APPARATUS FOR APPLYING RADIOACTIVE THERAPY IN THE PELVIC CAVITY OF THE BODY

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ATTORNEYS
This invention is concerned with a radioactive material applicator used in the treatment of malignant tissues in the human body, and is particularly concerned with a radioactive material applicator which may be detachably and adjustably mounted in the pelvis of a female human in position to most effectively direct and apply the radiations of radioactive materials to cancer affected areas of the pelvic walls, and at the same time protect normal structures from excessive and damaging radiation.

There are two recognized methods of treating cancer, namely: (1) The removal of the cancerous tissues by surgery; and (2) the application of radiation from radioactive material or by X-ray to the cancerous tissues to destroy them.

In many cases both of these methods are employed to advantage. This is particularly true in cancer of the cervix in adult females where the cancerous growth might have spread to other structures and organs of the surrounding pelvic walls so that the surgeon cannot be certain that he has removed all cancerous tissues by an operation to remove the uterus, ovaries or other known affected organs. Furthermore, many structures affected by cancer cannot be removed.

In many cases, in both early and advanced nature, the cancer cells have already lodged in lymph nodes surrounding the pelvic region.

It is therefore desirable that postoperative irradiation by radioactive material or X-ray of the pelvic walls be carried out with the purpose of destroying all cancer cells not removed by surgery.

This invention is primarily intended to provide a device for effectively applying radiation of radioactive material to the pelvic wall of an adult female human in a manner to protect normal tissues and organs in the region where the radiation is applied.

Devices heretofore used to hold radioactive material in position to irradiate cancer in the pelvis in a female are of two types, namely: (a) those devices which are inserted into the vagina or into the body tissues and pushed as high up into the pelvis as possible to deliver as much radiation to the pelvic walls as possible; and (b) those devices which maintain the radioactive material outside the patient's body, directing the radiation beams through the skin, muscle, bones and other intervening parts of the body into the cancerous tissues.

These old devices have been unsatisfactory because: (1) the radiation dose applied to the structures in the middle of the pelvis is too high, causing undesired damage; (2) the radiation dose applied to the far lateral or upper portions of the pelvic walls is too low to be effective to cure cancer; (3) there is too much irradiation of normal structures not involved by cancer, such as the skin, muscles, bones, small intestine, urinary bladder, rectum and other tissues exposed in the proximity to the radioactive material; and (4) uniform doses of radiation could not be applied to the same patient from time to time and from patient to patient due to the difficulties of reproducible placement of such old type radioactive material holders, and due to the absence of visual inspection of the affected areas to aid in placing the holder in position to apply radiation most effectively.

My device, constituting the subject of this application, overcomes the aforesaid disadvantages of prior devices because: (1) it is designed to be mounted inside the pelvis while the pelvis is exposed to view, so that it may be adjusted and placed exactly, correctly and the same in every patient; (2) it is designed to fit in the pelvis and is adjustable to conform to the shape and size thereof; (3) the radioactive material is so mounted in spaced relationship to the structures inside the pelvis that the dose of radiation applied to the middle of the pelvis is the same as that applied to the lateral walls of the pelvis, and the dose applied to both portions would be uniform and effective, but not excessive, and the dose may be exactly controlled; (4) the radiation dose applied to the upper and outer portion of the pelvic wall is the same as that applied to the lower portion of the pelvic wall, would be uniform and effective; (5) the abdominal walls, skin, small intestine, rectum, urinary bladder and bones are protected against damaging radiation by spacing and absorption elements provided as parts of my device; (6) the radiation dose is exactly reproducible from patient to patient by my device, because it permits exact control of the radiation dose, the period of time of irradiation, and the placement and distribution of radiation; and (7) my device will provide all the radiation necessary for the treatment of cancer of the cervix in the pelvic region, thus eliminating the need for supplementary X-ray treatments from outside the body through the abdominal walls and other structures aforementioned.

My device is universally adjustable so that it may be adjusted to fit and conform to pelves of different sizes and shapes, thus making it adaptable in each case regardless of the variation in pelvic size and shape.

My applicator is arranged to be firmly attached to, and the entire weight carried by, bone structures surrounding the pelvic region by means of adjustable brackets extending laterally from a central supporting frame. The frame is adjustable so that the radioactive material supports may be raised or lowered with relation to the supporting frame and the supports may be rotated for adjustment about the vertical axis of the frame. The width of the applicator can be adjusted, and the lateral spacer elements, carrying radioactive material, can be rotated for adjustment about their transverse axes. The angle of the rectal restrainer can be changed.

In short, the device may be adjustably rotated, elevated, lowered and expanded in all directions.

Furthermore, all parts thereof may be quickly and easily removed and replaced by like parts of different sizes. The whole assembly may be quickly assembled, adjusted and mounted inside the pelvis during an operation and prior to closing the abdominal wall incision, made during the operation.

Among the objects of this invention, in addition to the foregoing, are the following:

(1) To provide a radioactive material applicator to support radioactive material in relation to the internal walls and floor of the pelvis of an adult female afflicted with cancer in the pelvic region, and especially cancer of the uterine cervix, which is designed to destroy cancerous tissue by radiation, while inflicting a minimum of damage to normal tissue and organs.

(2) To provide a radioactive material applicator which is rigidly maintained so as to irradiate a uniformly thick lining or slab of tissue comprising the floor and walls of the pelvis.

(3) To provide a radioactive material applicator which

(4) To provide a radioactive material applicator which
excludes the small intestine from inside the true pelvis while the radioactive material is in place.

(4) To provide a radioactive material applicator to be mounted in the pelvis of a female which restrain and protects the urinary bladder and the rectum, so as to prevent them from coming in close proximity to the radioactive material, thus reducing the radiation of these structures.

(5) To provide a radioactive material applicator arranged to be mounted in the pelvis of a female which is adjustable to fit different sizes and shapes of pelvies and which may be quickly assembled and firmly attached in place by rigidly attaching it to the bones surrounding the pelvis.

Other and further objects of my invention will become apparent upon reading the detailed specification hereinafter following, and by referring to the drawings annexed hereto, and forming a part hereof.

In the drawings, a suitable embodiment of my invention is shown wherein:

Fig. I is a side elevational view of the radioactive material applicator mounted in the pelvis of a female with lateral supporting brackets thereon attached to the pubic bones and to the fifth lumbar vertebrae, the parts of the female anatomy being shown in broken lines, with the exception of the bones to which the applicator is attached;

Fig. II is a front elevational view of the radioactive material applicator;

Fig. III is a top plan view of the radioactive material applicator mounted in the pelvis of a female with one of the lateral pelvic wall radioactive material supports removed.

Fig. IV is a top plan view of the radioactive material applicator;

Fig. V is a perspective exploded view of the radioactive material applicator;

Fig. VI is a cross-sectional side elevational view of the radioactive material applicator;

Fig. VII is a rear elevational view of the radioactive material applicator; and

Fig. VIII is an enlarged view of a typical spring clip employed to detachably mount the tubular receptacles for the radioactive material.

In the drawings, numeral references are employed to designate the various parts shown therein, and like numerals indicate like parts throughout the various figures of the drawings.

The supporting frame for the applicator includes the spider 10, the brackets 14 and 25, the central post 38, the cross-arm 42 and the bracket 69, all of which will be described hereinafter.

The numeral 10 indicates the frame or spider by which the applicator assembly is mounted in the pelvis of the patient. The spider 10 includes a plurality of spaced, radially extending legs 11, 12 and 13, which are made integral therewith.

An adjustable extensible bracket 14 is attached to each of the legs 11 and 12, so as to extend laterally therefrom. An elongated slot 15 extends through each of the brackets 14, and a pair of screws 16 extends through each of the slots 15 and are threadedly engaged in threaded passages extending through the legs 11 and 12. The brackets 14 are slidably disposed in relation to the legs 11 and 12, and upon the loosening of the screws 16, the brackets 14 may be extended outwardly or inwardly with relation to the legs 11 and 12.

After the brackets 14 have been thus adjusted with relation to the legs 11 and 12, the screws 16 may be tightened to thus secure the brackets 14 in fixed relationship to the legs 11 and 12.

A screw receiving hole 18 is provided through the outer end of each of the brackets 14. Screws 21 may be passed through the holes 18 and threaded into the superior ramus of the pubic bone 19 on each side of the pelvis in order to secure the brackets 14 to such bone.

An adjustable extensible bracket 25 is attached to the leg 13. The bracket 25 has an elongated slot 26 extending therethrough, through which slot the screws 27 are extended. The screws 27 are threadedly in threaded holes extending through the leg 13. The bracket 25 is slidably related to the leg 13, and upon loosening the screws 27, the bracket 25 may be adjusted inwardly or outwardly with relation to the leg 13. After the bracket 25 has thus been extensibly adjusted with relation to the leg 13, the screws 27 may be tightened in order to secure the bracket 25 in fixed relationship to the leg 13.

An offset leg 29 is provided on the bracket 25, and a right angular engaging tongue 30 extends upwardly from the offset leg 29. A screw-receiving hole 31 is provided through the tongue 30.

The tongue 30 is attached to the fifth lumbar vertebrae 33 by means of a screw 32 which is passed through the hole 31 and threadedly engaged in said fifth lumbar vertebrae 33. The offset leg 29 places the tongue 30 in proper alignment with the fifth lumbar vertebrae 33, and also provides an offset area through which the rectum 89 may pass. Since the vertebrae is in vertical position, the tongue 30 is provided in order to provide an attachment surface on the same vertical plane with the vertebrae.

It will be understood, however, that the tongue 30 could be secured to the bones of the sacrum 34, if such becomes necessary due to the unusual depth of the pelvis of the female in which the device is mounted, or due to unusual bone structures of the vertebrae and sacrum which might be encountered.

It will be apparent that the brackets 14 and 25 can be adjusted in length with relation to the legs 11, 12 and 13 for the purpose of securing the applicator assembly in different sizes and shapes of pelvic cavities, and to conform said brackets for attachment to bone structures of different shapes and sizes.

An enlarged cylindrically shaped boss 35 is fixedly secured concentrically on the lower side of the spider 10, said boss 35 having a central longitudinal passage 36 extending therethrough, which is in registry with a passage extending through the spider 10. A reinforcing ring 37 is secured to the upper side of the spider 10 about the passage through the spider, said ring 37 having a central passage therethrough in registry with the passage 36.

An elongated cylindrical rod or post 38 slidably and rotatably extends through the passage 36 and through the spider 10 and the reinforcing ring 37.

A set screw 39 threadedly extends through the wall of the boss 35, and the inner end of such set screw is arranged to engage the post 38, in order to detachably secure the post 38 to the boss 35.

Upon loosening the set screw 39, the boss 35 and spider 10 may be rotated with respect to the post 38 in order to adjust the radial disposition of the brackets 14 and 25 and the attachments carried by post 38, as hereinafter described. The boss 35 and spider 10 may also be raised or lowered by sliding the boss 35 upward or downward on the post 38. After such adjustments have been made, the set screw 39 may be screwed inward to engage the post 38 and thereby fix the boss 35 and spider 10 in adjusted position to the post 38 against vertical or rotational movement with relation thereto. Such adjustment brings the brackets 14 and 25 in proper alignment for attachment to the pubic bone 20 and fifth lumbar vertebrae 33, as above described. It also permits a limited vertical adjustment of the spider 10 with relation to the post 38, and permits the entire assembly, carried by the post 38, to be vertically and radically adjusted with relation to the spider 10.

An elongated cylindrical cross-arm 42 is adjustably carried on the post 38. A transverse passage 43 extends through the cross-arm 42 midway of the length thereof,
said passage 43 (see Fig. VI) intersecting the vertical and longitudinal axes of the cross-arm 42. The post 38 slidably extends through the passage 43, but may be secured thereto by means of a set screw 44, which extends through the wall of the cross-arm 42 to engage the post 38. The set screw 44 may be loosened to allow the cross-arm 42 to be adjustably raised or lowered on the post 38, and the cross-arm 42 may be rotated about the post 38 to a desired position. After such adjustment, the set screw 44 may be screwed inward to engage the post 38 and thereby secure the cross-arm 42 to the shaft 48 against sidewise or rotational movement with relation thereto.

The radial position of the supports 50, carried by the cross-arm 42, may thus be adjusted. The longitudinal bore 45 extends concentrically through the cross-arm 42 in the outer ends of which bore the studs 51 (hereinafter described) may be slidably and rotatably inserted. A set screw 46 extends through the wall of the cross-arm 42 near each end thereof, and the inner ends of such set screws are arranged to engage the studs 51 to secure them in fixed relationship to the cross-arm 42. Each stud 50 may be thus adjusted in vertical angular position and in outward position by rotating the studs 50 and sliding them inward or outward with respect to the cross-arm 42 and then fixing them to the cross-arm in adjusted position.

Although the cross-arm 42 is shown as being cylindrical in shape, it will be apparent that it could be made in other shapes such as square or hexagonal, and still accomplish the same purpose.

A radioactive material carrier or support 50 is arranged to be adjustably carried at each end of the cross-arm 42.

The supports 50 are preferably made of relatively hard plastic material such as "Lucite." Such material has been found most suitable for supporting and carrying the radioactive material, because radiation from radioactive material passes through such material without appreciable absorption or attenuation and does not chemically react with the tissues of the body. Such material is also capable of being sterilized easily and is non-corrosive. The supports 50 are shown in the drawing as being made of transparent material.

It will be understood, however, that the supports 50 could be made of any material which does not materially absorb or retard radiation rays from radioactive material, and which is capable of being sterilized and is non-corrosive, and does not chemically react with the body tissues. Such material may be wood or hard rubber.

Each of the supports 50 is substantially convev-concave in contour, and the outer surfaces thereof are shaped to substantially conform to the downwardly sloping walls of the pelvic cavity. The walls of the supports 50 are of proper thickness to space the radioactive material, carried on the inner side thereof, from the tissues about the lateral walls of the pelvic cavity, so as to regulate and adjust the amount of irradiation applied to such tissues, and prevent the radioactive material from directly contacting the tissues, to thereby prevent excessive irradiation exposure. Thus, the supports 50 also serve as spacers for spacing the radioactive material from the tissues being treated.

A mounting lug 52 is secured to the inner side of each of the supports 50 by means of screws 53. Each lug 52 has an outwardly extending leg 54 thereon to which is pivotally attached a cylindrical stud 51 by means of a pivot pin 55, which passes through the inner end of the stud 51 and the leg 54. Preferably, the pivot pin 55 forms a relatively tight joint between the stud 51 and the leg 54, so that the supports 50 may be adjusted in vertical angular relationship to the studs 51 upon exerting pressure against the spacers 50.

The outer ends of the studs 51 may be slidably inserted in the outer ends of the bore 45 and adjusted inwardly or outwardly in relation to the cross-arm 42. The studs 51 may also be rotated in the bore 45 to angularly adjust the supports 50 in horizontal position. After such adjustments are made, the set screws 46 may be screwed inwardly to engage the studs 51 to secure said studs against rotational or sidewise movement with relation to the cross-arm 42.

It will, of course, be apparent that the supports 50 could be made of different sizes and shapes, so that a plurality of said supports of different sizes and shapes could be readily available, and quickly mounted and adjusted on the cross-arm 42 in the manner described.

A plurality of tubular receptacles 58 are detachably mounted on the inner side of each of the supports 50. Radioactive material may be inserted and supported in the tubular receptacles 58. The receptacles 58 are preferably made of such material as will readily pass the radiation from the radioactive material.

The tubular receptacles 58 are detachably engaged on the inner side of the supports 50 by pairs of spaced spring clips 59. A typical spring clip is shown in an enlarged view in Fig. VIII.

Each spring clip includes a pair of spaced inwardly extending legs 60 made of spring-like material, such as spring steel, and the opposite ends of the tubular receptacles 58 are forced between the legs 60, which gripingly engage the receptacle. Each of the spring clips 59 is secured to the support 50 by means of a rivet, indicated at 61.

The tubular receptacles 58 may be made of varying lengths, diameters, and wall thicknesses, as desired.

There are several different kinds of radioactive material which may be used in the treatment of cancer. The most common type used is radium chloride, usually referred to as "radium." Radium chloride is in granular form, and is sealed in small cylinders of varying lengths, called "cells."

The cylinders, containing the radium chloride, may be inserted in frictional engagement in the tubular receptacles 58, and after such tubular receptacles have been so loaded with the proper number of cylinders of radium to give the desired amount of radiation, the tubular receptacles may be closed and detachably mounted in the spring clips 59, as shown in the drawings.

Another type of radioactive material which may be employed with my applicator, is radioactive cobalt, which may be in the form of bars, sheets, or wires.

Another form of radioactive material usable with my applicator is radioactive cesium-147, which is a fission product secured from atomic energy plants. This product is in powder form and may be sealed in small cylinders of varying lengths.

A still further form of radioactive material usable with my applicator is radioactive gold-198, which is contained in cells similar to radium chloride.

Any of the above types of a radioactive material could be so formed as to be inserted in the tubular receptacles 58, and those types which are in solid form could be made in bars which could be attached directly by means of spring clips, such as shown at 59.

It will be understood that other means for detachably mounting the radioactive materials on the inner sides of the supports 50 could be provided. For instance it could be mounted to the inner sides of the supports 50 by means of cement or other adhesive material.

The form of mounting shown herein is merely illustrative. It has been found, however, that this form of mounting is particularly adaptable to mounting radium,
which is the form of radioactive material most commonly used in the treatment of cancer.

A lead bar 62 is attached on the inner edge of the rear side of each of the supports 50. It is known that lead absorbs radiation emitted by radioactive material, and the bars 62 extend outwardly from the inner wall of the supports 50 to intercept lateral rays from the radioactive material mounted on the inner side of the supports 50. The bars 62 absorb such lateral radiation to reduce the amount of radiation exposure to the rectum 89 of the patient. Each of the lead bars 62 is attached to the support 50 by means of a screw 63 at each end thereof.

Another lead bar shield 64 is mounted on the inner side of the front edge of each of the supports 50 by means of screws 65. The lead bars 64 extend outwardly from the inner walls of the supports 50 in position to intercept and absorb laterally directed radiation rays from the radioactive material mounted on the inner sides of the supports 50, thus reducing the amount of radiation applied to the urinary bladder 88 of the patient and preventing it from being over exposed to radiation.

The radiation from the radioactive material, carried on the inner sides of the supports 50, passes through the supports 50 and thus into the structures and tissues along the lateral walls of the pelvis, and such radioactive material is spaced from the lateral walls, and the tissues thereof, by the supports 50.

A transverse angular bracket 69 is detachably mounted at the lower end of the post 38 by means of a screw 70. An angularly offset leg 72 forms a part of the bracket 79, and a radioactive material support 71 is detachably mounted to the offset leg 72 by means of a screw 73. The support 71 is provided for mounting radioactive material for irradiation of the tissues along the floor of the pelvis, between the rectum and the urinary bladder. The support 71 is made of the same material as the lateral supports 50, as indicated hereinabove.

A plurality of hollow tubular receptacles 74, for receiving radioactive material, are detachably mounted on the inner side of the support 71 by means of spring clips 75, which are the same in construction as the typical spring clip 59, shown in Fig. VII.

The tubular receptacles 74 are exactly the same in construction as the tubular receptacle 58, already described, and the radioactive material is mounted in the tubular receptacles 74 in the same manner as was described with reference to the tubular receptacles 58. The tubular receptacles 74 are also engaged by the typical spring clips 75, in the same manner as was described above with reference to the engagement of the tubular receptacles 58 by the spring clips 59.

The support 71 may be removed from the bracket 69, and a support 71 of a different size may be substituted therefor. This may be done by merely removing the screw 73 and attaching another support 71.

The support 71 is of such shape and contour as to conform to the contour of the floor of the pelvis of the patient and it is of such thickness as to properly space the radioactive material from the tissues along the pelvis floor.

A lead bar shield 76 is attached to the beveled surface 81 at the upper edge of the support 71 by means of screws 77. The lead bar 76 extends inwardly of the upper edge of the support 71 in position to intercept laterally directed rays from the radioactive material carried on the inner side of the support 71. Such rays are absorbed by the lead bar 76 to reduce the amount of radiation applied to the urinary bladder 88 of the patient, thus protecting the urinary bladder from damaging radiation.

An angled restrainer plate 78 is detachably secured to the inner side of the lead bar 76. The plate 78 has an angularly disposed offset leg 79 thereon which is attached to the inner edge of the lead bar 76 by means of a screw 80, and such plate includes an upwardly and outwardly extending flange 82 which engages the urinary bladder 88 and prevents it from materially entering the field of irradiation, produced by the radioactive material mounted on the inner sides of the supports 50 and 71.

It will be apparent that the plate 78 may be removed and replaced by a plate of different size or shape, in order to provide a suitable restrainer for the urinary bladder of different patients.

An angular offset leg 84 is provided at the opposite end of the bracket 69 from the offset leg 72. A rectum restrainer plate 83, which is of convexo-concave contour, is attached in angular disposition to the offset leg 84 by means of a screw 85. The outer concave side of the restrainer plate 83 is arranged to receive the rectum 89 and restrain the rectum from materially entering the field of radiation produced by the radioactive material carried on the inner sides of the supports 50 and 71.

The beveled lower end of the restrainer plate 83 is provided to conform to the sloping floor of the pelvic cavity. The angular disposition of the restrainer plate 83 may be adjusted by providing differently angled legs on the brackets 84. It will also be apparent that the restrainer plate 83 can be quickly removed and a restrainer plate 83 of different size or shape may be substituted therefor.

All metallic parts of the applicator assembly, with the exception of the lead shields 62, 64 and 76, and the supports 50 and 71, should be made of corrosion resistant metals such as Monel or stainless steel, and the tubular receptacles 58 and 74 are preferably made of hyper-chrome steel.

All parts of the device should be made of material which is non-corrosive and easily sterilized.

The applicator device is prepared, assembled and mounted in the pelvis of the patient in the following manner:

The required amount and distribution of radioactive material to be carried by the device will be determined in the laboratory prior to insertion. Various sizes of lateral supports 50 and pelvic floor supports 71 may be on hand, and supports of proper size and shape may be selected and rapidly loaded with radioactive material in the operating room as soon as the sizes and shapes are determined by measurement, during the operation.

All the component parts of the device will be sterilized prior to the operation, in the usual manner.

The surgeon will open the abdomen by an incision of such size and shape as to permit the removal of the uterus, Fallopian tubes, broad ligaments and ovaries, or other organs affected by cancer, and the raw surfaces are covered with the peritoneum lining of the peritoneum cavity; and all openings made during the operation are closed by sutures in the usual way. In Fig. I the uterus has been removed and the opening from the uterus to the vagina 90 has been closed by a suture 91.

Catheters are placed in the urinary bladder and in the rectum, so as to maintain them in an empty state.

The applicator device, without radioactive material therein, may then be lowered into the pelvic cavity 87 and adjustments, indicated hereinabove, may be made so as to properly fit and position the applicator in the pelvis. The device will then be removed and the tubular receptacles 58 and 74 are filled with the proper amount of radioactive material and the device is then ready for re-insertion and mounting in the pelvis.

Preferably, the pelvic cavity will be lined with a thin, inert, flexible plastic material (not shown), and the device may then be lowered into the pelvis with the supporting brackets 14 and 25 in position to be attached to the superior surface of the superior ramus of the pubic bones on each side thereof, and to the fifth lumbar
vertebrae or to the sacrum at the rear. The brackets are then securely attached to these bones by means of the screws and, when fully tightened, will have been previously adjusted and securely tightened so as to prevent any shifting of the device after the abdomen is closed.

After the applicator device is thus secured in place in the pelvis, in the position shown in Fig. 1, a rubber or plastic bag (not shown), filled with plastic beads, which bag becomes rigid upon evacuation of the air therein, may be placed over the device and superposed by the spider and brackets and in position to close all the spaces between the brackets and so as to prevent the small intestine from entering into the pelvis within the field of radiation.

After the said bag is in place, evacuated and sealed off, the flexible plastic material with which the pelvis has been lined, will be brought together and tied securely over the top of the bag, thus completely sealing the entire applicator device within the plastic material. After this procedure has been completed, the incision in the abdomen will be closed with surgical sutures, in the usual manner.

An interval of about five days, during which time the bladder and the rectum are kept empty by cathetometers, the abdomen will be opened, and the entire applicator device, together with the plastic bag and the plastic material in which it is enclosed, will be removed. The incision in the abdomen will then be closed for the second time.

During the time the applicator device is mounted in the pelvis, as shown in Fig. 1, radiation from the radioactive material, carried by the supports and, as applied to the lateral walls and floor of the pelvis, destroys cancerous cells which may be present therein. Such cancer cells are most likely to be lodged in the lymph nodes surrounding the pelvis, and the radiation is applied to such lymph nodes and to tissues between and among them.

One or more of the supports and brackets could be eliminated from the applicator device when it is mounted in the pelvis, so as to apply radiation to only one or more walls of the pelvis. This arrangement is illustrated in Fig. III, wherein one of the lateral supports has been left off of the applicator assembly when it was mounted in the pelvis and radiation is applied to only one side and to the floor of the pelvis wall. This arrangement would be applicable where it is definitely known that cancer is present in only certain localities surrounding the pelvis, and radiation is applied only to those areas.

It will be understood that other and further forms and modifications of my invention may be devised without departing from the spirit and scope of the appended claims.

I claim:

1. A radioactive material applicator, comprising, a supporting frame; means for attaching the frame to bone structure of a patient so as to be positioned in the pelvis of the patient; a plurality of radioactive material supports carried by the frame; and means for mounting radioactive material on the supports.

2. A radioactive material applicator, comprising, a supporting frame; means for attaching the frame to bone structure of a patient so as to be positioned in the pelvis of the patient; a plurality of radioactive material supports carried by the frame; and means for mounting radioactive material on the supports.

3. A radioactive material applicator, comprising, a supporting frame, means for attaching the frame to bone structure so as to be positioned in the pelvis of a patient; a plurality of radioactive material supports carried by the frame; means for mounting radioactive material on the supports; holding means carried by the frame to restrain the urinary bladder from entering the field of radiation produced by the radioactive material; and plate means carried by the frame to restrain the rectum of the patient from entering the field of radiation produced by the radioactive material.

4. A radioactive material applicator, comprising, a supporting frame; a plurality of attachment brackets radiating from the frame having means thereon for attaching the brackets and frame to bone structure adjacent the pelvis region of a patient to support the applicator in the pelvis of the patient; a plurality of radioactive material supports carried by the frame and radially spaced thereabout; and means to mount radioactive material on the supports.

5. A radioactive material applicator, comprising, a spider; a plurality of adjustable extensible brackets extending radially from the spider, means on each bracket enabling attachment to a bone in the body of a patient; a central post slidably and rotatably carrying the spider; a cross-arm slidably and rotatably carried by the post; and a plurality of radioactive material supports carried by the cross-arm.

6. A radioactive material applicator, comprising, a spider; a plurality of adjustable extensible brackets extending radially from the spider, means on each bracket enabling attachment to a supporting bone in the body of a patient; a central post slidably and rotatably carrying the spider; a cross-arm slidably and rotatably carried by the post; a radioactive material support carried by the cross-arm at each end thereof, and means for adjusting said supports radially and in angularity with respect to said cross-arm and in angularity with respect to said spider.

7. A radioactive material applicator, comprising, a spider; a plurality of adjustable brackets extending radially from the spider, means on each bracket enabling attachment to a supporting bone in the body of a patient; a central post slidably and rotatably carrying the spider; a cross-arm slidably and rotatably carried by the post; a radioactive material support carried by the cross-arm at each end thereof, and means for adjusting said supports radially and in angularity with respect to said cross-arm and in angularity with respect to said spider.

8. A radioactive material applicator, comprising, a spider; a plurality of arms extending radially from the spider; an extensible spider support extending from each arm, means for attaching each of said brackets to a bone adjacent the pelvis of a patient; said arms and brackets comprising a support for a head filled spacing bag to prevent the small intestine of the patient from entering the field of radiation produced by radioactive material carried by supports on the applicator; a central post slidably and rotatably carrying the spider; a cross-arm slidably and rotatably carried by the post; a lateral pelvic wall radioactive material support carried at each end of the cross-arm; a pelvic floor radioactive material support carried at the lower end of the post; radioactive material detachably carried on the inner sides of the supports; and a plurality of lead shields carried by the supports in position to intercept rays from the radioactive material carried by the supports to protect the urinary bladder and rectum of a patient from excessive radiation.

9. A radioactive material applicator, comprising, a supporting frame, means for securing said frame in the pelvis of a patient so as to be immovable with respect to the bone structure in the pelvic region, at least one radioactive material support carried by said frame, and means for mounting radioactive material on said support.

10. A radioactive material applicator, comprising, a supporting frame, means for attaching said frame in the pelvis of a patient, a radioactive material support carried by said frame, and means for mounting radioactive material on said support.
supporting frame; means for attaching the frame to bone structure so as to be positioned in the pelvis of a patient; and a plurality of radioactive material supports carried by said frame in spaced relation about the frame, each of said supports being made of radiation conducting material.

12. A radioactive material applicator as defined in claim 11, and radiation absorbing material carried by said supports in position to intercept laterally directed radiation.

13. A radioactive material applicator as defined in claim 11, and means for detachably securing radioactive material on the inner sides of said supports.

References Cited in the file of this patent

UNITED STATES PATENTS
2,516,261 Schutt -------------- July 25, 1950
2,544,939 Ritala -------------- Mar. 13, 1951

FOREIGN PATENTS
845,558 Germany -------------- July 8, 1949
852,277 Germany -------------- Oct. 13, 1952

OTHER REFERENCES