about to be exposed position to the fully exposed position and back. The PRIMARY and SECONDARY timers are actuated by different locations of the source so that, in the unlikely event of a source drawer system failure, the operator may determine in which zone the source remained, as follows:

- if both PRIMARY and SECONDARY displays are accumulating time, the source is in the fully exposed position. The unit BEAM ON light will be illuminated, the BEAM OFF light will be off.

- if the SECONDARY display is accumulating time and the PRIMARY display is static, the source is between the just about to be exposed and fully exposed positions; i.e., it is partially exposed. Both the BEAM ON and BEAM OFF lights will be illuminated.

- if both PRIMARY and SECONDARY displays are static and both the BEAM ON and BEAM OFF lights are illuminated, the source is between the fully shielded and just about to be exposed positions.

- if both PRIMARY and SECONDARY displays are static, the unit BEAM OFF light is illuminated and the BEAM ON light is off, the source is in the fully shielded position.

The difference between the PRIMARY and SECONDARY displays is a natural consequence of a system designed to provide the operator with the above information.

The SECONDARY display shows certain timer and therapy unit conditions by flashing various messages alternately with the secondary time.

(4) RESET Pushbutton

Pressing this pushbutton at any time other than when treatment is in progress, clears all displays to zero. Pressing it once while treatment is in progress interrupts treatment but does not reset the displays to zero.

(5) TREAT Pushbutton

Pressing this pushbutton, when set-up is complete, initiates treatment. Pressing it once while treatment is in progress interrupts treatment.

(6) SET TIME Pushbuttons

Pressing any of these pushbuttons causes the SET TIME display digit to which it is connected to slowly roll up. Pulsing a pushbutton causes the associated digit to increment up by one. Pressing any pushbutton once while treatment is in progress interrupts treatment.

When a message is flashed on the SET TIME or SECONDARY displays, the timer will emit one of two sounds. For conditions that are not immediately potentially hazardous, a single beep is emitted to draw the operator's attention to the display. For immediately potentially hazardous conditions a continuing string of beeps is emitted to alert the operator to the need to take immediate action.

WARNING

A continuous string of beeps indicates that there may be an unwanted exposure of the source and that immediate action is required to minimize the exposure of personnel to radiation. See section 2.5.3 for emergency procedure.

In addition to the measurement of treatment time, the timer monitors various aspects of its own operation and that of the source drawer system. It displays messages and gives audible alarms as listed in Table 3.1.

If any message other than those listed in Table 3.1 is observed, a system malfunction has been detected. A continuing string of beeps will be emitted and operation of the unit is inhibited. The timer can be reset only by the licensee or designate, who will be provided with separate reset instructions.

Table 3.1. Timer Messages

MESSAGE		CONDITION	AUDIBLE ALARM
SET TIME DISPLAY	SECONDARY DISPLAY		
End	-	End of treatment	-
OP.P	-	Operator interruption of treatment	-
Un.P	-	Unit interruption of treatment	-
rSEt	rSEt	Electrical power restored following interruption	-
-	Eror	Set time is zero or exceeds 20.99 minutes	Single beep
-	-	Therapy unit not reset before TREAT pushbutton depressed	Single beep

g. Circuit Breaker

A 10-amp resettable type circuit breaker. It springs up when breaking the circuit and must be depressed to be reset.

3.2.3 Wedge Filter Interlock Panel (Fig. 3.5)

This panel is supplied only on units equipped with the optional wedge filter interlock system.

The wedge filter interlock system is designed to reduce the probability of using the wrong wedge filter. Each wedge filter is fitted with a coded actuator. The installed wedge filter (or no filter condition) must be confirmed by entering the corresponding code at the wedge filter display panel before treatment can be started or resumed following an operator interruption.

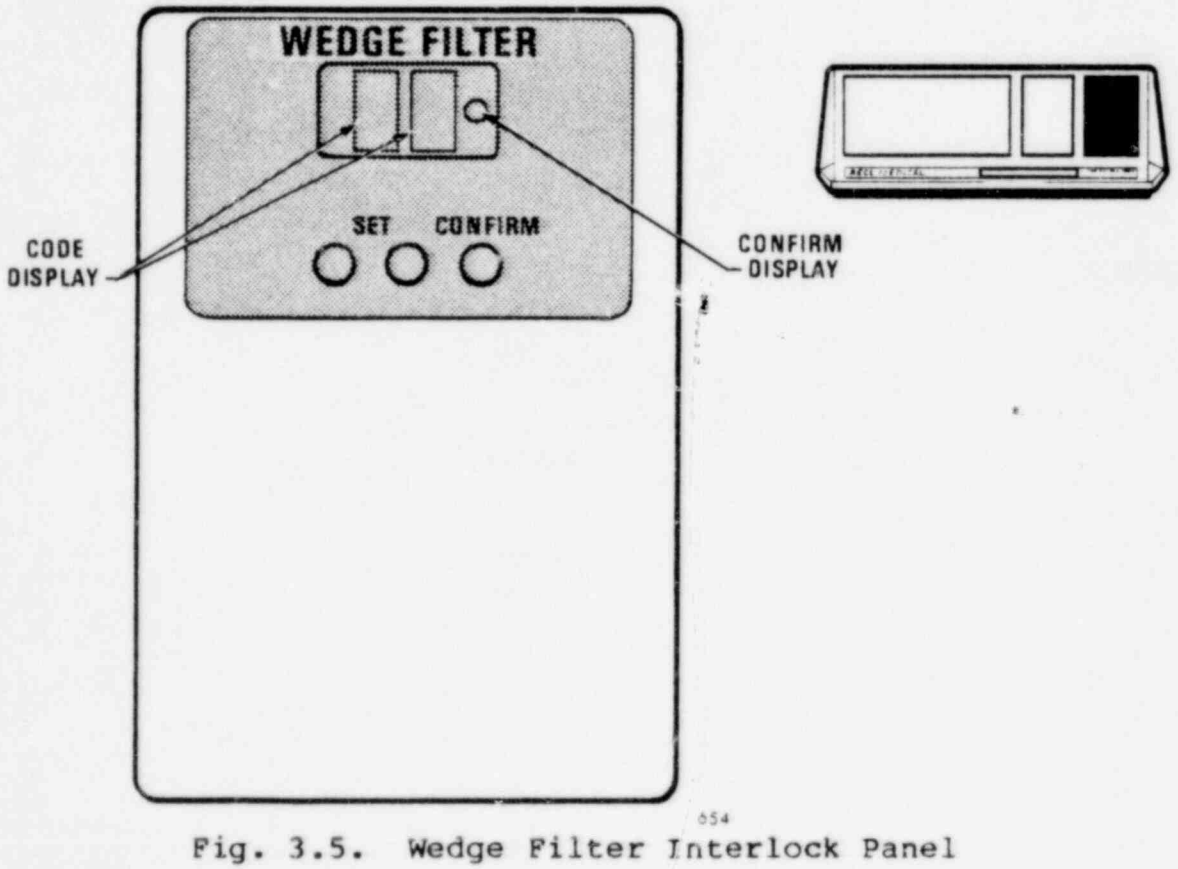


Fig. 3.5. Wedge Filter Interlock Panel

a. Code Display

This display indicates the wedge filter code entered by the SET pushbuttons.

b. Confirm Display

This display is illuminated when the installed wedge filter corresponds to the code display and the CONFIRM pushbutton is pressed. This display must be illuminated before the unit can be reset.

c. SET Pushbuttons

Pressing either of these pushbuttons causes the code display digit to which it is connected to slowly roll up. Pulsing a pushbutton causes the associated digit to increment up by one.

d. CONFIRM Pushbutton

Pressing this pushbutton, when the installed wedge filter and the code display correspond, will illuminate the confirm display.

3.2.4 Interlock Status Panel (Fig. 3.6)

Various unit conditions are monitored and interlocked with the treatment controls (section 2.4.2). Their status is indicated by red LED displays as described in Table 3.2.

3.3 UNIT MOUNTED CONTROLS

These controls comprise:

a. head panel

b. collimator panel

c. mainframe controls

d. backpointer controls

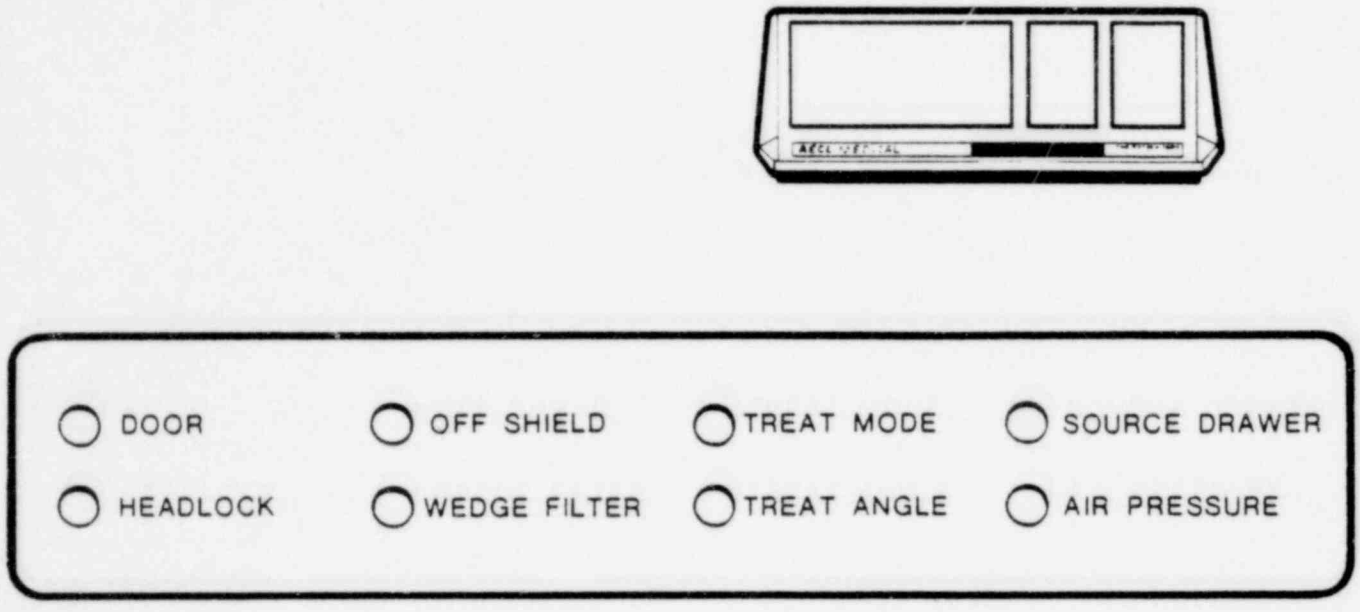


Fig. 3.6. Interlock Status Panel

Table 3.2. Interlock System Operation

STATUS INDICATOR	ON	OFF	CONDITIONS
DOOR	•		Treatment room door open
		•	Treatment room door closed
HEADLOCK		•	Head locked at 0°
	•		Head not locked at 0° and fixed mode not selected
		•	Head not locked at 0° and fixed mode selected
SHIELD	•		'Off Shield' indicator light on head display panel ON
		•	'Off Shield' indicator light on head display panel OFF
WEDGE FILTER(1)	•		Wedge filter not confirmed
		•	Wedge filter confirmed
TREAT MODE	•		None of four treatment pushbuttons depressed
		•	One of four treatment pushbuttons depressed. If ROT, ARC or SKIP is selected, either CW or CCW must also be selected
TREAT ANGLE	•		One of four treatment angles selected is 360° or more
		•	None of four treatment angles selected is 360° or more
AIR PRESSURE	•		Air pressure in compressed air storage tank less than 30 psig
		•	Air pressure in compressed air storage tank 30 psig or more
SOURCE DRAWER	•		Source not in fully shielded position and treatment not in progress
		•	Source drawer not in fully shielded position and treatment in progress, or source in fully shielded position

(1)The wedge filter interlock is optional. On units without this interlock the status indicator is permanently off.

3.3.1 Head Panel (Fig. 3.7)

a. Beam On

This red indicator lamp is illuminated when the source is in any location other than the fully shielded position.

b. Beam Off

This green indicator lamp is illuminated when the source is in any location other than the fully exposed position.

NOTE

When the source is in transit between the fully shielded and fully exposed positions, both BEAM OFF and BEAM ON lamps are illuminated.

c. Off Shield

This white indicator lamp is illuminated when the head is directed toward an unshielded area of the treatment room. The source cannot be moved to, or remain in, the fully exposed position.

d. Field

This white alternate-action pushbutton controls the field defining light. It is illuminated when the field lamp is on.

e. Collimator Rotation Control

This spring-return-to-center-zero thumbwheel controls the speed and direction of collimator rotation. An enabler switch, on the underside of the cover, must be depressed before the collimator can be rotated.

CAUTION

Do not press or release the enabler switch while operating the thumbwheel as this will reduce the operating life of some unit components.

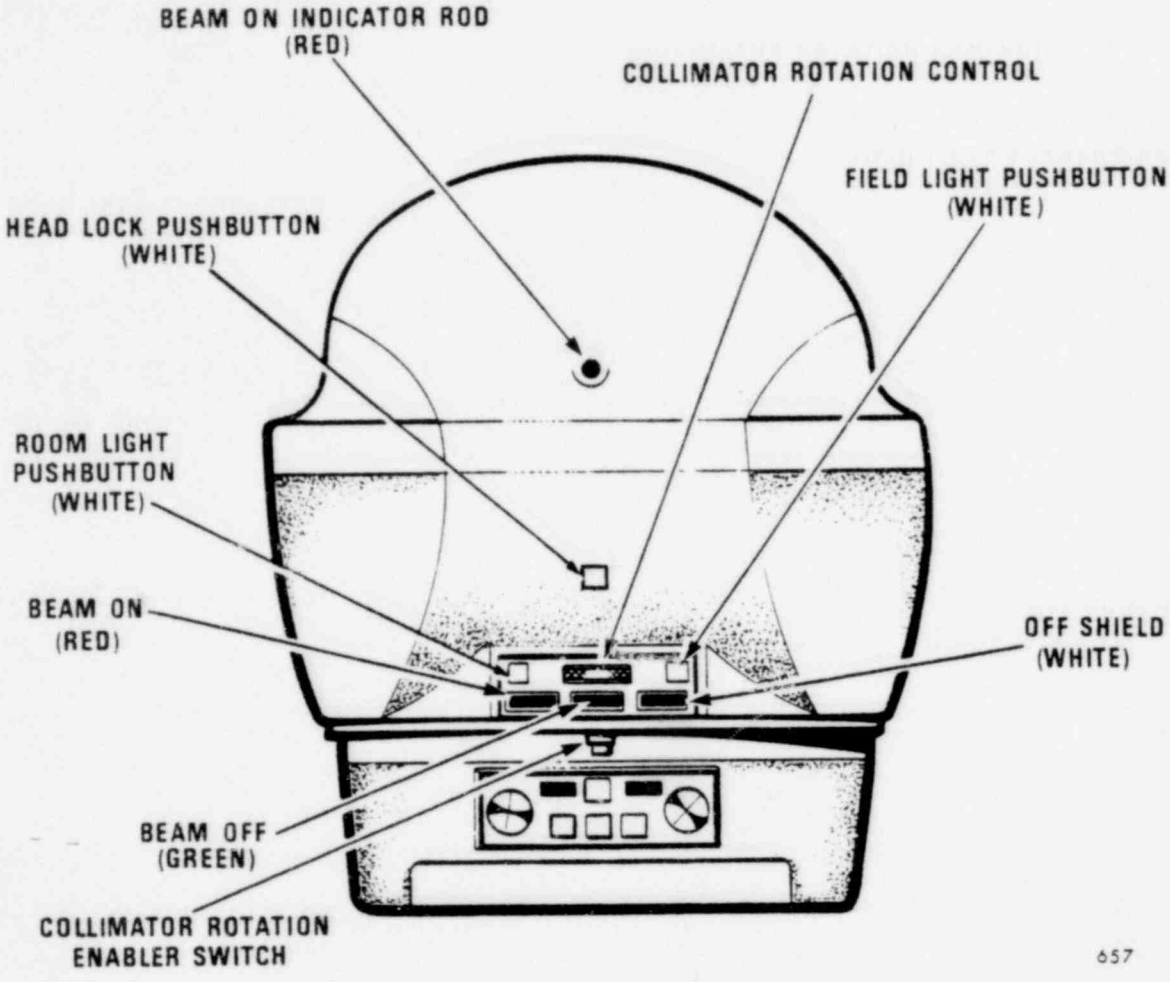


Fig. 3.7. Head Panel

f. Room Light

This white, alternate-action pushbutton controls the treatment room lights.

g. Headlock (located above the head panel)

This white, momentary-action pushbutton is used to engage or disengage the headlock. It is illuminated while the lock is engaged. The lock can be engaged only when the head is within 1° of the 0° position. The headlock must be engaged when isocentric accuracy, within unit specification, is required and for ARC, SKIP and ROT treatments.

h. Beam On Indicator Rod (located above the head panel)

This red indicator rod protrudes from the head when the source is in or near the fully exposed position. It is retracted into the head when the source returns to the

fully shielded position. If this rod is not visible but the BEAM ON lamp is illuminated, radiation fields will be substantially below the source fully exposed level but may be sufficiently high that personnel should not unnecessarily remain adjacent to the unit.

j. T-bar

The T-bar is used to secure the source in its fully shielded position while the unit is off and, in the unlikely event of source drawer system failure, to return the source to its fully shielded position.

3.3.2 Collimator Panel (Fig. 3.8)

a. Collimator X and Y Controls

These independent spring-return-to-center-zero knobs control the speed and direction of the collimator leaves. Corresponding enabler switches must be depressed before any motion can take place.

CAUTION

Do not press or release the enabler switches while operating the speed control knobs as this will reduce the operating life of some unit components.

b. Collimator X and Y Readouts

These readouts display the field size at 80 cm from the front face of the source.

The X dimension is perpendicular to, and the Y dimension is parallel to, the collimator control panel.

c. Trimmer

The rotary trimmer factor switch adjusts the X and Y readout calibrations.

Set to 45 when using only the permanently installed standard trimmers and to 55 when the 55 cm accessory trimmers (G85-092) are attached.

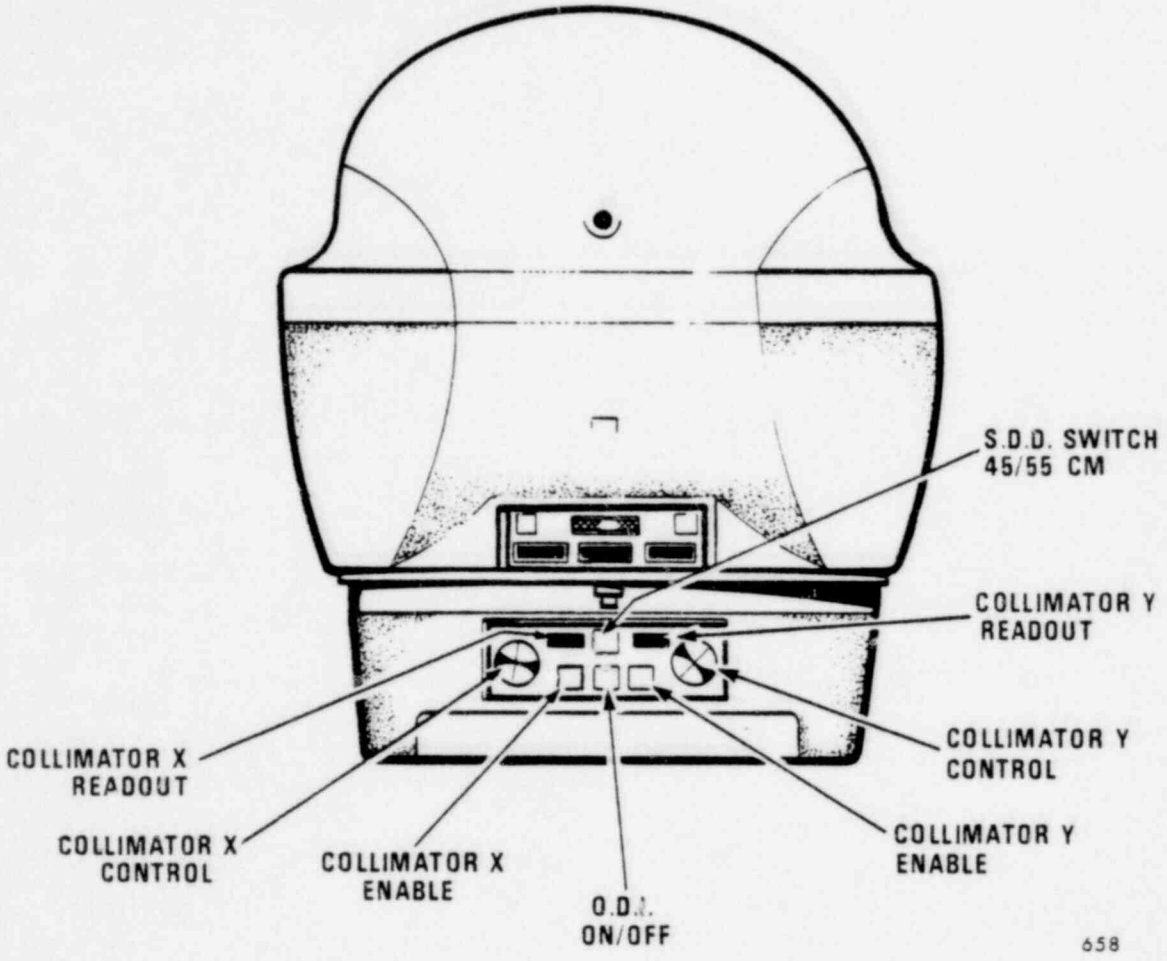


Fig. 3.8. Collimator Panel

d. SSD (source-to-skin distance) Pushbutton

This white alternate-action pushbutton controls the optical distance indicator (ODI) lamp. It is illuminated when the ODI lamp is on.

3.3.3 Mainframe Controls (Fig. 3.9)

a. Emergency Stop

Depressing either of these two red latching pushbuttons (one on each side of the unit) will place the unit in its emergency state. All motions will stop and the source will return to, or remain in, the fully shielded position. To unlatch, the button is rotated. Unlatching does not restore service; this requires the use of the keyswitch (section 3.2a) or RESTART POWER (section

3.3.3b) controls. These pushbuttons are illuminated when any EMERGENCY pushbutton is in its latched state.

b. Restart Power

This black momentary-action pushbutton, mounted on the left side of the mainframe, is used to restore service following operation of an emergency switch. It duplicates the START position of the control console keyswitch (section 3.2.1a).

WARNING

If the alarms continue to sound when the key and pushbutton are released, the emergency circuit may not operate when an EMERGENCY pushbutton is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

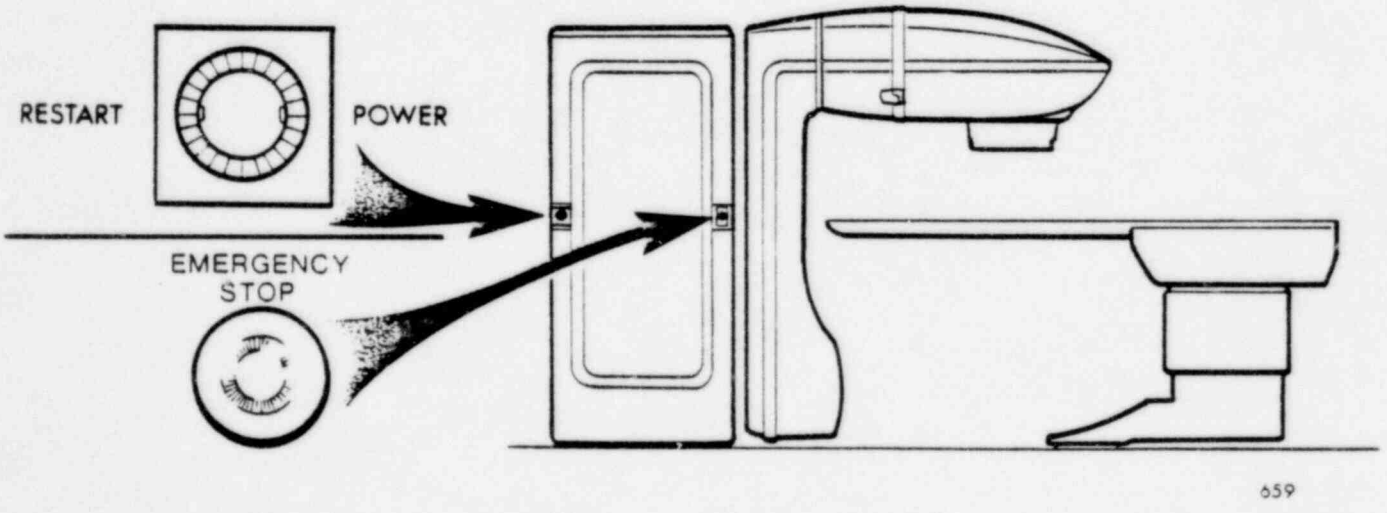


Fig. 3.9. Mainframe Controls

3.3.4 Backpointer Controls

The optical backpointer projects a cross-wire image toward the isocentre. It is used to determine the center of the treatment beam, at its exit from the patient, when the head-lock is engaged.

On beamstopper units the backpointer is standard equipment and is mounted on the beamstopper. It is controlled by an adjacent pushbutton which is illuminated when the backpointer is on.

On pendulum units the backpointer is optional and is mounted on an accessory mounting bracket. The bracket will normally be kept in its retracted position against the pendulum. The backpointer is positioned on the beam axis by pulling the bracket away from the pendulum until it is felt to engage in its detent stops. The backpointer is controlled by an adjacent toggle switch.

3.4 TABLE MOUNTED CONTROLS

3.4.1 Table 23 (Fig. 3.10)

Alternate-action switches, mounted on both sides of the front face of the table, control the lateral and longitudinal free float option. Separate switches are provided for each motion. Lamps in the switches are illuminated when the motions are locked and are off when the motions are free.

3.4.2 Table 27 (Fig. 3.11)

Locking levers for the longitudinal motion are provided on both sides of the table. The motion is locked when the levers are pointing toward the rear of the table top.

Locking levers for the lateral motion are provided on both ends of the table. The motion is locked when the levers are pointing toward the left side of the table, when viewed from the rear.

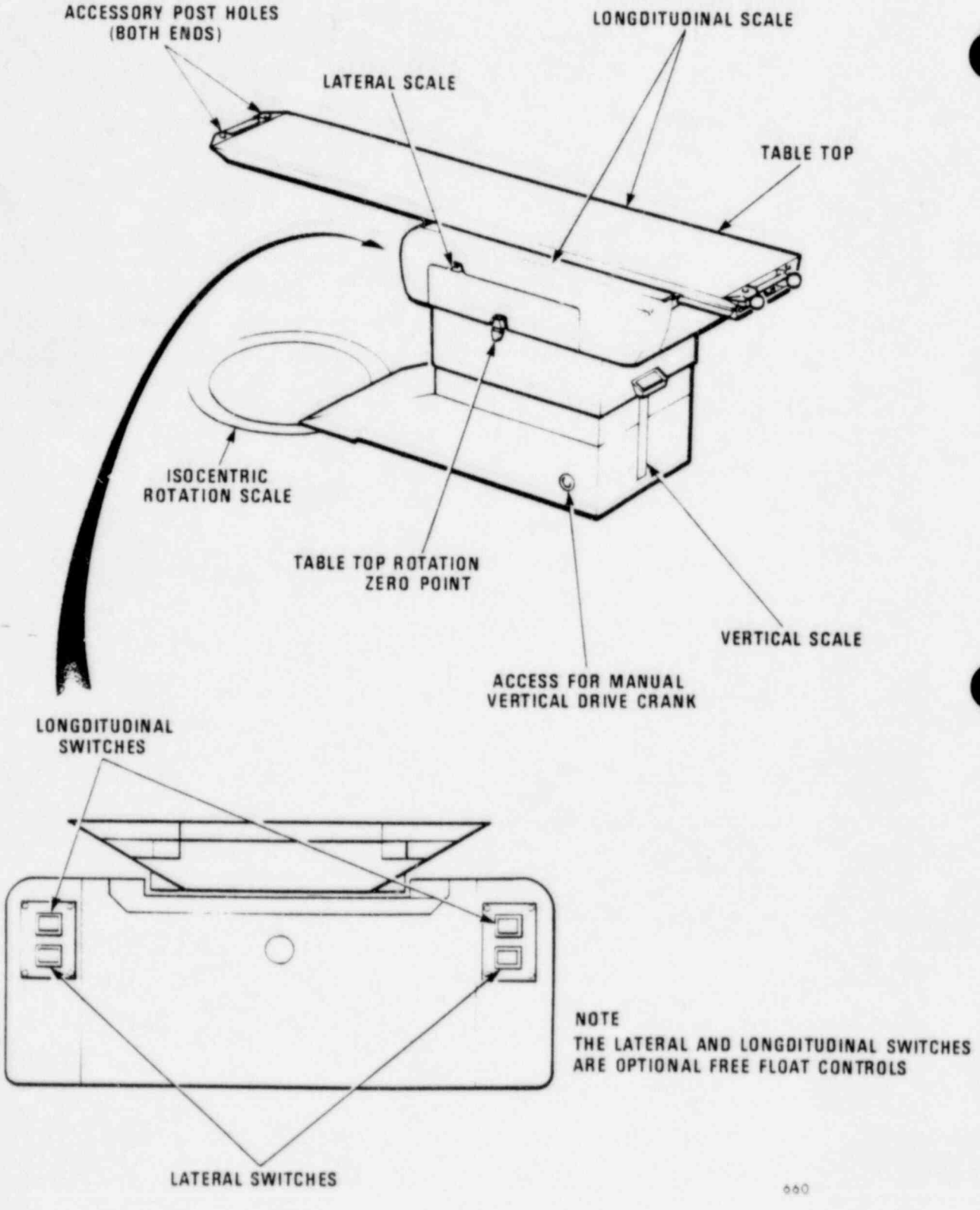


Fig. 3.10. Table 23 Controls

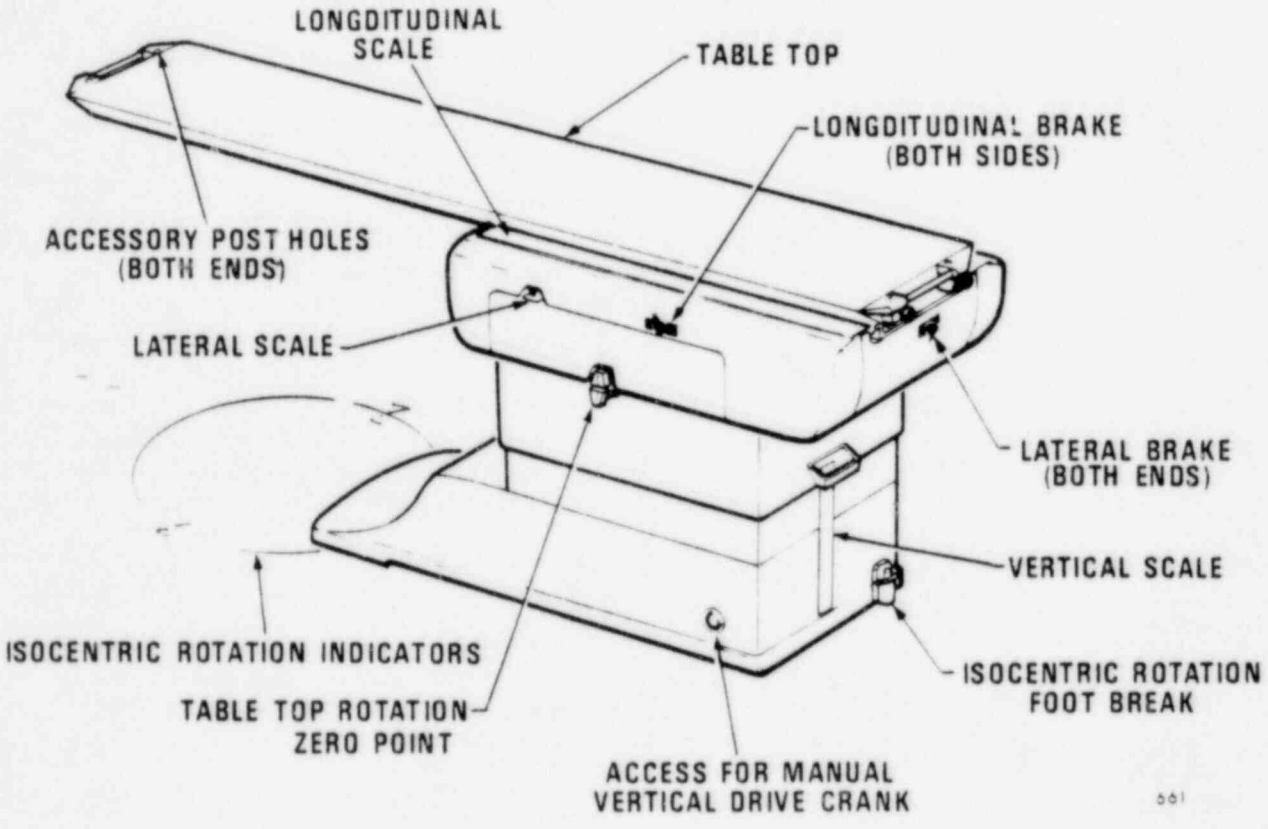


Fig. 3.11. Table 27 Controls

An isocentric rotation lock is provided on the rear of the table. The lock is engaged by depressing the central plunger and released by depressing the surrounding ring.

3.5 HAND CONTROL (Fig. 3.12 and 3.13)

This control is used for patient set-up. It contains the following controls and indicators:

a. Unit Motions

Motions are controlled by individual rocker switches. Any number of motions can be operated at the same time. Each switch is spring returned to centre and has two positions either side of centre. Light pressure on a switch will cause the motion to move slowly, heavier pressure will cause the motion to move at full speed. Slow speed has instantaneous response to permit jogging for fine positioning. High speed is ramped to provide controlled acceleration and deceleration for patient comfort.

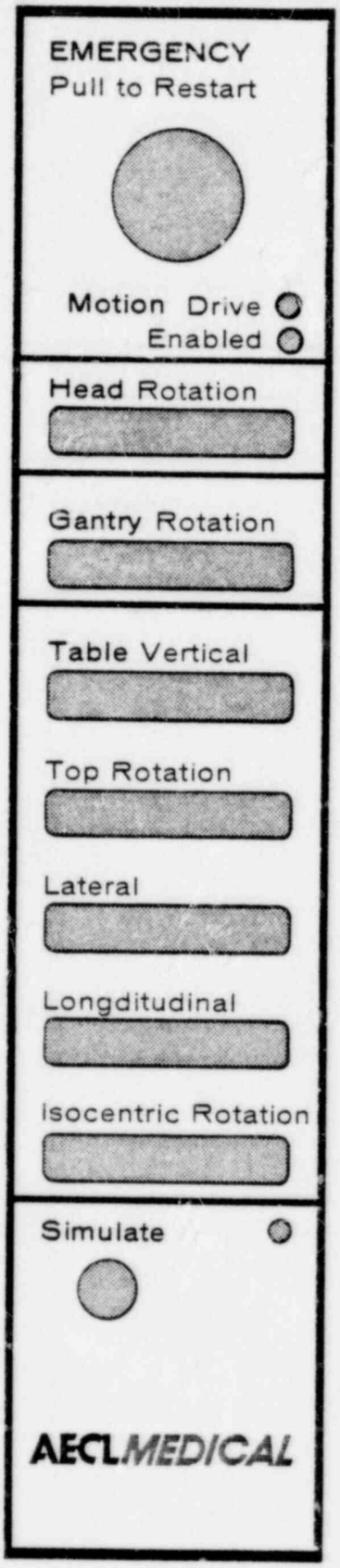
The enabler switch on the underside of the hand control must be depressed before any motion will operate.

CAUTION

Do not press or release the enabler switch while operating the rocker switches as this will reduce the operating life of some unit components.

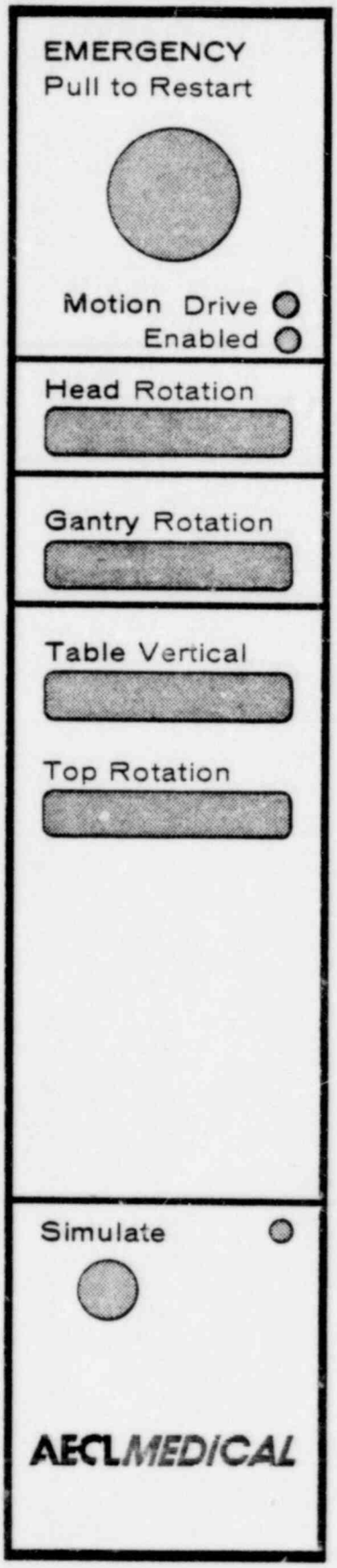
When any switch is operated, the MOTION DRIVE light is illuminated. When the enabler switch is operated, the MOTION ENABLED light is illuminated.

The slow speed of each motion can be adjusted by inserting a small slotted screwdriver into the hole in the side of the hand control adjacent to the rocker switch and turning it to obtain the desired speed. Speed increases when the screwdriver is turned clockwise.



NOTE
MOTION ENABLER LOCATED ON BACK OF HAND CONTROL

Fig. 3.12. Hand Control (Table 23)



NOTE
MOTION ENABLER LOCATED
ON BACK OF HAND CONTROL

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Fig. 3.13. Hand Control (Table 27)

b. Simulate

The SIMULATE pushbutton is provided for the confirmation of gantry rotation settings during ROT, ARC and SKIP treatments. Depressing the SIMULATE pushbutton and the enabler switch will cause the gantry to rotate in accordance with the control console settings and the SIMULATE lamp to illuminate to simulate the beam-on condition.

c. EMERGENCY

Pressing this red, non-illuminating, latching pushbutton, places the unit in its emergency state. All motions will stop and the source will return to, or remain in, the fully shielded position.

To reset the emergency circuit, the pushbutton is pulled out. Unlatching does not restore service; this requires the use of the keyswitch (section 3.2.1a) or RESTART POWER (section 3.3.3b) controls.

The hand control is either connected to the table or suspended from an overhead boom. A change from one configuration to the other can be made by properly trained service personnel. The unit must not be equipped with both configurations; such an arrangement would cause erratic operation and equipment damage.

The table mounted hand control must be parked only on its bar at the rear of the table body.

WARNING

Do not park the hand control on the table top end or side handles. To do so may actuate the enable switch and, if a simultaneous dual system failure should occur, may initiate an unwanted table or unit motion, causing injury or death.

PART 4

OPERATING PROCEDURES

4.1 GENERAL

This part contains detailed operating instructions for the Theratron 780-C:

- Start-up
- Checkout
- Patient Set-up
- Treatment
- Shutdown
- Loss of Electrical Power
- Troubleshooting

WARNINGS

1. Before operating the Theratron 780-C, the operator must be thoroughly familiar with parts 2, 3, 4 and 5 of this manual. Failure to understand and follow the proper operating and emergency procedures may cause personnel injury, death and/or equipment damage.

2. To minimize the probability of an unwanted exposure to radiation:
   a. keep the door open while working in the treatment room,
   b. always check that red tip of source indicator rod is not protruding through head cover when entering room. If the tip is visible, high radiation levels exist in the treatment zone and surrounding area.

   Unwanted exposure of personnel to radiation may cause injury or death.

4.2 START-UP

To start the unit:

a. Turn keyswitch to ON. Further turn keyswitch to START and observe sounding of alarms. Then release key for its return to ON position. The alarms should stop.

WARNING

If the alarms continue to sound when the key is released, the emergency circuit may not operate when an EMERGENCY push-button is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

b. System is now in service; record time and date in unit logbook. Perform checkout procedure, section 4.3.

4.3 CHECKOUT

The following checks must be performed each time the unit is started. If any specified performance criterion is not met, do not use the unit:

a. Beam Indicators and Emergency Tools

(1) Check that yellow RESET and green BEAM OFF lamps are on, red BEAM ON lights are off. (Check all the warning lamps on the console, the unit and any located in adjacent areas.)

NOTE

Procedures for lamp replacement are given in section 5.8.

(2) Remove the T-bar from the head and return it to the control console area. Moderate resistance to removal of the T-bar will be felt for the first 2 cm of travel. If

resistance is felt beyond this point, the source drawer is still attached to the T-bar. Push the T-bar back into the head and re-install the locking pin. Do not use the unit, consult AECL MEDICAL or their accredited Representative for service.

WARNING

Pulling the T-bar against resistance for more than 2 cm will move the source toward its fully exposed position and may expose personnel to unwanted radiation.

(3) Check that the couch vertical drive wrench is accessible at the control console.

b. Treatment Mode

(1) Ensure that gantry can rotate safely without unit and table colliding and that nobody is in the treatment room. Close the treatment room door.

(2) Set up a rotation (ROT) treatment for 0.5 minutes and press TREAT key (sections 4.4 and 4.5).

(3) Red BEAM ON lights should come on immediately and the gantry should start rotating. In two seconds, green BEAM OFF lights should go out and red indicator rod should be visible.

(4) Depress console EMERGENCY STOP pushbutton: green BEAM OFF lights should come on, timer PRIMARY and SECONDARY displays should stop counting up and SECONDARY display should flash Un.P. EMERGENCY STOP pushbutton should be illuminated. In two seconds, BEAM ON lights should go out and red indicator rod should disappear.

(5) Rotate EMERGENCY STOP pushbutton until it springs out. Its light should turn off.

(6) Turn keyswitch to START, an audible alarm should sound. Release key, it should return to ON position and alarms should stop.

WARNING

If the alarms continue to sound when the key is released, the emergency circuit may not operate when an EMERGENCY pushbutton is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

(7) Press timer RESET pushbutton twice to reset timer.

c. Timer

(1) Set up FIX treatment for 0.1 minute and press TREAT key. PRIMARY and SECONDARY displays should start counting up (sections 4.4 and 4.5).

(2) When PRIMARY time equals SET TIME, the SET TIME display should flash 'End', the BEAM OFF and RESET lights should come on and FIX pushbutton should spring out. In two seconds, BEAM ON lights should go out.

NOTE

Different PRIMARY, SECONDARY and SET TIME displays are normal, see section 3.2.2f.

d. Door Interlock

(1) Be sure nobody is in line with door opening.

(2) Set up FIX treatment; start treatment. Check that beam is on (sections 4.4 and 4.5). Open door slightly.

(3) Green BEAM OFF lights should immediately come on, PRIMARY and SECONDARY displays should stop counting. In two seconds, red BEAM ON lights should go out.

(4) Close door. Beam should remain off.

(5) Press timer RESET pushbutton to reset timer. Enter room to continue checkout procedures.

e. Motion Enabler

(1) Ensure that gantry can rotate safely, without unit and table colliding.

(2) Without depressing hand control enabler switch, operate gantry control; gantry should not move.

f. Emergency Stop (hand control)

(1) Depress enabler switch and, using gantry control, check for gantry movement.

(2) Depress hand control EMERGENCY STOP pushbutton while gantry is rotating. The gantry should stop moving. Check that all unit, table and collimator motions will not move.

(3) Pull out EMERGENCY STOP pushbutton to unlatch it.

g. Restart Power

Depress RESTART POWER pushbutton on left side of mainframe, audible alarms should sound. Pushbutton should spring back upon release and audible alarms should stop.

WARNING

If the alarms continue to sound when the pushbutton is released, the emergency circuit may not operate when an EMERGENCY pushbutton is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

h. Emergency Stop (mainframe)

(1) Depress EMERGENCY STOP pushbutton on one side of mainframe, it should be illuminated. Check that gantry, head, collimator and stretcher will not move.

(2) Rotate EMERGENCY STOP pushbutton knob counterclockwise until it springs out. Its light should turn off.

(3) Depress RESTART POWER pushbutton on left side of mainframe, audible alarms should sound. Pushbutton should spring back upon release and audible alarms should stop.

WARNING

If the alarms continue to sound when the pushbutton is released, the emergency circuit may not operate when an EMERGENCY pushbutton is depressed. Discontinue use of the unit. Continued use may cause injury or death to personnel.

(4) Repeat steps 1 to 3 using EMERGENCY pushbutton on other side of unit.

j. Collimator Controls

(1) Ensure collimator can move freely.

(2) Without depressing enabler switch, operate collimator rotation control. Collimator should not move. Repeat for collimator X and Y motions.

(3) Depress enabler switch and, using speed control, check that collimator rotation is smooth. Repeat for collimator X and Y motions.

k. Field Light

(1) Check field size readout calibration by switching on FIELD light and, using distance indicator, place field size template 80 cm from source.

(2) Set field size to 10 cm x 10 cm or 30 cm x 30 cm, using the X and Y readouts.

(3) Using Fig. 4.1, template dimension A should not differ by more than 0.2 cm from field dimension B. Dimension B must be measured between the 50% penumbra lines of the light field.

NOTE

A and B must be measured parallel to each other on one side of template to ensure accuracy as field light might not be a perfect square.

(4) If the error exceeds 0.2 cm, check that the template is exactly 80 cm from the source face and that it is at 90 degrees to the collimator axis.

(5) Check field symmetry. Align the center mark of the template with the cross-wire image. Adjust the collimator and the template until a square light field just touches the square template. No point on the 50% light penumbra line should be more than 0.25 cm from the square.

l. Radiation Monitors

If any radiation monitors are installed, test according to their manufacturer's instructions.

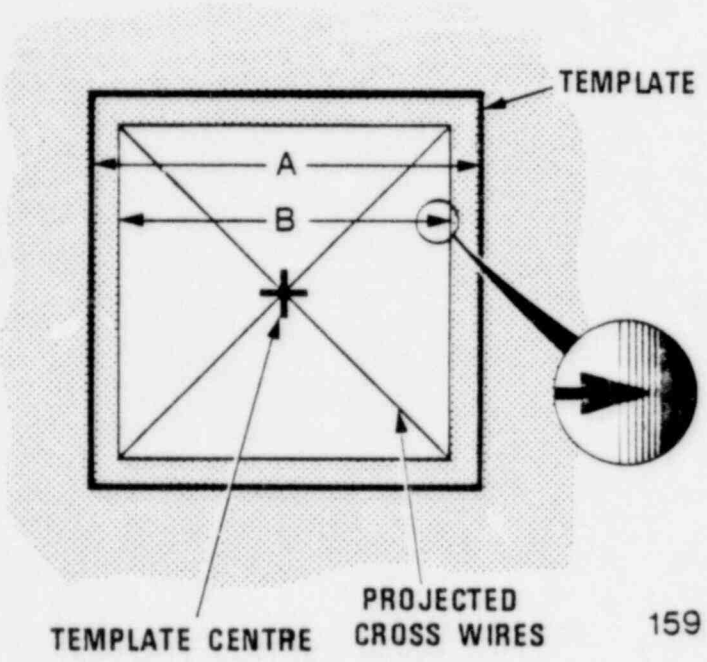

Fig. 4.1. Field Size and Symmetry

4.4 PATIENT SET-UP

a. At control console, check that all controls are set to zero. Select ARC, SKIP, ROT or FIX mode and CW or CCW direction for rotary treatments.

b. Set treatment angles for ARC and SKIP modes:

(1) For ARC treatments, adjust angle selectors to limits of treatment sector; gantry will move and beam will be on within sector in which gantry is located at start of treatment (Fig. 4.2). Initial direction of gantry movement will be as selected, CW or CCW.

(2) For SKIP treatments, adjust angle selectors to limits of treatment sectors. Gantry will rotate continuously in selected direction, with beam alternately turning on and off as it passes from sector to sector (Fig. 4.3). Beam will be on in sector occupied by gantry at start of treatment.

1. Adjust angle selectors to limits of treatment sector; e.g., 045° and 315°. See Fig. 4.2a.

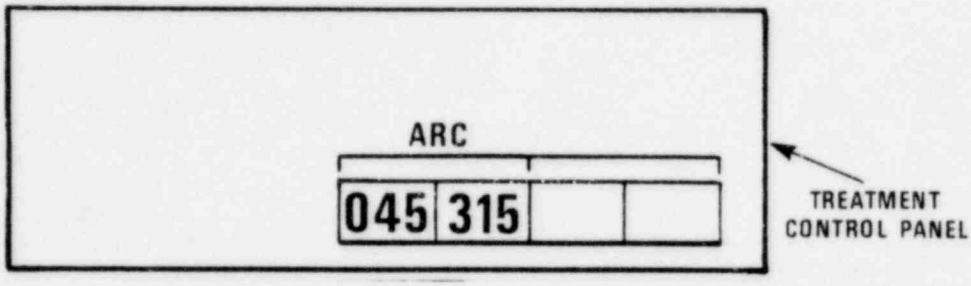

Fig. 4.2a

2. If at start of treatment the gantry is between 315° and 45°, then the beam will be on within that sector. See Fig. 4.2b.

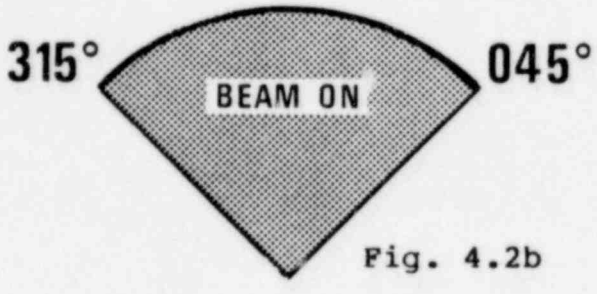

Fig. 4.2b

3. If at start of treatment the gantry is between 45° and 315°, then the beam will be on within that sector. See 4.2c.

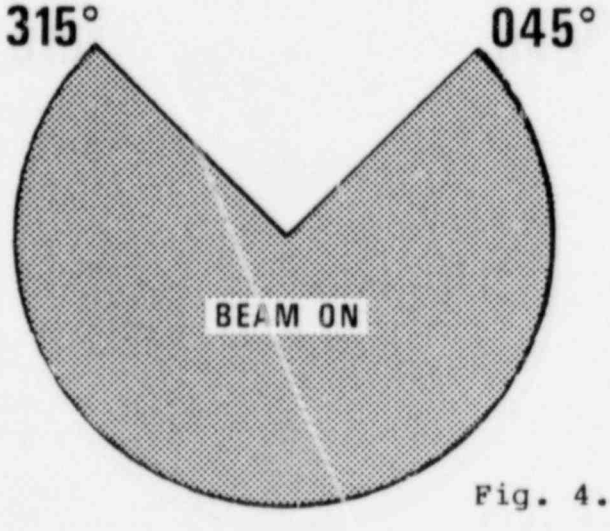

Fig. 4.2c

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Fig. 4.2. Arc Treatment

1. Adjust angle selectors to limits of treatment sectors; e.g., 045°, 135° and 225°, 135°. See Fig. 4.3a.

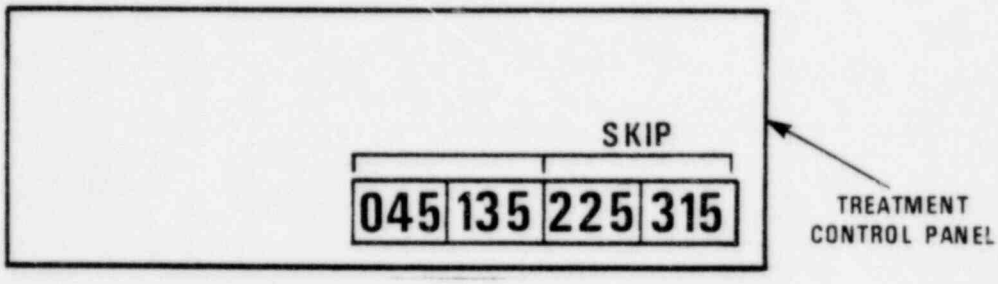

Fig. 4.3a

2. If at start of treatment the gantry is between 45° and 135° or between 225° and 315°, then the beam will be on within those sectors. See Fig. 4.3b.

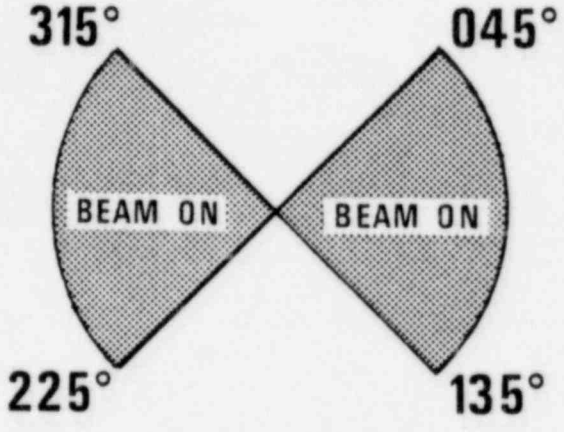

Fig. 4.3b

3. If at start of treatment the gantry is between 315° and 45° or between 135° and 225°, then the beam will be on within those sectors. See Fig. 4.3c.

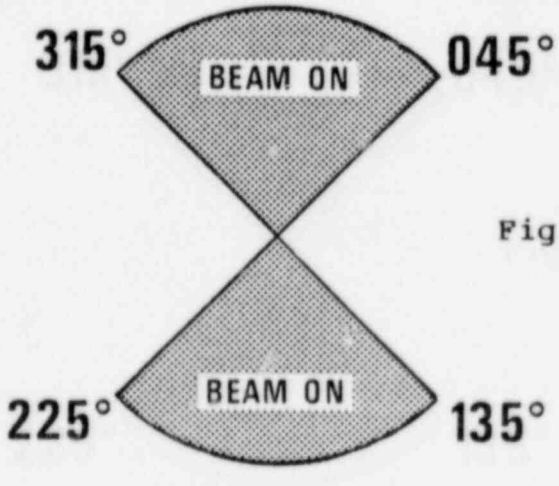

Fig. 4.3c

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Fig. 4-3. Skip Treatment

c. For ARC, SKIP and ROT treatments, set gantry speed as follows:

(1) Set control console gantry speed knob to approximate speed (e.g., 0.5 rpm).

(2) Ensure that gantry is free to rotate without colliding with the table.

(3) At hand control, rotate gantry by depressing SIMULATE button.

(4) Use stop watch to check actual speed over a large sector (e.g., 90 degrees in 0.5 minutes).

(5) Adjust control console GANTRY SPEED dial and repeat steps 3 and 4 until desired speed is obtained.

d. In the treatment room, set open section table top cranks (if installed) to desired position:

(1) Lift latch lever to disengage latch keeper (Fig. 4.4). Lift latch end of removable support and withdraw it from the locating pins.

(2) Rotate the cranks to required positions. Check that cranks are resting on crank stop pins.

(3) Re-fit removable support on the locating pins and secure with latch.

WARNING

Failure to secure latch properly will allow the removable support to move. This might cause injury to the patient.

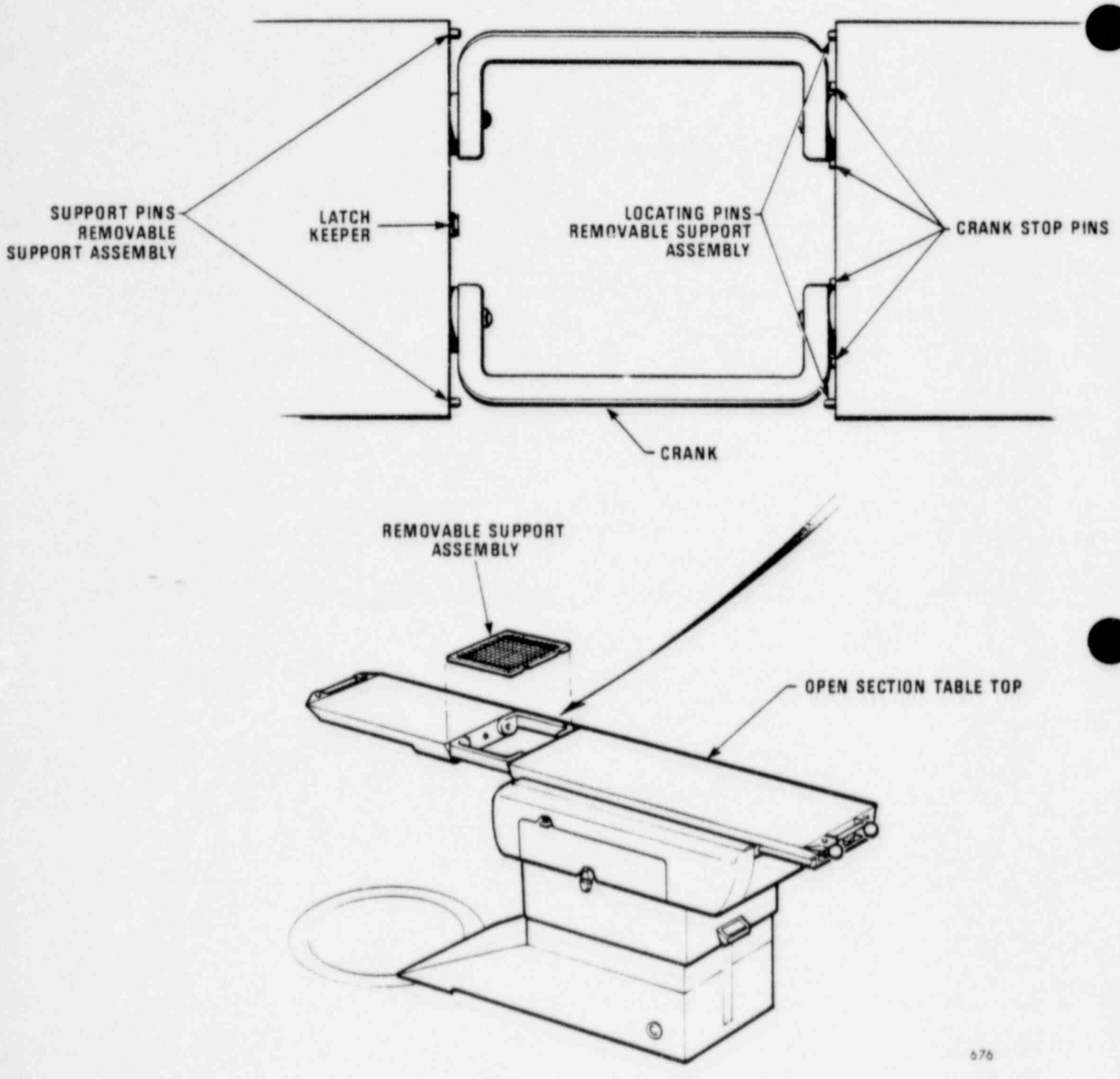

Fig. 4.4. Open Section Table Top

e. Accommodate patient on table top.

WARNINGS

1. **Ensure that the isocentric rotation, longitudinal and lateral brakes are engaged on Table 27. Ensure that the lateral and longitudinal free float drives (if installed) on Table 23 are in the locked, not the free position (the switches should be illuminated). If these motions are not locked, the table top might move causing injury to personnel.**

2. **The static load capacity of the table is 136 kg (300 lb). If a higher load is placed on the top, it may collapse causing injury to personnel.**

f. Adjust unit and table to direct beam to prescribed area.

WARNINGS

1. **Protect patient against accidental collision as follows:**
   - **Advise patient not to move when any motion is in operation. It is essential that patient should not move unless operator is inside treatment room.**
   - **Observe both unit and patient when operating any motion.**
   - **Ensure that the collimator and the collimator mounted accessories are not in contact with the patient while engaging or disengaging the headlock. Head movement may cause injury to the patient.**

2. **The red beam-on indicator rod protrudes about 5 cm (2 in.) past the front of the head covers when the beam is on. It may strike the table in some unit and table positions, causing the source not to move completely to the fully exposed position and unwanted radiation to be delivered to the patient.**

NOTE

If treatment is in the ARC, SKIP or ROT mode, or if it requires the sourcehead to be at 0° with optimum isocentric accuracy, the headlock must be engaged.

g. Operating instructions for accessories are given in Part 5.

WARNING

Be careful when using any collimator mounted accessory that touches or comes close to a patient. Although accessories are designed to minimize the probability of injuring the patient, in some combinations of unit and patient position an accessory might be forced into contact with the patient, causing injury.

h. Simulate rotary treatments:

(1) For ARC treatments, position gantry within beam-on sector, at least two degrees from limit angles. Actuate hand control enabler switch and depress SIMULATE button. Confirm that gantry moves to and fro within treatment sector; SIMULATE lamp should be on and unit should move without colliding with patient or table. Release SIMULATE button when gantry is more than two degrees from limit angles.

(2) For SKIP treatments, position gantry within beam-on sector, at least two degrees from limit angles. Actuate hand control enabler switch and depress SIMULATE button. Confirm that gantry rotates continuously; SIMULATE lamp should be on in the sector in which the gantry starts to rotate and should turn off and on as the gantry passes through subsequent sectors. The unit should move without colliding with patient or table. Release SIMULATE button when gantry is within a beam-on sector and is more than two degrees from limit angles of sector.

(3) For ROT treatments, actuate hand control enabler switch and depress SIMULATE button. Confirm that gantry rotates continuously; SIMULATE lamp should be on and the unit should move without colliding with patient or table. Release SIMULATE button to stop gantry in required position.

NOTES

1. If the simulate button is released and re-pressed, gantry motion will continue in the same direction, and the simulate lamp will give the same indication, as when the button was released.

2. If prior simulations have been attempted since the last treatment, the initial direction of gantry motion and the simulate indication may not be as expected. Press the control console RESET pushbutton and repeat the simulation.

j. Re-assure patient; buzzers and flashing lights are normal and the air compressor may operate.

k. Close door when leaving treatment room.

4.5 TREATMENT

a. Enter the prescribed time (in minutes) into the timer (Fig. 3.3). A maximum of 20.99 minutes may be entered.

   If the entry exceeds 20.99 minutes, the timer cannot be turned on to start treatment. To clear the error, press timer RESET pushbutton and re-enter the prescription.

b. If unit is equipped with a wedge filter interlock, confirm the wedge filter:

   (1) From the prescription, determine the wedge filter to be used.

   (2) Determine the prescribed wedge filter code number from Table 5.1.

   (3) Enter the code number on the wedge filter display panel (Fig. 3.5).

   (4) Press the CONFIRM pushbutton. The confirm indicator should be illuminated. If the confirm light is not illuminated, the wedge filter and code do not correspond or the wedge filter is installed in the wrong position. Check the wedge filter installation and repeat this confirmation procedure.

c. Confirm that all settings comply with prescription. For ARC, SKIP and ROT treatments, ensure that the proper direction of initial movement (CW or CCW) has been selected. For ARC and SKIP treatments, ensure that gantry is in a prescribed beam-on sector and is more than 2 degrees from limit angles of sector. This applies both when starting a treatment and resuming an interrupted treatment.

WARNING

If an ARC or SKIP treatment is started with the gantry in a prescribed beam-off sector, unwanted radiation will be delivered to some areas of the patient.

d. Check that all interlock status indicator lamps are off; then depress unit RESET button. This will turn off the RESET light.

e. Start treatment by pressing the timer TREAT pushbutton. Observe the patient and unit, through shielded window or on TV monitor, and the console controls. If a collision is imminent or if the treatment does not proceed as described below, terminate the treatment.

(1) The BEAM ON lamp is illuminated.

(2) In 2 seconds the BEAM OFF lamp turns off and the PRIMARY and SECONDARY displays start to count up.

(3) For ARC and SKIP treatments, the gantry moves and the beam is on within the prescribed sectors. When irradiation is automatically interrupted during SKIP treatments, the timer SET TIME display will flash 'Un.P' alternately with the set time.

(4) For ROT treatments, the gantry rotates.

(5) For FIX treatments, the gantry does not move.

(6) When PRIMARY time equals SET TIME, the SET TIME display flashes 'End', the RESET and BEAM OFF lamps are illuminated and the treatment mode pushbutton springs out.

(7) Two seconds after event (6) the BEAM ON lamp turns off.

WARNING

If at the end of treatment the BEAM ON lamp remains on or the BEAM OFF lamp is not illuminated, the patient may be receiving unwanted radiation. Proceed as instructed in emergency procedure posted at control console (section 2.5.3).

f. At end of treatment record angle at which gantry stops and direction in which it was moving. This information may be required for future treatments. Return console controls to zero. To clear gantry direction selection, push and release CW and CCW pushbuttons simultaneously. Press timer RESET pushbutton to reset timer.

g. To interrupt a treatment, press any timer pushbutton. This will cause the BEAM ON lamp to turn off, the BEAM OFF lamp to be illuminated and the SET TIME display to flash 'OP.P' alternately with the set time. Adjust patient set-up as required. Re-select treatment mode. Resume treatment by proceeding from step b above.

h. To manually terminate a treatment, press any timer pushbutton. This will cause the BEAM ON lamp to turn off, the BEAM OFF lamp to be illuminated and the SET TIME display to flash 'OP.P' alternately with the set time. Record the PRIMARY time reading, the angle at which the gantry stops and the direction in which it was moving. Return console controls to zero. Press timer RESET key to reset timer.

j. The treatment will be automatically terminated if the status of any treatment interlock is changed during treatment. The timer SET TIME display will flash 'Un.P' alternately with the set time. Determine the cause of the termination (section 4.8.4b).

If treatment is not to be resumed, record the PRIMARY time reading, the angle at which the gantry stopped and the direction in which it was moving. Return console controls to zero. Press timer RESET pushbutton twice to reset timer.

If treatment is to be resumed, press any pushbutton to cause the timer to flash 'OP.P' and proceed from step b above.

4.6 SHUTDOWN

When treatments are completed, switch off keyswitch and remove key from console for safekeeping.

Secure the source in the fully shielded position by:

a. inserting the T-bar through the hole in the front of the head cover until it is felt to engage the indicator rod.

b. aligning the hole in the T-bar with the hole in the cover and inserting the locking pin.

4.7 LOSS OF ELECTRICAL POWER

A loss of electrical power will shut down the complete system, including turning off the radiation beam. If this occurs, proceed as follows:

a. Remove patient from treatment room promptly.

WARNING

If Table 23 is equipped with the free float option, the lateral and longitudinal motions will be free. Take care to prevent injury when unloading the patient.

NOTE

To lower the table top by hand, pry off the chrome-plated disc (marked DOWN) from the base of the table (Figs. 3.8 and 3.9). Fit the cranked wrench supplied with the table (it should be stored near the control console) to the hexagonal shaft and rotate the handle rapidly. (The table will move very slowly; 47 turns of the wrench will move the stretcher 1 cm.)

b. Record PRIMARY treatment time.

c. When power is restored, timer SET TIME and SECONDARY displays will flash 'rSEt' alternately with 8.8.8.8.

Clear displays (to 0.00) by pressing the timer RESET pushbutton. The timer will not respond to any other command.

d. Restart unit according to the procedures given in sections 4.2 and 4.3.

4.8 TROUBLESHOOTING

4.8.1 Start-up

If all control console lamps remain off when key is turned to ON (indicating electrical power cut-off), check as follows:

a. Circuit breaker on console. If it springs out when depressed, a short circuit exists. Call service agent.

b. Main disconnect, or isolating switch. If it is turned off, check with building maintenance staff before turning switch on.

4.8.2 Emergency Stop System

If depressing RESTART POWER button on mainframe or turning console keyswitch to START will not reset the emergency circuit, check the control console or mainframe EMERGENCY STOP pushbuttons. If they are illuminated, one or more of the emergency pushbuttons is latched. Check all locations, control console, hand control, mainframe. The circuit can be reset only when they are unlatched.

4.8.3 Gantry Rotation

If gantry will not rotate when console SET UP or hand control SIMULATE pushbuttons are depressed but does rotate when hand control is used, check that:

a. Console GANTRY SPEED control is not set too low.

b. Either CW or CCW pushbutton at console is depressed and that one of the rotary treatment mode pushbuttons (ARC, SKIP or ROT) is depressed.

If the gantry stops rotating during patient set-up, check that the head is locked when the gantry rotation angle is in the sector 115 through 180 to 245 degrees.

4.8.4 Reset System

The reset system will stop or prevent treatment and the RESET lamp will be on if any treatment interlock is not satisfied or is changed during treatment.

If the unit RESET pushbutton light will not go out when depressed, or comes on during treatment, check that:

a. Treatment timer is not in a 'Un.P' condition.

b. On the interlock status indicator (Table 3.2) all lamps are extinguished.

If the DOOR, HEADLOCK, OFF SHIELD, WEDGE FILTER, TREAT MODE, or TREAT ANGLE lamps are illuminated, correct the set-up.

If the AIR PRESSURE or SOURCE DRAWER lamps are illuminated, discontinue use of the unit and call service agent.

NOTE

It is normal for the air compressor to run and the AIR PRESSURE interlock indicator to be illuminated for a short period following unit start-up.

4.8.5 Timer

The timer flashes various messages (ref. Table 3.1) to indicate particular timer and unit conditions. The operator actions required are:

MESSAGE		AUDIBLE	ACTION REQUIRED
SET TIME DISPLAY	SECONDARY DISPLAY		
End		-	Normal condition. No special action required.
OP.P		-	Normal condition. No special action required.
Un.P		-	Normal condition. No special action required.
rSEt		-	This message accompanies restoration of electrical power following interruption. See Section 4.7.
	Eror	Single beep	Treatment time not properly entered. Press timer RESET pushbutton and re-enter treatment time.
-	-	Single beep	Press unit RESET pushbutton. Then press timer TREAT pushbutton to commence treatment.
Other messages		Single beep	System malfunction. Shut down unit (Section 4.6) and advise licensee or designate.
All other messages		Continuous beeps	System malfunction with possible unwanted source exposure. Immediate action required to minimize exposure of personnel to radiation. See Section 2.5.3 for emergency procedure.

If timer will not accept a prescription entry, ensure that it has been reset by depressing timer RESET key.

PART 5

ACCESSORIES

5.1 INTRODUCTION

This part describes the use of the accessories. For a complete listing of the available accessories consult AECL MEDICAL or their accredited Representative.

The accessories have been grouped by function:

- General Accessories
- Beam Modifying Accessories
- Beam Positioning Accessories
- Stretcher Accessories

WARNINGS

1. **Be sure accessories are properly secured. A loose or falling accessory may cause patient or operator injury.**

2. **Be careful when using any collimator mounted accessory that touches, or comes close to a patient. While accessories are designed to minimize the probability of injuring the patient, in some combinations of unit and patient position they may be forced into contact with the patient, causing injury.**

3. **Do not engage or disengage the head swivel lock while using collimator mounted accessories that are in contact with, or near to, the patient. The head movement that accompanies actuation of the lock may cause patient injury.**

4. **Before any isodose charts are used for treatment planning, measurements should be made to ensure the radiation pattern for the particular unit agrees with the charts. Recommended tests and procedures are given by IAEA (1970) - Technical Reports Series No. 110 "Manual of Dosimetry in Radiotherapy" J.B. Massey. If the charts are not verified, unwanted radiation may be delivered to the patient.**

5. **Do not allow personnel to look into laser beams, otherwise damage may occur to eye tissue.**

5.2 GENERAL ACCESSORIES

5.2.1 Isodose Charts

The set (G22-010) of approximately 250 isodose charts is printed on shrink-resistant paper. Each set contains charts for:

a. Various source sizes.

b. Source-to-skin distances of 65, 80 and 100 cm.

c. Fixed treatments (at maximum normalization 0.5 cm below the surface).

d. Rotational treatment with the source-to-axis distance of 80 cm (normalized at 75 and 15 cm below the surface).

The charts were prepared using a computer-controlled scanner moving a Baldwin 0.6 cm^3 probe in a water phantom. Measurements were recorded at 0.25 cm intervals over a horizontal and vertical grid. Using this data, the charts were plotted by a computer-controlled drafting machine.

The charts are based on the recommendations of the International Commission on Radiation Units Report 10(d) "Clinical Dosimetry" (reprinted in the U.S. National Bureau of Standards Handbook 87) and the International Atomic Energy Authority, Technical Report Series 8 "Single Field Isodose Charts for High Energy Radiation".

5.2.2 Therapy Dosimetry System

An instruction manual is included with the dosimetry system (G74-00).

5.2.3 Room Radiation Monitor

An instruction manual is included with the radiation monitor (G22-135A).

5.2.4 Transit Dosemeters

Operating instructions are contained in a separate manual supplied with the dosemeter (G22-081B and G22-081C): "Operating Instructions for the Transit Dosemeter, G22-081".

On beamstopper units the dosemeter ion chamber is permanently installed in line with the isocenter.

On pendulum units the ion chamber is installed on the accessory mounting bracket (G22-013). To align the ion chamber with the isocenter, pull the bracket away from the pendulum until it is felt to engage in its detent stops.

5.3 BEAM MODIFYING ACCESSORIES

5.3.1 Trimmers

The 55 cm trimmer set (G85-092) consists of four uranium or tungsten bars which attach to the collimator leaves with one-turn screws. When correctly attached, the bars are aligned with the faces of the leaves; the distal edge of the lower pair being 55 cm from the source.

The trimmers reduce the penumbra; they also slightly reduce the field size. The collimator panel trimmer factor switch setting must correspond with the attached trimmers to obtain correct field size display.

The required wedge filter rail must be installed before the 55 cm trimmers are attached.

CAUTION

The wedge filter rails cannot be inserted or removed with the 55 cm trimmers installed. Any attempt to do so may damage the trimmers, the wedge filter rails or the collimator.

If the trimmer material is depleted uranium, it has a reduced content of the fissile isotope uranium-235. Over 99.6 percent of the material is the stable isotope uranium-238. However, as the bars are slightly radioactive, they are electro-plated and painted to reduce the risk of contamination. They should be handled with reasonable care, to avoid scratches and other damage, and should periodically be checked for removable contamination (section 5.7).

5.3.2 Wedge Filters

Various wedge filters are available for modifying the isodose characteristics of the radiation beam. The filters are mounted on plates which slide into wedge filter rails.

a. Wedge Filter Rails

45 and 55 cm wedge filter rails (G85-094 and G85-173, respectively) are used to hold the 45 and 55 cm SDD wedge filters.

The wedge filter rails fit on rollers on the inside of the collimator enclosure. They must be pushed home smartly until both latches snap into their locked positions. Then proper engagement of the latches must be checked by attempting to pull the rails from the collimator. To remove the rails, both latch knobs must be pulled simultaneously until the rails are ejected a small distance. The rails

are then pulled free of the collimator. The resistance of an auxiliary holding device will be felt just before the latches snap into place during installation and as the rails are pulled free during removal.

WARNING

The auxiliary holding device is not designed to retain the wedge filter rails. Any attempt to use this device to retain the rails, may permit them to fall from the collimator and cause injury to personnel.

CAUTION

The wedge filter rails cannot be inserted or removed with the 55 cm trimmers installed. Any attempt to do so may damage the trimmers, the wedge filter rails or the collimator.

b. Filters

Available lead-alloy wedge filters are listed in Table 5.1.

Each wedge filter is designed to provide one isodose angle (15, 30, 45 or 60 degrees) and to be used at one distance (45 or 55 cm nominal) from the source.

WARNING

The stated isodose angle will not be obtained if a filter is used at a distance other than that for which it is designed. This might cause the wrong radiation treatment to be delivered to the patient.

To install a wedge filter, it is inserted under the latch roller and between the guide rollers. To facilitate entry into the rail, the wedge filter should be inclined upward toward the rail at an angle of approximately 15° to the horizontal. It

Table 5.1. Wedge Filters

WEDGE NUMBER	SDD-cm	WEDGE ANGLE	FIELD SIZE cm x cm	INTERLOCK CODE NUMBER
G85-282E	45	15	15 x 20	11
G85-151A	45	30	6 x 15	12
B			8 x 15	13
C			10 x 15	14
E			15 x 20	15
G85-152A	45	45	6 x 15	16
B			8 x 15	17
C			10 x 15	18
E			15 x 20	19
G85-153A	45	60	6 x 15	20
B			8 x 15	21
C			10 x 15	22
G85-174A	55	30	6 x 15	51
B			8 x 15	52
C			10 x 15	53
G85-175A	55	45	6 x 15	54
B			8 x 15	55
C			10 x 15	56
G85-176A	55	60	6 x 15	57
B			8 x 15	58
C			10 x 15	59
No wedge	-	-	-	00

should then be raised until horizontal and pushed home smartly until the retaining latch snaps into the locked position. Proper retention of the wedge filter should be checked by attempting to pull it from the rails.

CAUTION

The wedges are keyed to prevent incorrect insertion. Any attempt to force a wedge into an incorrect position may cause damage.

To remove the wedge, raise the latch lever and pull out the wedge.

A storage rack (G85-178) for holding up to 9 wedges is available.

c. Wedge Filter Interlock System

The wedge filter interlock system is designed to reduce the probability of using the wrong wedge filter. Each wedge filter is fitted with a coded actuator. The installed wedge filter (or no filter condition) must be confirmed by entering the corresponding code at the wedge filter display panel before treatment can be started or resumed following an operator interruption.

The interlock system comprises three components:

- G85-179A. The interlock control panel and the addition of a coding connector to the 45 cm wedge filter rails.
- G85-179B. The addition of a coding connector to the 55 cm wedge filter rails.
- G85-179C. The addition of a coded actuator to the wedge filter. Each wedge filter uses the same coding kit; the code is set at the time of connector installation.

See sections 3.2.3 and 4.5b for a description of the wedge filter interlock panel and its method of operation.

5.3.3 Beamshaping Blocks and Trays

Various radiation attenuating blocks are available for shaping the treatment field. The blocks sit on trays which are inserted into beamshaping tray rails.

The maximum load that may be placed on any beamshaping tray is 20 kg (44 lb).

a. Beamshaping Rails

Three sets of beamshaping tray rails are available so that maximum clearance can be obtained around the isocentre for various combinations of wedge filters and beamshaping blocks. Each can be attached to both the 45 cm and 55 cm wedge filter rails. The characteristics of the various rails are:

BEAMSHAPING TRAY RAILS	APPLICATION	CLEARANCE TO ISOCENTRE	
		with 45 cm WF rails	with 55 cm WF rails
G85-169A (short)	a. 5 cm lead blocks, no wedge filter.	27 cm	16 cm
G85-169B (medium)	a. 5 cm lead blocks with wedge filter, or b. 7.6 cm (3 in.) cerrobend blocks, no wedge filter.	24 cm	13 cm
G85-169C (long)	a. 7.6 cm (3 in.) cerrobend blocks with wedge filter, or b. By using both slots in these rails, the 5 cm lead blocks can be inverted about their mid-plane to give a mirror image. Can be used with wedge filters.	21.5 cm	10.5 cm

The beamshaping tray rails fit over rollers on the outside of the wedge filter rails. They must be pushed home smartly until the latch snaps into the locked position. Then proper engagement of the latch should be checked by attempting to pull the rail from the wedge filter rails. To remove the rails, the latch knob on the side of the rails is first pulled outwards.

CAUTION

The beamshaping tray rails should never be installed or removed whilst loaded with blocks. To do so would place excessive strain on the guide rollers.

b. Beamshaping Trays

Various beamshaping trays are available:

(1) Collimator Mounted Trays

Two trays are available for use with the beamshaping rails described in 'a' above:

- a plain beamshaping tray (G85-150B) which must only be used in the horizontal position as the beamshaping blocks are not secured to the tray.
- a slotted beamshaping tray (G85-150A) which may be used at various angles when the beamshaping blocks are secured in position.

To install a plain or slotted tray, push it into the slots in the beamshaping tray rails. Pull out the latch knob on the side of the rails, push the tray fully home and release the latch. Check for proper engagement of the latch by trying to pull the tray from the rails.

(2) Mobile Beamshaping Tray

The mobile tray (G21-105) can be adjusted vertically over a range of 95 to 137 cm above the floor, using a hand crank at the rear of the frame. When in position, it may be locked in place by depressing both floor locks. To release the locks, depress the lever below the plunger. The plunger should spring up.

(3) Table Mounted Beamshaping Tray

The table mounted tray (G22-087) is assembled as shown in Fig. 5.1. The locking collars must be securely pinned to the tee supports and rest on the accessory clamp (G22-080). The tray might slip if it is supported only by the table accessory clamp screws. Instruction for attaching the accessory clamp to the table top are given in paragraph 5.5.2.

c. Beamshaping Blocks

Lead and tungsten beamshaping blocks are available.

(1) Lead Beamshaping Blocks

Kit G85-239 contains 21 lead blocks of assorted shapes. Each block, which is 5 cm high, has a screw for securing it to the slotted tray. The screws should not be overtightened. The blocks transmit 5 percent of the radiation.

Kit G85-097 contains 21 blocks (G85-239), one plain beamshaping tray (G85-150B) and one slotted beamshaping tray (G85-150A).

Screws or inserts must be kept in the blocks while they are in use. Special inserts are provided for use while the blocks are sitting unsecured on the tray and the securing screws would interfere with the trimmers or wedge filters.

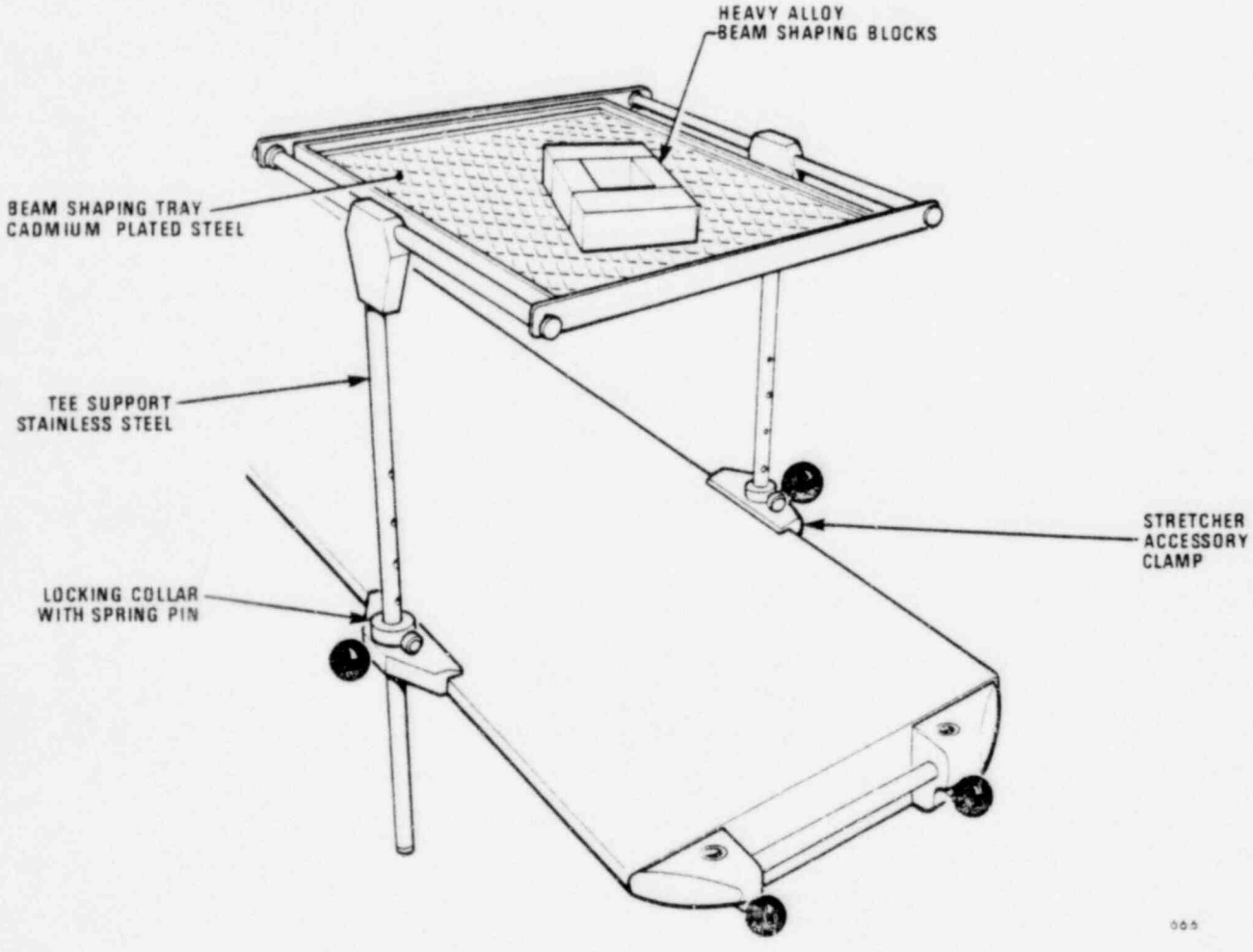

Fig. 5.1. Table Mounted Beamshaping Tray (G22-087)

WARNING

If the securing screws or inserts are omitted, radiation transmission may exceed 5% through some parts of the blocks and unwanted radiation may be delivered to the patient.

(2) Tungsten Beamshaping Blocks

G10-148A contains 7 tungsten blocks of assorted shapes. The tungsten blocks have a smaller penumbra than the lead blocks. They are 2.85 cm high and transmit 7 percent of the radiation. Having no clamping screw, they can only be used with a horizontal tray.

5.4 BEAM POSITIONING ACCESSORIES

5.4.1 Mechanical Indicators

There are two mechanical distance indicators. One indicating 80 cm (G85-078A) and one indicating 100 cm (G85-078B). They attach magnetically to mounting pads on the lower collimator face.

5.4.2 Positioning Lights

The wall and ceiling-mounted positioning lights (G09-065) are used as an aid to align the patient with the beam. They are normally aimed at the isocenter and aligned parallel to one of the couch motions.

5.4.3 Lasers

Operating instructions are supplied with the lasers.

5.5 TABLE ACCESSORIES

5.5.1 Patient Straps

The 71 cm and 102 cm long straps (G22-147A, B and C) are used to hold the patient in position or to support bolus bags, etc. Each strap has a metal ring at one end and an area of Velcro hooks at the other. The remaining area is covered with Velcro loop pile. The straps can be linked together and wrapped around the table top and patient. They are secured by pressing the hook section into the pile area. The straps may also be secured with end clamps when they cannot be passed around the table top. See Fig. 5.2.

5.5.2 Patient Supports

The patient support accessories are available in kits or as individual components. The rests are thermoplastic mouldings, fitted with a ball socket clamp that allows them to be fixed at any angle over a 90 degree range. Each rest has a short Velcro strap which may be used to secure the patient's head, arm or leg.

(1) Leg Support Kit

The leg support kit (G22-200A) consists of two posts and two rests designed to support one or two legs above the table top. See Fig. 5.3.

(2) Arm Support Kit

The arm support kit (G22-201A) consists of two posts and two rests designed to support one arm on either side of the table top. See Fig. 5.4.

(3) Head Rest Kit

The head rest kit (G22-204A) consists of one head rest and a post. See Fig. 5.5.

The posts in the above kits may be clamped in the accessory holes located in the handles at either end of the table top. They may also be clamped to the table accessory clamp

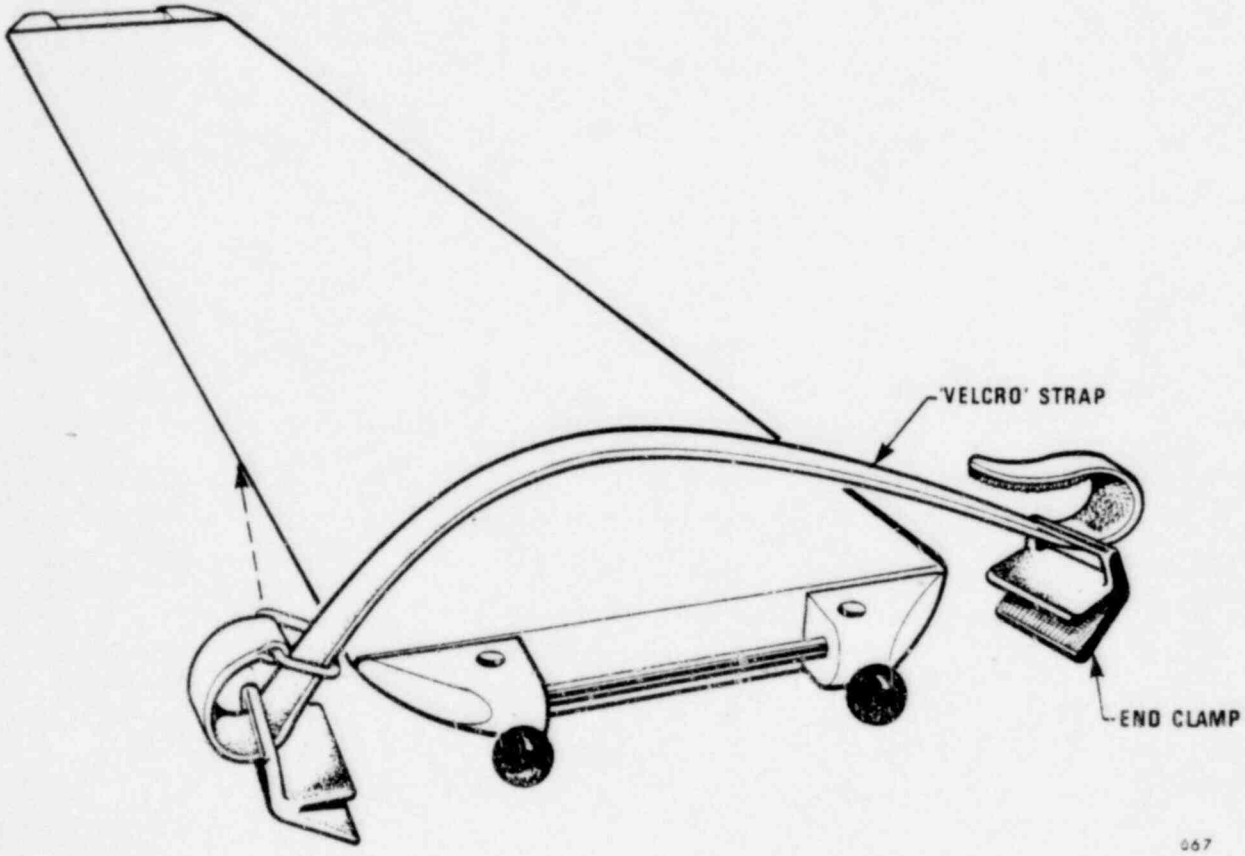

Fig. 5.2. Patient Strap (G22-147A,B,C)

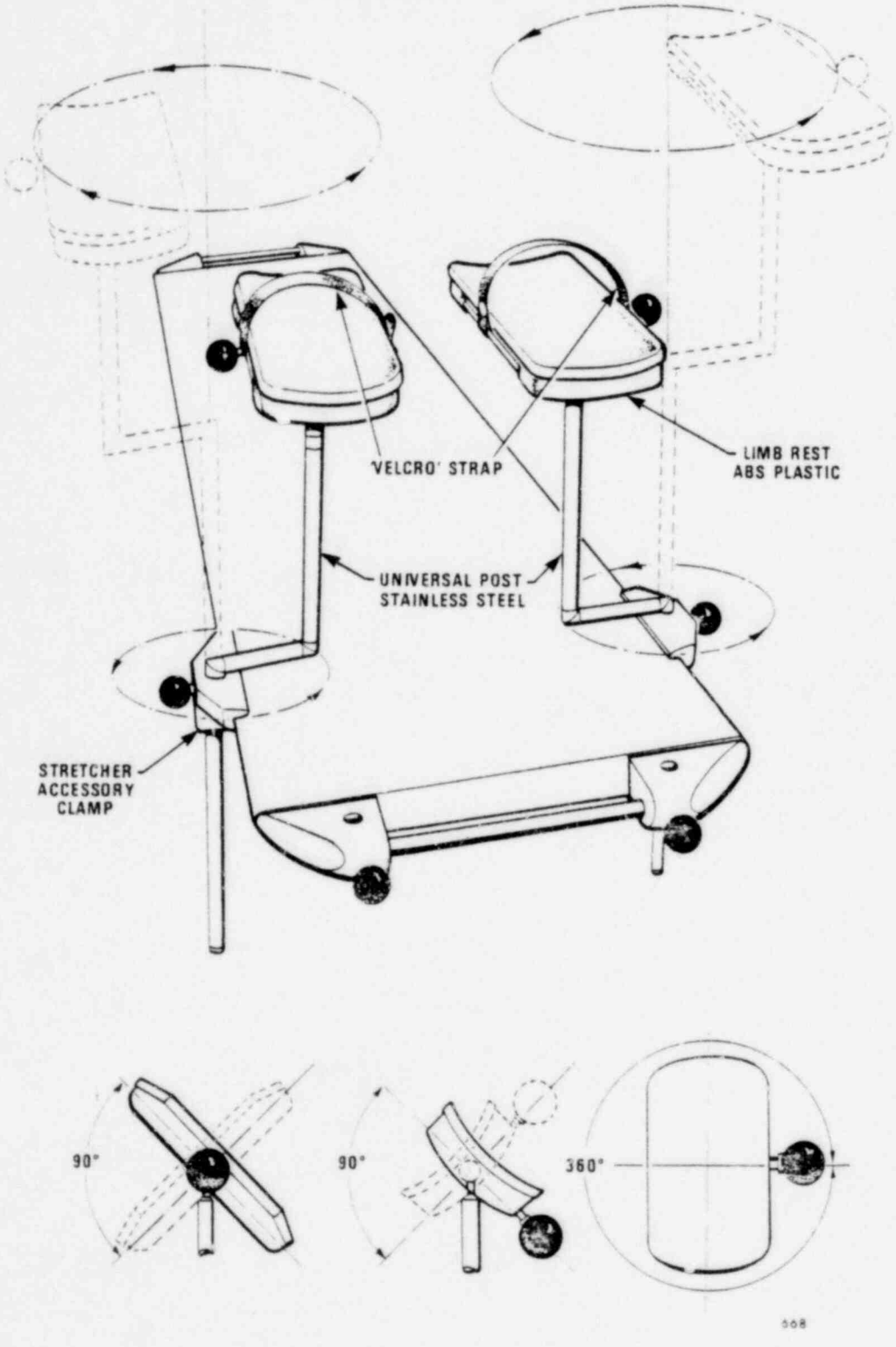

Fig. 5.3. Leg Support Kit (G22-200A)

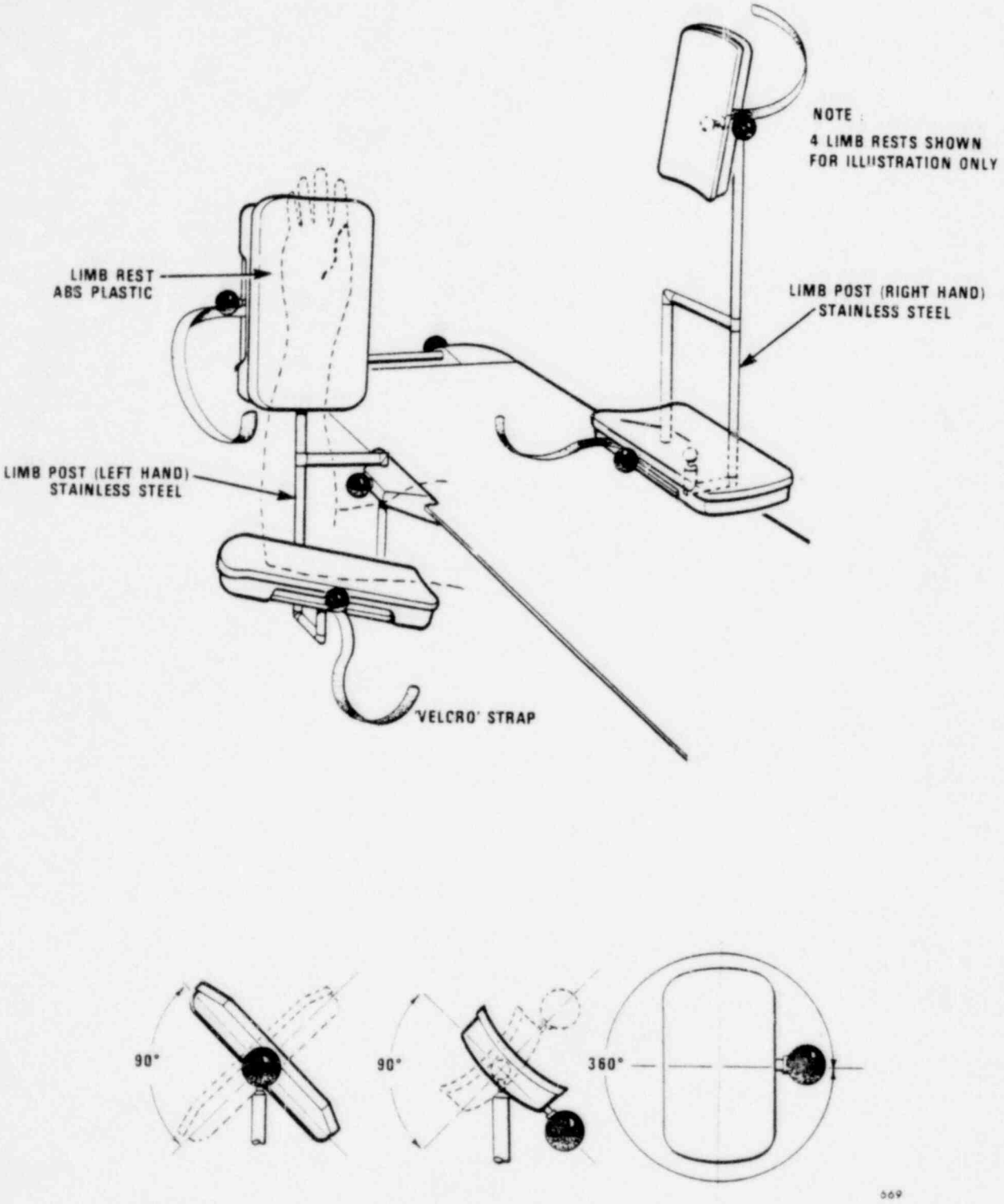

Fig. 5.4. Arm Support Kit (G22-201A)

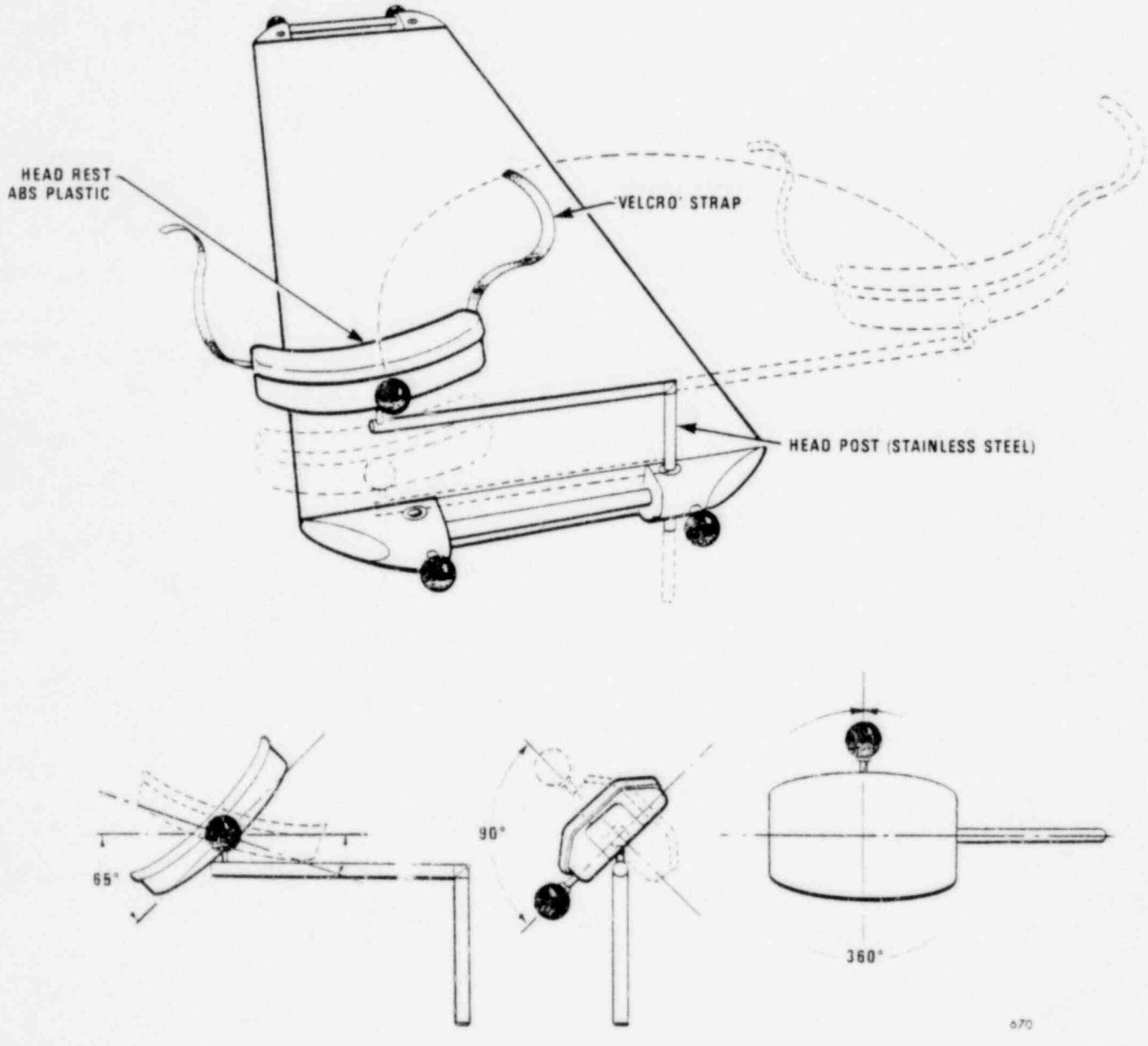

Fig. 5.5. Head Rest Kit (G22-204A)

(G22-080) which permits accessories to be attached along the unsupported edge of the table top. See Fig. 5.6.

To attach the clamp to the table top, open the latch, hook one end of the clamp to one edge of the top, hook the other end of the clamp to the other edge of the top and close the latch. If the clamp is loose, or if the latch cannot be closed, rotate the latch end of the clamp to adjust the screw tension.

CAUTION

Be careful not to overtighten the screw so as to avoid damage to the table top and clamp when engaging the latch.

5.5.3 Cassette Holder Kit

The cassette holder kit (G22-202) consists of one cassette holder and post. The holders can be clamped at any angle below, or above, the table top. See Fig. 5.7.

The posts can be mounted in the table top accessory clamp (G22-080). Instructions for attaching the clamp to the table top are given in section 5.5.2, above.

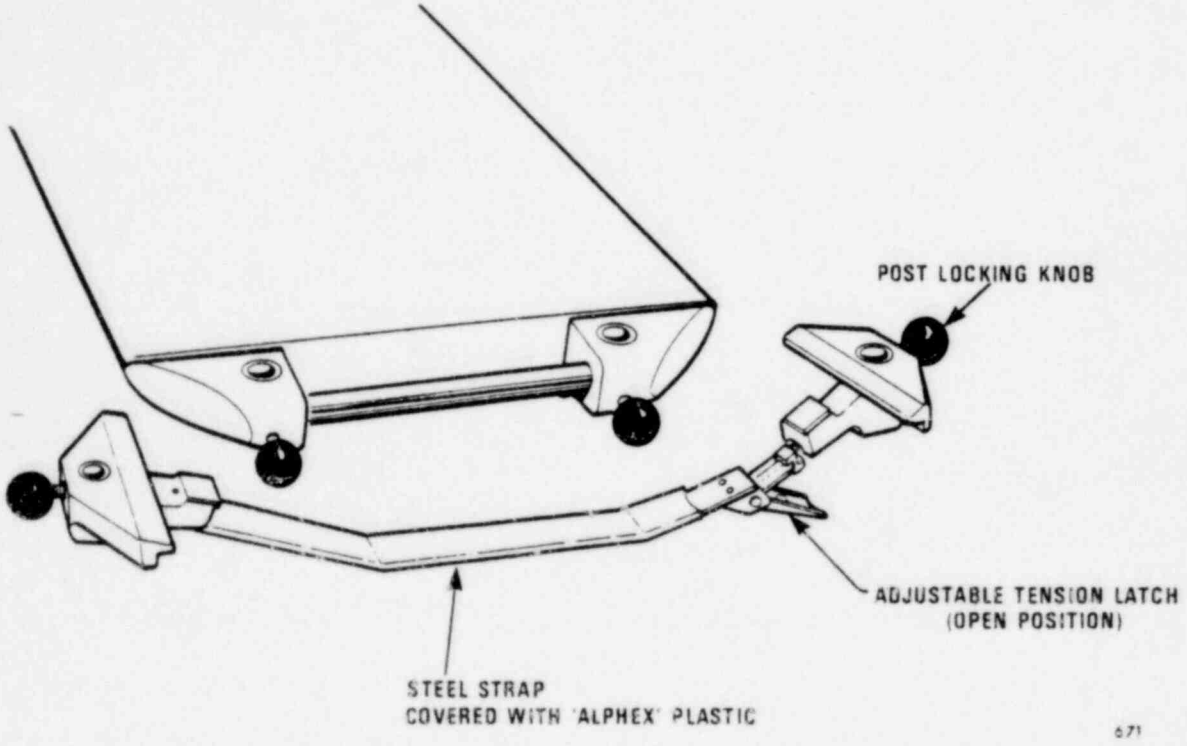

Fig. 5.6. Table Accessory Clamp (G22-080)

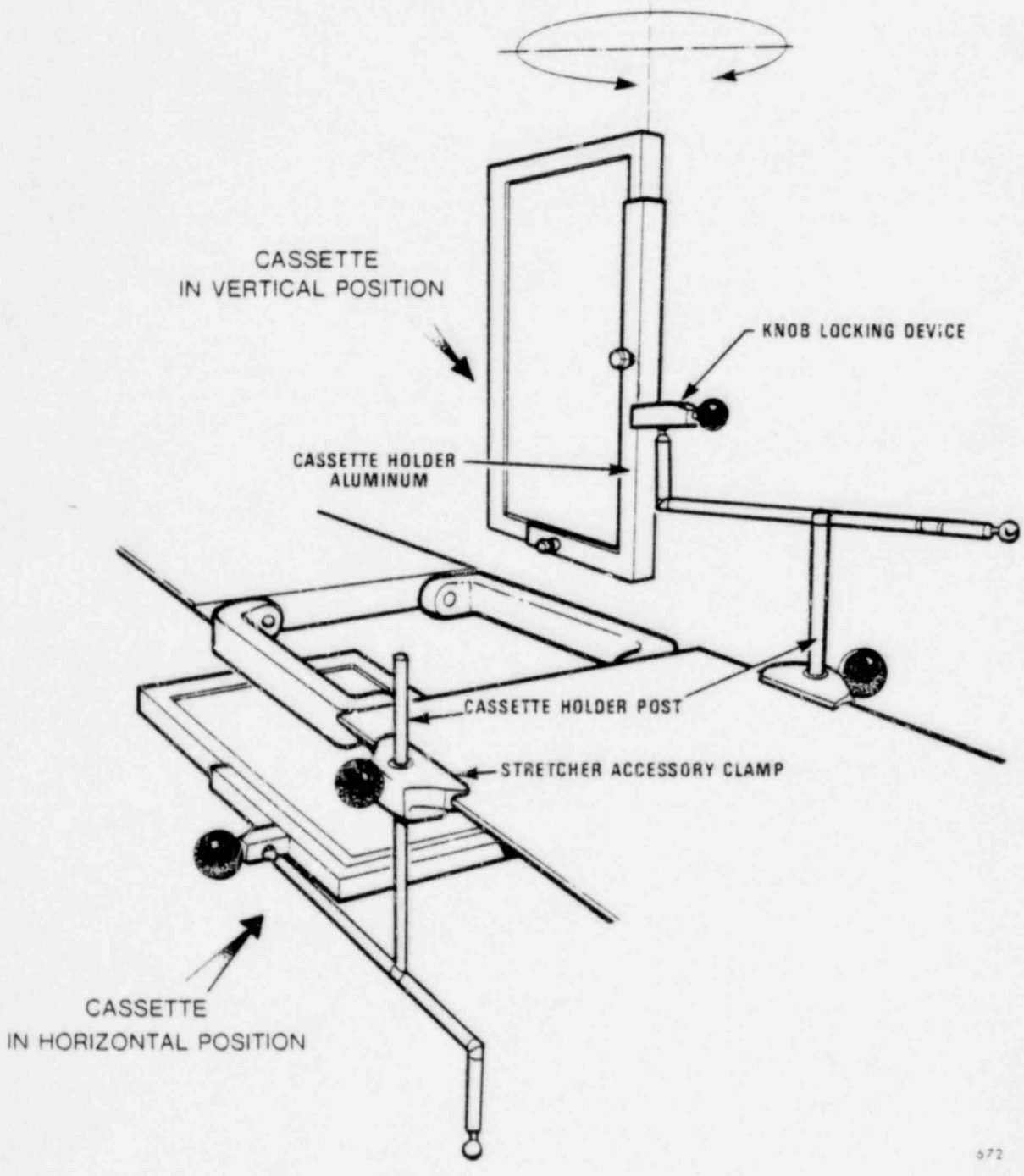

Fig. 5.7. Cassette Holder Kit (G22-202)

PART 6

ROUTINE MAINTENANCE

6.1 GENERAL

This section describes the routine maintenance that is required to:

- Minimize potential hazards associated with the operation of the unit.
- Minimize unit downtime.
- Maximize unit operating life.

Routine maintenance comprises:

- Cleaning.
- Scheduled maintenance.
- Radioactive contamination tests.

Persons maintaining and servicing the Theratron 780-C must be trained and experienced in radiation safety and in the operation of the teletherapy unit and its accessories. They must be properly equipped with replacement parts, handling equipment and other special equipment dictated by the individual maintenance and service procedures.

The Licensee may perform the procedures given in sections 6.6, 6.7 and 6.8 of this manual, unless otherwise specified by the competent authority. When other maintenance or service work is required, contact AECL MEDICAL or their accredited Representative.

WARNINGS

1. Adjustments or repairs to the source drawer operating system (including mechanical, pneumatic and electrical systems) and the headlock pneumatic system must be made only by authorized personnel. Improper adjustments or repairs may cause unwanted exposure of personnel to radiation.

2. When equipment covers are removed, be very careful not to touch exposed wires or terminals while power is on. Operating the emergency push-buttons does not remove power from the unit. Electrical shock may cause death.

3. Observe all warnings given in the operating procedures (Part 4).

4. Do not apply any lubricants to the source drawer or head bore. Lubricants are adversely affected by radiation; they may cause faulty drawer movement and, consequently, unwanted exposure of personnel to radiation.

6.2 MAINTENANCE RECORD

A log book should be kept in which the following information is recorded for all maintenance and service activities:

a. Name of person performing the work.

b. Date.

c. Description of work performed, including the results of all inspections and a list of parts replaced.

d. Descriptions and results of tests made following maintenance and service work.

e. Acknowledgement signatures of service personnel and the Licensee.

6.3 CLEANING

CAUTIONS

1. **Do not use cleaning solvents containing acetone, methyl ethyl ketone, or other related chemicals which might damage equipment covers.**

2. **Make sure that cleaning liquids do not come in contact with electrical wiring or other internal components.**

3. **Do not clean depleted uranium trimmers and accessories.**

Cleaning of equipment covers and other exterior surfaces should be performed on a routine basis as follows:

a. Use soft cloth dampened with a solution of water and detergent or soap.

   For stubborn stains, use mixture of sodium bicarbonate and water.

   Superficial abrasions may be removed with fine buffing compound.

b. Wipe away cleansing agent with soft cloth moistened with water.

c. The thermoplastic covers may be protected by waxing.

NOTE

Chemical or ink stains should be removed promptly.

6.4 SCHEDULED MAINTENANCE

Regular maintenance tasks must be performed as listed in Tables 6.1 to 6.5 inclusive.

NOTE

Daily system checks are specified in Part 4.

Procedures for the tasks listed in Tables 6.1 to 6.3 inclusive are given in sections 6.5 and 6.6.

Items listed in Table 6.5 are critical to the proper clinical use of the unit. Their failure may contribute directly or indirectly to conditions producing hazards that will:

a. cause personnel injury or major system damage, or
b. require immediate corrective action for personnel or system survival, or
c. cause death or severe injury to personnel or system loss.

The five year replacement interval is based on 2000 hours of clinical use per year and 4 patients per hour.

For higher rates of clinical use, the required replacement interval is given by:

$$\frac{2000 \times 4 \times 5}{\text{Average number of hours of clinical use per year} \times \text{Average number of patients per hour}} \text{ years}$$

Example:

If the average clinical use is 2500 hours per year and 3.6 patients per hour, the required replacement interval is:

$$\frac{2000 \times 4 \times 5}{2500 \times 3.6} \text{ years}$$

$$= 4.4 \text{ years.}$$

Table 6.1. Weekly Maintenance

ITEM	LOCATION	MAINTENANCE TASK	REF. SECTION
Gantry drive gear	Mainframe	Check level of oil in bath	6.5.1
Air tank and water trap	Mainframe	Drain water and check operation of low pressure switch	6.5.2

Table 6.2. Monthly Maintenance

ITEM	LOCATION	MAINTENANCE TASK	REF. SECTION
Interlocks	Various	Check for proper operation	6.5.3
Unit, operations and accessories	Various	Check alignment and accuracy	6.5.4
Treatment timer	Console	Check for proper operation	6.5.5
Unit motion controls	Console and hand control	Check for proper operation	6.5.6

Table 6.3. Semi-annual Maintenance

ITEM	LOCATION	MAINTENANCE TASK	REF. SECTION
Gantry rotation drive belt	Mainframe	Check for tension and wear	6.5.7
Table vertical drive belt	Table	Check for tension and wear	6.5.7
Accessories	Various	Check for wear	6.5.8
Radioactive materials	See ref. paragraph	Contamination test	6.6

Table 6.4. Annual Maintenance

ITEM	LOCATION	MAINTENANCE TASK
*Pneumatic system	Mainframe and neck	Test for leaks and proper functioning of complete pneumatic system, including compressor and tank, low pressure switch, solenoid air valves and air hoses. Check operation of source drawer, including function of interlock status indicator on console and secondary return mechanism.
Motion drives	All	Lubricate and inspect.
Radiation field alignment	Head	Check coincidence of light and radiation fields.
Isocentricity	General	Check isocentric accuracy of unit and couch.
*Source drawer detent pin	Neck	Check for signs of wear.
K1 contactor	Mainframe	Check contact wear.
*Slip ring assembly	Mainframe	Inspect and clean.
*Field light cord reel	Head	Inspect cord for signs of chafing. Be sure cord is tensioned properly and reel is operating smoothly.
Hand control cable	Hand control	Check for signs of chafing of cable.
Gantry retaining bolts	Gantry	Check torque is not less than 150 pound feet.

Table 6.4. Annual Maintenance (continued)

ITEM	LOCATION	MAINTENANCE TASK

NOTES

1. Some competent authorities specify that maintenance work associated with the source or related systems shall be undertaken only by a specially licensed technician or "source handler". Items falling into this category are marked * in the "Item" column.

2. All annual servicing to be performed by AECL MEDICAL or their accredited Representative.

Table 6.5. Five Year Maintenance

ITEM	LOCATION	MAINTENANCE TASK
*Field light cordreel	Head	Replace
*Source drawer control valves including solenoids	Neck	Overhaul or replace
*Low air pressure switch	Mainframe	Replace
*Air hoses and fittings	Mainframe, neck	Replace
*Source drawer detent pin	Neck	Replace
K2 relay contactor	Mainframe	Replace
Gantry drive belt	Mainframe	Replace
Table vertical drive belt	Table	Replace

NOTES

1. Some competent authorities specify that maintenance work associated with the source or related systems shall be undertaken only by a specially licensed technician or "source handler". Items falling into this category are marked * in the "Item" column.

2. All five year servicing to be performed by AECL MEDICAL or their accredited representative.

3. If the source is changed after less than 5 years, it is recommended that these components be replaced at the same time.

6.5 SCHEDULED MAINTENANCE PROCEDURES

6.5.1 Gantry Drive Gear

Depth of oil in bath should be maintained at 3.2 to 3.8 cm (1-1/4 to 1-1/2 in.). To change oil, remove plug and drain oil into a container. Replace plug and refill with SAE 40 oil (non-detergent).

6.5.2 Compressed Air System

Water will form due to condensation in the compressed air system, and will accumulate in the air tank and water trap. Drain water as follows:

a. Switch off power.

b. Remove screw from bottom of mainframe right-hand access panel and lift panel off.

c. Slowly open drain cocks on air tank and water trap and drain water into a container.

d. Close drain cocks and switch on power.

6.5.3 Interlock Tests

These tests must be performed in their entirety in the order shown. If any specified performance criterion is not met, discontinue use of the unit.

a. Source Drawer Interlock

(1) Position gantry at zero, lock head at 0 degrees, close treatment room door and set up FIXED treatment (section 4.4).

(2) Press timer TREAT pushbutton, then, after about 0.2 minutes, press any timer push-button to turn off the treatment. Check that source drawer status indicator lamp is on while both the BEAM ON and BEAM OFF lights are illuminated. The status

indicator lamp should be off when either the BEAM ON or BEAM OFF light is illuminated.

b. Reset Pushbutton and Timer Interlocks

(1) Set up FIXED treatment but do not press unit RESET pushbutton, which should remain on. FIX pushbutton should be illuminated.

(2) Press timer TREAT pushbutton and check that BEAM ON lamp remains off. Timer should emit one beep.

(3) Press timer RESET pushbutton and check that unit RESET lamp remains on, BEAM ON lamp remains off and the timer displays indicate 0.00.

c. Treatment Mode Interlock

(1) Ensure that FIX pushbutton is cleared and that none of the other treatment pushbuttons are depressed.

(2) Press unit RESET pushbutton and check that both unit RESET pushbutton and TREAT MODE status indicators remain on.

(3) Select ROT, ARC, and SKIP pushbuttons (ensuring that neither CW or CCW pushbuttons are depressed) and perform step 2, above, for each mode. The mode pushbuttons should illuminate when depressed.

d. Treatment Angle Interlock

(1) Set up SKIP treatment (section 4.3), positioning thumbwheel switches at 090, 180, 270 and 0. Press unit RESET pushbutton and check that both unit RESET pushbutton and TREAT angle status indicator remain on.

(2) Repeat step 1, above, with thumbwheel settings at:
090, 180, 0, 270.
090, 0, 180, 270.
0, 090, 180, 270.

e. Wedge Filter Interlock (if installed)

(1) Inside treatment room install wedge filter, do not confirm.

(2) Set up FIXED treatment at console. Press unit RESET pushbutton and check that both unit RESET pushbutton and WEDGE FILTER status indicator remain on.

(3) Remove wedge filter.

f. Headlock Interlock

(1) Inside treatment room disengage headlock. HEADLOCK pushbutton should be illuminated when the lock is disengaged and off when the lock is engaged.

(2) Close treatment room door and set up ARC treatment at console. Press unit RESET pushbutton and check that both unit RESET pushbutton and HEADLOCK status indicator remain on.

g. Off-shield Interlock

(1) Inside treatment room rotate head CW until OFF SHIELD light on head panel comes on.

(2) Check that angle at which this occurs agrees with angle specified for the particular treatment room.

(3) Close treatment room door and at console select FIXED treatment. Press unit RESET pushbutton and check that both unit RESET pushbutton and OFF SHIELD status indicator remain on.

(4) Repeat steps 1 to 3, above, with head rotated CCW.

h. Air Pressure Interlock

(1) Ensure gantry is positioned at zero, rotate head to 0 degrees and engage headlock.

(2) Drain water from air tank and water trap (section 6.6.2) but do not switch on power.

(3) Close treatment room door and, at console, switch on power. Immediately select FIXED treatment, press unit RESET pushbutton and check that both unit RESET pushbutton and AIR PRESSURE status indicator remain on.

(4) Observe AIR PRESSURE status indicator and, immediately after it goes off, turn off power.

(5) In treatment room check that pressure gauge on air tank registers 28 psi minimum.

j. Gantry Rotation Limit Switches

(1) Position gantry at zero.

(2) Position head between 5 and 10 degrees.

(3) Rotate gantry CW and check that it stops automatically at 112 to 118 degrees.

(4) Swivel head to 0 degrees, engage headlock and re-position gantry at zero.

(5) Again position head between 5 and 10 degrees.

(6) Rotate gantry CCW and check that it stops automatically at 242 to 248 degrees.

6.5.4 Alignment and Accuracy Checks

These tests must be performed in the order shown. They provide the Licensee with information regarding the performance of the unit and its options and accessories. While corrective action should be taken as soon as possible if any specified performance criterion is not met, use of the unit may continue if, in the judgement of the Licensee, the deviation observed does not increase any potential hazard associated with the operation of the unit.

a. Pre-alignment Set-up

(1) Position gantry at zero, head at 0 degrees (headlock engaged) and table top at isocenter height.

(2) Rotate table top to 180 degree position.

(3) Make a screen by gluing or taping a piece of translucent (tracing) paper over a piece of stiff cardboard with a 5 to 7.5 cm (2 to 3 in.) diameter hole in it.

(4) Position screen horizontally under the field light and secure to end of table top so that it is visible from above and below the table top.

(5) Secure piece of stiff wire to collimator rail so that wire tip is close to center of field and touching screen.

(6) Rotate collimator through its full range and mark pattern traced by wire tip at 45 degree intervals.

(7) Find center of pattern and mark with dot. Dot represents axis of collimator rotation.

(8) Double check position of axis of rotation by positioning wire tip above dot and rotating collimator through its full range. Wire tip should remain positioned directly above dot.

(9) Remove wire pointer from collimator rail. Be careful not to disturb screen.

b. Field Light Alignment

Switch on field light and rotate collimator through its full range. Cross-wire image center should remain within 0.1 cm of dot marking axis of collimator rotation.

c. Headlock Alignment

(1) Without disturbing screen, rotate gantry to 180-degree position.

(2) Again, use wire to find axis of collimator rotation and mark its position on screen with dot. This dot should lie within 0.2 cm of that marked in step a(7).

(3) Remove wire pointer from collimator rail and rotate gantry to zero position.

d. Optical Backpointer Alignment (if installed)

(1) Switch on field light and optical backpointer, then position collimator at 0 degrees.

(2) Remove screen from table top, hold screen within light beam and check that center of field light and backpointer cross-wire images coincide within 0.2 cm over a range of 55 to 100 cm SSD.

(3) Repeat step 2, above, with collimator in 90, 180 and 270 degree positions.

e. Mechanical Distance Indicator Accuracy

(1) Mount 80 cm mechanical distance indicator on one of the mounting pads.

(2) Rotate table top to zero position and adjust its height until table top just touches tip of pointer.

(3) Measure distance from table top to indicator mounting pad. This distance should be 35 cm ±0.2 cm.

NOTE

Ensure that both indicator mounting pads are equidistant from table top; adjust gantry angle if necessary.

(4) Repeat for 100 cm mechanical distance indicator. Distance measured in step (3) should be 55 cm ±0.2 cm.

f. Optical Distance Indicator Accuracy

(1) Set table top height so that distance from top to indicator mounting pads is 35 cm.

NOTE

Ensure that both indicator mounting pads are equidistant from stretcher top; adjust gantry angle if necessary.

(2) Switch on ODI (SSD) and FIELD lights. Check that 80-cm mark on scale projected by ODI and center of field light crosswire image coincide within 0.1 cm.

(3) Place a small box on top of stretcher and adjust stretcher height until distance from top of box to indicator mounting pads is 15 cm. Check that ODI reads 60 cm.

(4) Remove box and adjust stretcher height so that distance from top of stretcher to indicator mounting pads is 55 cm. Check that ODI reads 100 cm.

6.5.5 Treatment Timer

a. Test the timer monthly as follows. If any specified performance criterion is not met, discontinue use of the unit.

Without a patient, set up the unit for a FIX treatment (section 4.4) and perform the following operations. If the timer does not respond as specified, discontinue its use and call a service agent.

(1) Enter any SET TIME and start treatment. Check that timer behaves as described in section 4.5e.

(2) Interrupt treatment and check that timer behaves as described in section 4.5g.

(3) Resume treatment.

(4) Terminate treatment and check that timer behaves as described in section 4.5h. Do not reset timer. Record SET TIME, PRIMARY and SECONDARY displays.

(5) Turn off external electrical power supply. Restore electrical power to the unit. Check that timer behaves as described in section 4.7c.

6.5.6 Unit Motion Control Tests

Test the controls as follows. If any specified performance criterion is not met, discontinue use of the unit.

a. Operate the gantry, head, collimator and table motions. Check that:

(1) Each motion operates over its specified range (Tables 1.2 and 1.3).

(2) Each motion operates smoothly.

b. Check that the gantry rotates smoothly when operated using the console SET UP pushbutton. The SET UP pushbutton should be illuminated when depressed and should spring out, causing gantry motion to stop, immediately finger pressure is removed. The CW and CCW pushbuttons should be illuminated when depressed. The gantry position circular scale and digital readout should agree within 1 degree at any gantry position.

6.5.7 Gantry and Table Drive Belts

Check for tension and wear. The tension in each timing belt must be sufficient that it cannot slip off its pulleys and that its teeth are positively engaged in the pulley sprockets. The belts must be free of cuts, nicks and frayed surfaces.

Gantry drive belt tension should be adjusted using belt tension gauge (tool no. A102413-360). Ensure that the gauge is correctly calibrated. (See AECL MEDICAL Spec. P 0915 G00.) Mount gauge on belt midway between the two pulleys (Fig. 6.1). Position gear reducer/motor assembly such that gauge indicates correct belt tension. Tighten the adaptor plate bolts and re-check belt tension. Remove gauge from the belt.

6.5.8 Accessory Wear Check

a. Check the collimator lower frame, wedge filter rail and beamshaping rail latches and latch plates for wear and smooth operation. If the locking surfaces have become tapered or rounded, they may not properly secure the accessories and should be replaced or repaired.

b. Check that the beamshaping block retaining screws are a good fit in the blocks. If there is excessive wear, the screws may not properly secure the blocks in position. The blocks and/or screws should be repaired.

c. Check that the beamshaping trays are not discoloured. Any trays showing discoloration have suffered radiation damage which may have reduced their strength; they should be replaced.

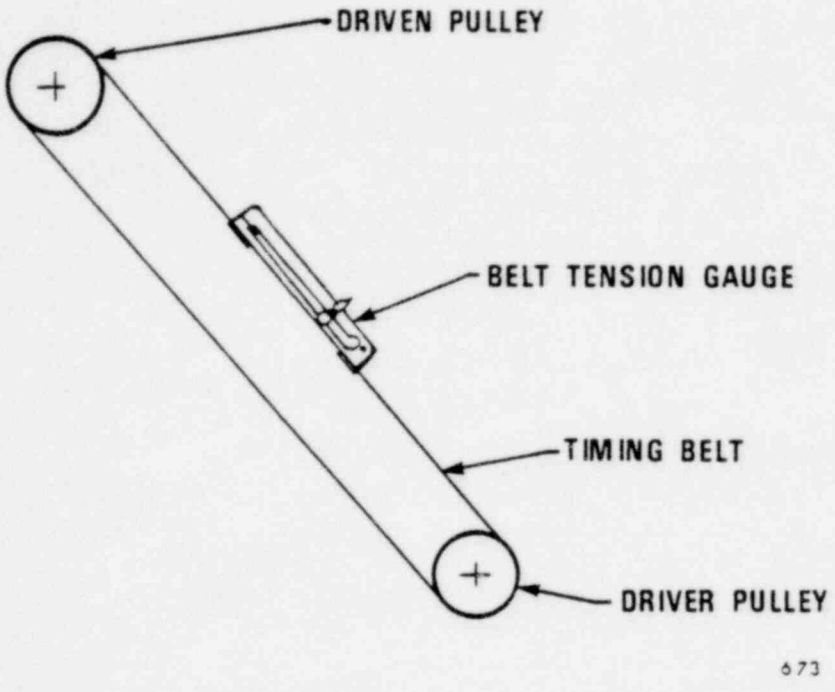

Fig. 6.1. Gantry Drive Belt Adjustment

WARNING

Keep hands clear of drive mechanisms if operating motions during this test. touching the mechanisms may cause injury.

6.6 CONTAMINATION TEST PROCEDURE

The unit contains radioactive materials in the form of encapsulated cobalt-60 and depleted uranium shielding which are subject to the regulations of the competent authority. This section describes a routine wipe test used for the detection of removable contamination.

This test must be performed every six months, or more frequently if so required by the competent authority.

NOTE

Contamination tests must be performed by persons trained and experienced in contamination testing. Some competent authorities specify that these tests must be made by specially licensed personnel.

6.6.1 Wiping

a. Be sure source is in fully shielded position. The BEAM OFF lamp should be on. Rotate table top from unit and rotate gantry to 90 or 270 degree position. Position head for easy access to inside of collimator.

b. Fully open collimator leaves. Switch off main power supply and remove top head cover.

c. Wipe each of the following areas (Fig. 6.2) with separate 7 cm (3 in.) diameter high wet strength filter papers, slightly moistened with water:
   (1) Inside of head drawer tube
   (2) Primary definer
   (3) Inside surface of collimator leaves
   (4) 45 cm trimmer bars
   (5) Accessory trimmers
   (6) Uranium beamshaping blocks
   (7) Table top.

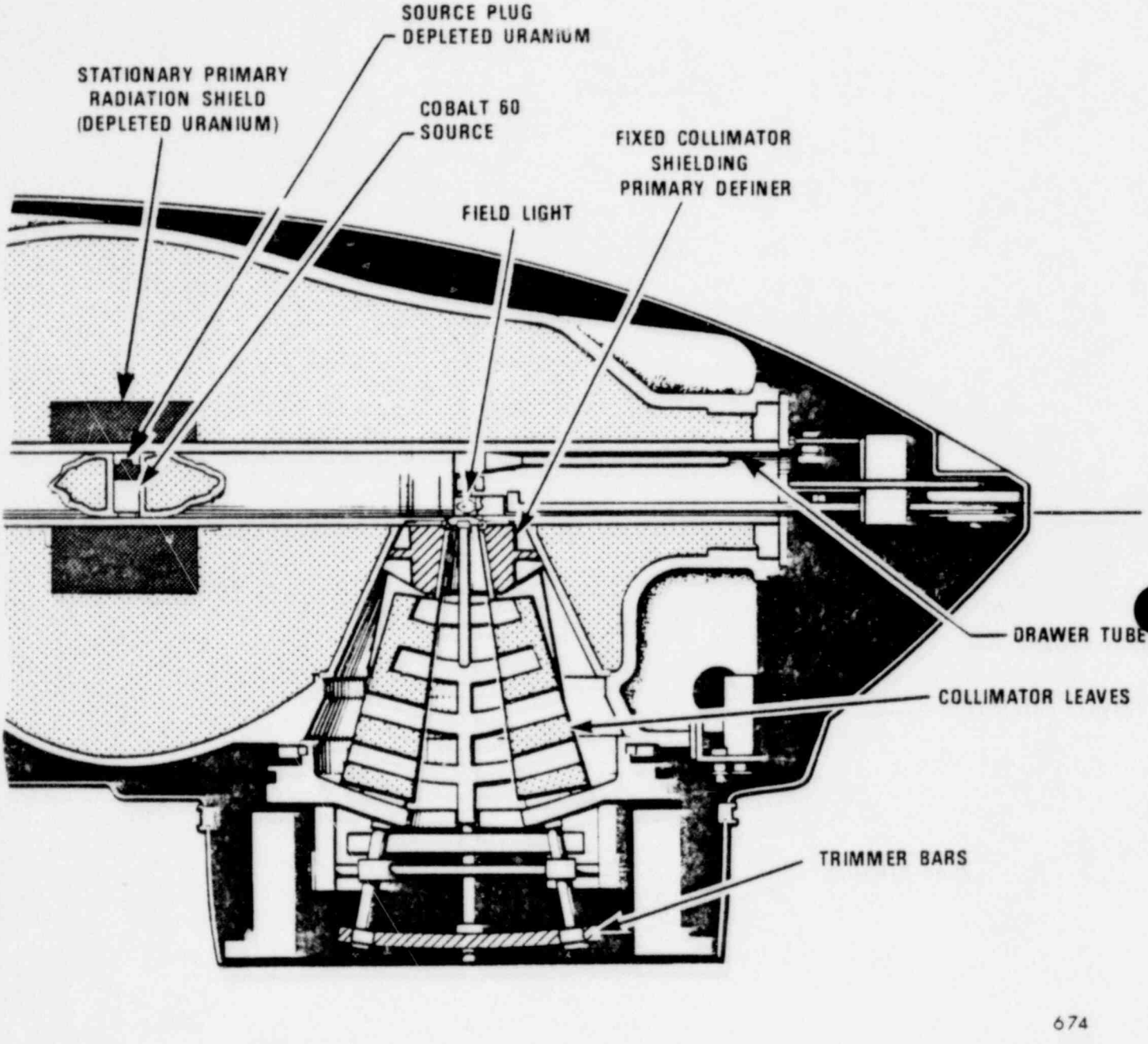

Fig. 6.2. Head and Collimator

NOTE

Be careful not to damage collimator cross-wires or beam defining light bulb when performing wipe tests.

6.6.2 Counting

a. A suitable instrument is the Berthold Rato-F Survey Meter, as used by AECL MEDICAL Service Representatives. With beta window open a typical background is 20 to 30 counts per minute. With this background subtracted the net count rate accuracy is ±5 counts per minute. The limit of detection may be considered to be 5 counts per minute or, using the efficiencies shown below, less than 0.0006 microcuries cobalt-60 or less than 0.0001 microcuries uranium-238.

Efficiency of Berthold Rato-F

	COUNTS PER MINUTE FROM 1850 BECQUERELS (0.05 MICROCURIES)	
	COBALT 60	URANIUM
Beta window open	400	3500
Beta window closed	200	0

b. Open beta window and record background count rate reading.

c. Place each filter paper, one at a time, in contact with meter window and record its count rate reading.

NOTE

Allow meter to stabilize before recording each reading. At the activity levels being measured great care must be taken to ensure that the observed readings are not random fluctuations in background.

d. Determine net count rates by subtracting the reading obtained in step b from those observed in step c.

6.6.3 Evaluation

a. If any net count rate exceeds 100 counts per minute, determine whether cobalt-60 (leaking source) or uranium-238 (depleted uranium components) is the origin of the activity. Repeat the count (section 6.7.2c) with the meter window closed. If the activity is cobalt-60, approximately half the open window net count rate will be detected; if it is uranium-238, no net counts will be seen. Alternatively uranium-238 may be detected with an alpha counter.

b. Convert the net count rate to microcuries using the efficiencies given in section 6.7.2a.

c. The test is considered negative if the amount of radioactive material detected on any wipe is less than the reportable level prescribed by the competent authority; e.g., 1850 becquerels (0.05 microcuries) of cobalt-60 and 185 becquerels (0.005 microcuries) of uranium-238 for facilities under jurisdiction of the USNRC.

The test is considered positive if the quantity of material detected equals or exceeds these levels.

d. If the test is positive, suspend operations and take appropriate action to prevent exposure of personnel and further dispersal of radioactive material. Immediately notify:

(1) the competent authority,
(2) the treatment facility Radiation Safety Officer,
(3) AECL MEDICAL.

6.6.4 Reporting

a. Record all measurements in the maintenance log.

b. Notify all interested parties as required by the competent authority and by the Licensee.

c. Notify AECL MEDICAL if the activity detected exceeds 370 bequerels (0.01 microcuries) of cobalt-60 or 37 becquerels (0.001 microcuries) of uranium-238.

6.7 PARTS REPLACEMENT PROCEDURES

The Licensee may replace components as described in sections 6.7.1 to 6.7.3 inclusive.

6.7.1 Console Lamp Bulbs

a. BEAM ON/BEAM OFF/RESET Lamps (Fig. 6.3)

Replace bulbs (AECL MEDICAL No. 3L009901) in the console as follows:

(1) Ensure keyswitch is off and remove key.

(2) Unscrew lens caps with special wrench (AECL MEDICAL No. 1W029802).

(3) Push small end of bulb puller (AECL MEDICAL No. 3L030701) over bulb and pull bulb out of holder.

(4) Fit new bulb to big end of puller and push bulb into holder.

(5) Turn keyswitch to START and check that lamp is working before replacing lens cap.

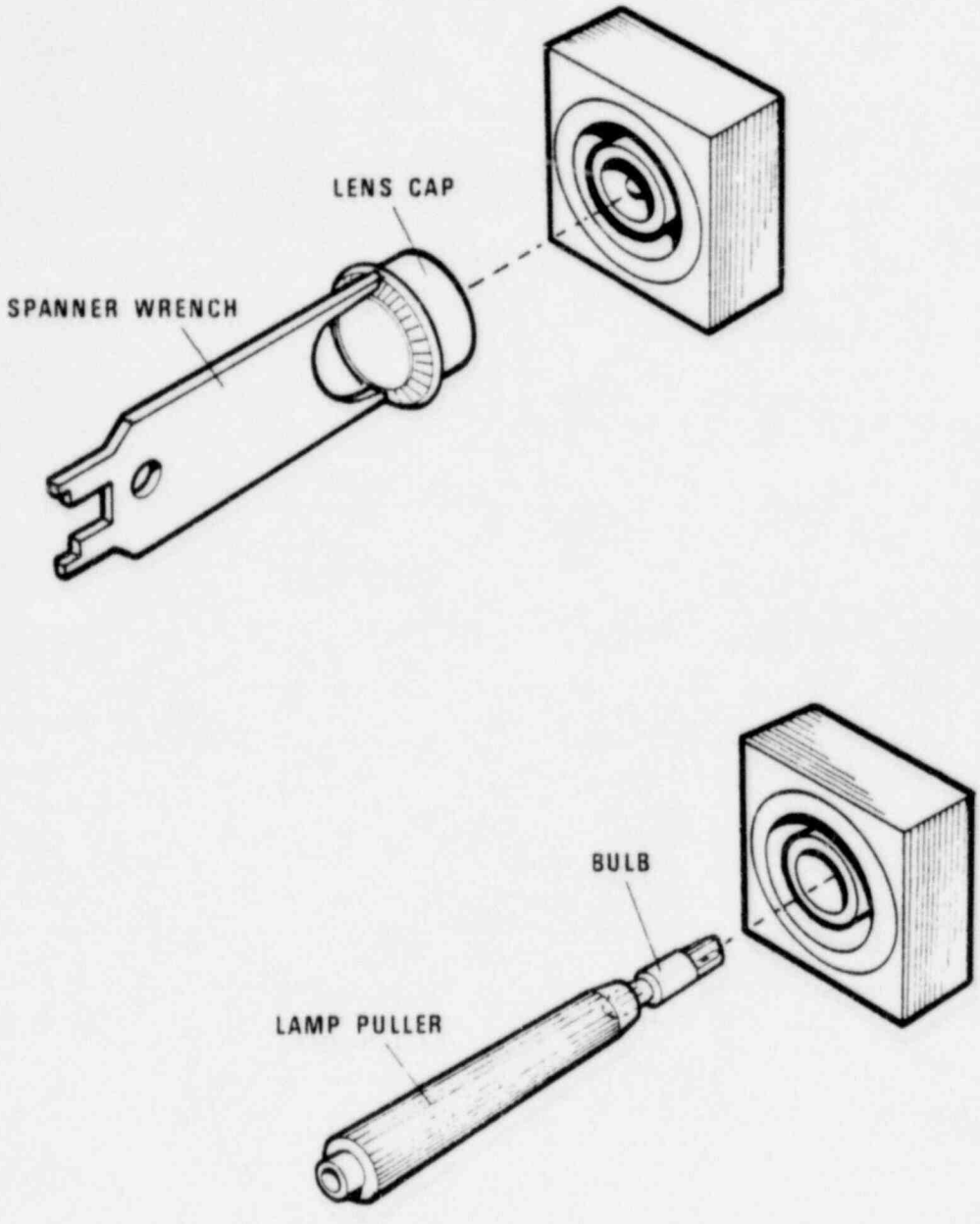

Fig. 6.3. Bulb Replacement

b. Other Pushbutton Lamps

Replace bulbs (AECL MEDICAL No. 3L010005) in CW, CCW, SET UP, FIX, ARC, SKIP and ROT pushbuttons in console as follows:

(1) Turn keyswitch to OFF and remove key. Pry off pushbutton cap. (If necessary, turn off main isolating switch, remove console cover and push cap off from back.)

(2) Unclip bulb by moving it sideways with small screwdriver before pulling it out.

(3) Insert new bulb and install pushbutton cap.

6.7.2 Head and Collimator Panels

a. Indicator Lamps on Head Panel (Fig. 6.4)

Replace BEAM ON (red AECL MEDICAL No. 3L017705), BEAM OFF (green AECL MEDICAL No. 3L017757) and OFF SHIELD (white AECL MEDICAL No. 3L017792) lamps on head panel as follows:

NOTE

Indicator lamps are sealed units. The complete unit must immediately be replaced in the event of failure.

(1) Move head to convenient position.

(2) Turn keyswitch to OFF and remove key.

(3) Remove screw at front of top head cover and pull off cover. If necessary, rotate cover slightly to reveal an edge so it can be pried off.

(4) Reach inside bottom cover and remove two clips from lamp housing. Do not pull on wire as this might pull it away from clip.

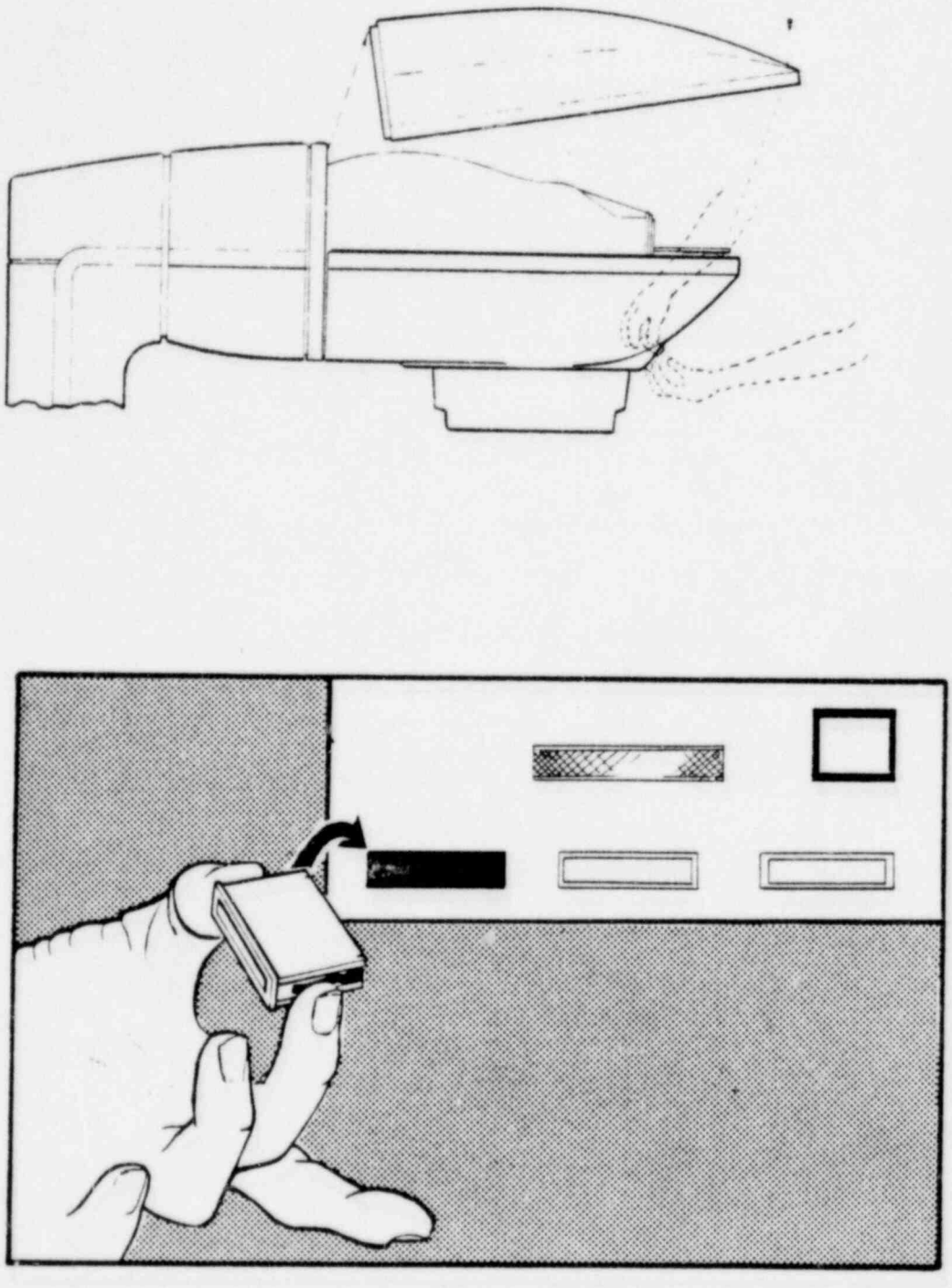

Fig. 6.4. Indicator Lamp Replacement

(5) Squeeze two black springs on lamp housing and push housing outward.

(6) Install new lamp of same color, re-connect wire clips, and check lamps before replacing the cover.

b. Pushbutton Lamps on Head, Collimator Panels and Couch (Fig. 6.5)

Replace bulbs (AECL MEDICAL No. 3L009309) in FIELD, SSD, ROOM LIGHT and HEADLOCK pushbuttons as follows:

(1) rotate gantry to convenient position.

(2) Pry off pushbutton cap.

(3) Replace bulb in cap and re-assemble cap.

6.7.3 Fuses and Circuit Breakers

Fuses are located in the mainframe cardfile and electrical panel and in the head and collimator sub-panels. A circuit breaker is located on the front of the control console.

CAUTION

Only fuses of the correct rating must be used, otherwise fire may result.

6.7.4 Spare Parts Kit

Two spares kits are available. One containing printed circuit boards (G85-158A) and one containing bulbs, fuses and small tools required for bulb replacement (G85-158B). These kits are available from AECL MEDICAL or their accredited Representative.

6.8 COBALT-60 SOURCE REPLACEMENT

For source replacement contact AECL MEDICAL or their accredited Representative.

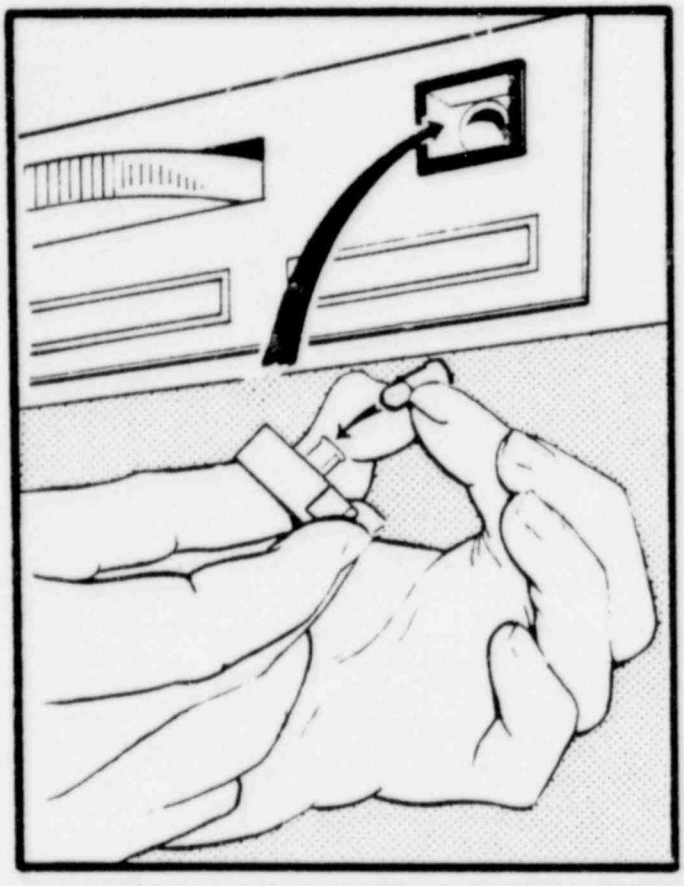

Fig. 6.5. Pushbutton Lamp Replacement (head panel)

PART 7

REGIONAL LICENSING OFFICES IN CANADA AND THE U.S.A.

7.1 REGIONAL LICENSING OFFICES IN U.S.A.

Head Office:

Directorate of Materials Licensing
Materials Branch
Office of Regulation
United States Nuclear Regulatory Commission
Washington, D.C., 20555
U.S.A.
1-301-427-4228

Region	Address	Telephone
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island and Vermont	Region I, USNRC Office of Inspection and Enforcement 631 Park Avenue King of Prussia Pennsylvania, 19406	(215) 337-5000 (24 hours)
Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands and West Virginia	Region II, USNRC Office of Inspection and Enforcement 101 Marietta Street Suite 3100 Atlanta, Georgia, 30303	(404) 221-4503 (24 hours)
Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin	Region III, USNRC Office of Inspection and 799 Roosevelt Road Glen Ellyn, Illinois 60137	(312) 790-5500 (24 hours)
Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah and Wyoming	Region IV, USNRC Office of Inspection and Enforcement 611 Ryan Plaza Drive Suite 1000 Arlington, Texas, 76012	(817) 860-8100 (24 hours)

Region	Address	Telephone
Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington and U.S. territories and possessions in the Pacific	Region V, USNRC Office of Inspection and Enforcement 1990 N. California Blvd. Suite 202 Walnut Creek, California 94596	(415) 943-3700 (24 hours)

7.2 REGIONAL LICENSING OFFICES IN CANADA

Canadian Atomic Energy Control Board Office:

National Atomic Energy Control Board
Martel Building
270 Albert Street
P.O. Box 1046
Ottawa, Ontario
K1P 5S9
(613) 995-0479 (24 hours)

Region	Address	Telephone
Nova Scotia	Consultation Services Department of Health P.O. Box 488 Halifax, Nova Scotia	(902) 424-7571
New Brunswick	Radiation Protection Officer Department of Health Fredericton, New Brunswick	(506) 453-2542
Quebec	Division of Industrial Hygiene Ministry of Municipal Affairs and Environment 9310 St. Laurent Blvd. Montreal, P.Q.	(514) 873-3454
Ontario	Senior Consultant Health Physics Community Health Standards Division Ontario Ministry of Health 15 Overlea Boulevard Toronto, Ontario	(416) 965-8178

Region	Address	Telephone
Manitoba	Co-ordinator Radiation Protection Department of Mines, Research and Environmental Management Box 7 139 Tuxedo Avenue Winnipeg, Manitoba	(204) 489-4511
	Radiation Protection Section Physics Department Manitoba Cancer Treatment and Research Foundation 700 Bannatyne Avenue Winnipeg, Manitoba	(204) 786-4731
Saskatchewan	Occupational Health Division Department of Labour Regina, Saskatchewan	(306) 265-4538
Alberta	Industrial Health Services Division Alberta Health and Social Development 10523-100 Avenue Edmonton, Alberta	(403) 427-2691
British Columbia	Occupational Health Division Department of Health Services and Hospital Insurance 828 West Tenth Avenue Vancouver, British Columbia	(604) 874-2331