

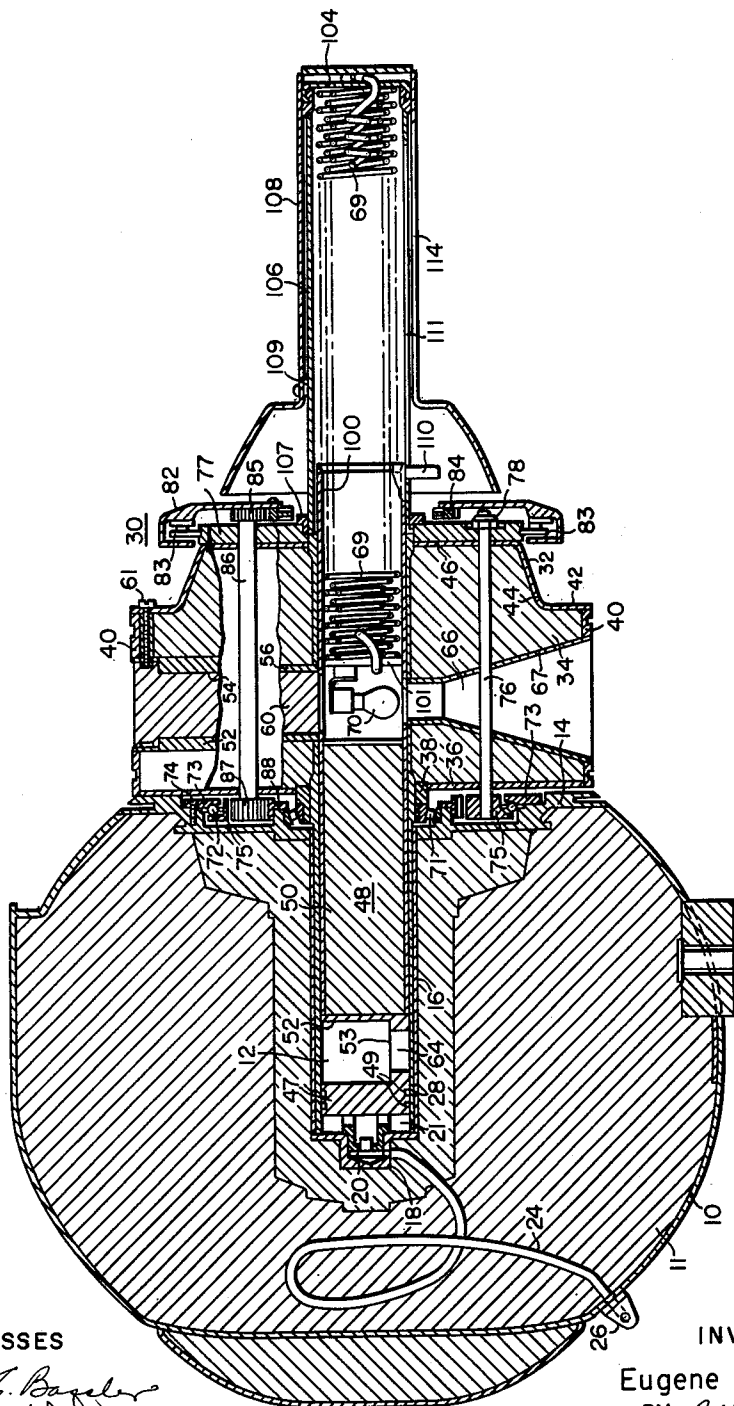
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RADIOACTIVE SOURCE HOLDER

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WITNESSES

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1

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RADIOACTIVE SOURCE HOLDER

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This invention relates to shielded devices for holding a source of radioactive material and directing a beam of radiant energy therefrom for medical therapy and other purposes; and more particularly to such source holder devices as comprise a main body for containing the radioactive source and shielding the same in a safe manner when in a repose position, and a radiation emergence portion into which portion said source is moved for registry with a radiation emergence aperture therein.

It is a prime object of the present invention to provide a source holder device of the above general type having improved means for effecting actuation of the radioactive source from its repose position to its active position whereby such actuation is greatly facilitated and fail-safe operation of the device is assured.

It is another object of the invention to provide a source holder device of the above general type having improved means for shielding the guideway along which said source is moved.

It is a still further object of the present invention to provide a source holder device of the above general type having improved means for locating the path of the radiation beam collimated by the radiation emergence aperture.

It is another object of the present invention to provide a source holder device of the above general type having improved means enabling loading of the device with the radioactive source material in a facile and safe manner.

Other objects and advantages of the invention will become apparent from the following detailed description of the invention when taken in connection with the accompanying drawing, in which the single figure is a side sectional view, several components being in outline, of the source material holder embodying the invention.

Referring to the drawing, the source holder embodying the invention is primarily, though not necessarily, intended for employment with a cobalt-60 source, and, to provide adequate shielding with minimum bulk, includes a generally spherical-shaped hollow metal container 10 filled with shielding material 11, such as lead, in which is centrally located a source capsule 12 when in a fully shielded position at a repose station. One end of the container 10 is blunt and enclosed by a substantially disc-shaped front wall 14 to which is attached a cylinder member 16 extending inwardly of container 10 centrally of wall 14. An end member 18, attached to the innermost end of the cylinder member 16, is provided with a fluid pressure port 20 to enable ingress and egress of fluid under pressure to and from a pressure chamber 21 via a labyrinth conduit 24, embedded in the material 11, and an external fitting 26, for actuation of the source capsule 12 in manner as will be set forth in detail hereinafter.

A hollow cylinder member 28 is rotatably mounted in cylinder member 16 to act as a cylindrical guideway for directing movement of the source capsule 12 from its repose position in which it is shown in the drawing to an operative position hereinafter defined, and to define the hub of a novel radiation emergence portion 30 of the source holder.

The radiation emergence portion 30 includes a substantially cylindrical metal shell 32 filled with a shielding

2

material 34, such as lead, the central portion of shell 32 being defined by an extension of the cylindrical member 28 which is attached to such shell by means such as welds (not shown). An end of the shell 32 adjacent to the front wall 14 of the container 10 is defined by an annular end wall 36 and bearing race support member 38 encircling member 28, each component being attached suitably one with the other to provide a fluid tight container adapted for holding the shielding material 34 when introduced initially thereinto in its molten state. The periphery of the shell 32 is defined by an elongated ring member 40, and the other end of such shell is defined by a portion including an annular flange 42 attached at its outer periphery to ring member 40, an integral frustoconical portion 44 and an end wall 46 attached at its inner periphery to cylinder member 28.

The source capsule 12 is carried in an end portion 47 of an elongated piston assemblage 48, such end portion being of a special grade of high lead (30%) bearing bronze which will not gall in contact with cylinder member 28 which is of stainless steel, and the remainder of piston member 48 is hollow and filled with a shielding material such as lead. Lubrication is obtained by a dry film type lubricant such as graphite in epoxy binder.

According to a feature of the invention, bronze piston rings 49 are provided on the end portion 47 of piston member 48 for substantial sealing engagement with the inner wall of cylinder member 28 while at the same time providing for slight clearance therebetween to enable some fluid under pressure at a controlled rate to leak past such rings between the piston member 48 and the inner wall of said cylinder member, for reasons which hereinafter will be set forth.

End portion 47 of piston 48 is further provided with a cylindrical socket 52 terminating at an annular shoulder 53 formed in portion 47 at the juncture of such socket 52 with an emergence port 64. Socket 52 is adapted for registry, in a displaced position of piston 48, with an aperture 54 defined by a sleeve member 56 associated with portion 30 and extending radially outward from corresponding apertures in cylinder member 28 at its inner end and in ring member 40 at its outer end. Registry of socket 52 with sleeve member 56 enables the source capsule 12 to be inserted into and ejected out of such socket via the aperture 54, at any angular position, according to the rotary position of portion 30 with respect to container 10. A lead plug 60, removably secured by a set screw 61, normally fills the aperture 54 subsequent to insertion of the source capsule 12 into socket 52.

The emergence port 64 opens from the socket 52 radially of piston member 48 oppositely to the open end of socket 52, for registry with a radiation emergence aperture 66 formed by a hollow member 67 extending radially outward from cylinder member 28 to sleeve member 40, for emergence of radiation from capsule 12 to the exterior of the source holder when the piston assemblage 48 is fluid pressure actuated to attain such registry. As a feature of the invention, the radiation emergence aperture 66 is disposed in alignment with the loading aperture 54 to enable an instrument to be inserted through the emergence aperture 66 and port 64 to force the source capsule out through aperture 54 during unloading, should such capsule become jammed at this time. A spring detent means (not shown) preferably is employed to restrain the source capsule 12 within the socket 52 and thereby yieldably retain same in place against undesirable shifting within such socket.

A return spring assemblage 69, including a plurality of coaxially arranged helical compression springs, is arranged to return the piston assemblage 48 to the repose

position in which it is shown in the drawing and in which the source capsule 12 is completely shielded by material 11 of container 10 and by material 50 within piston assemblage 48. In such repose position, a source of visible light in the form of a bulb 70, carried by piston member 48, is brought into registry with the emergence aperture 66 to provide for focusing such aperture by visible light with the area of a patient or target to be subjected to radiation. In accord with the feature of the invention, it will be appreciated that such direct registry of bulb 70 with emergence aperture 66 provides for reliable focusing without resort to mirrors or reflecting elements which might be subject to misalignment periodically.

To enable the emergence portion 30 and piston member 48 to be turned about the axis of such piston member for selective orientation of the radiation emergence aperture 66 while at the same time relieving the hollow cylinder member 28 of the load of such portion and providing a relatively frictionless rotary connection, a tapered roller bearing assemblage 71 is interposed radialwise between bearing race support member 38 and a portion of wall 14 of container 10, and a ball-type thrust bearing assemblage 72 extends radialwise in interposition between wall 14 and such portion 30. An outer raceway 73 of assemblage 72 is removably secured by screws 74 to wall 14, and the inner raceway 75 of assemblage 72 is attached to a plurality of bolts 76 which extend through the portion 30, including an annular end member 77 attached to end wall 46 of such portion 30. By means of nuts 78, the portion 30 is removably attached to container 10 through the medium of the bolts 76 and the thrust bearing assemblage 72.

To enable accurate and facile rotary movement of the beam emergence portion 30, relative to container 10, a handwheel 82 is provided which is rotatably supported on the outer periphery of end member 77 through the medium of rollers 83 and is connected to container 10 through a gear train. The gear train includes a large ring gear 84 attached to handwheel 82, an engaging small gear 85 attached to one end of a rotatable shaft 86 journaled in end member 77 and extending through material 34 and through end wall 36, a gear 87 attached to the opposite end of shaft 86, and a gear 88 attached to the front wall 14 of container 10. An idler gear, not shown, may be suitably arranged in such gear train where it is desired to change the directionality relationship between rotary movement of shell 32 and that of the handwheel 82. It will be apparent by reference to the drawing that turning movement of shaft 86 around its own axis through the medium of handwheel 82 and gears 84, 85 will cause gear 87 to roll around gear 88 and carry such shaft 86 and shell 32 with it, thereby turning the emergence aperture 66 about the axis of the piston member 48 which will also be turned correspondingly during the turning of cylindrical member 28 in which it is disposed.

To assure that the emergence portion 30 may not accidentally be moved from a selected rotary position relative to container 10, a friction assemblage (not shown) may be provided for cooperation between portion 30 and such as wall 14 of container 10.

The spring assemblage 69 extends into the end of a hollow extended portion 100 of piston assemblage 48 and into contact at its one end with an interior wall 101 of such piston assemblage. The opposite end of the spring assemblage is in thrust engagement with an end wall 104 of a cylindrical spring container 106 which is attached at a flanged end 107 to the end member 77. A cover 108, attached at 109 to spring container 106, encases same and covers a substantial front portion of the handwheel 82 primarily to enhance the appearance of the source holder.

A tab 110, attached to the end of the hollow extended portion 100 of piston assemblage 48, extends radially outward therefrom through a longitudinal slot 111 in

spring container 106. During rotary movement of the emergence portion 30 by manipulation of the handwheel 82 for orientation of the radiation emergence aperture, the spring container 106 attached to end member 77 will turn in unison with the shell 32, and through contact of a side wall of the slot 111 with the tab 110, turning of the piston assemblage 48 in unison with portion 30 for maintaining proper registry of emergence ports 64 and 66 in unison with portion 30 will be assured. In addition, an elongated slot 114 in registry with slot 111 is formed in the cover 108 for accommodation of the tab 110 during fluid pressure actuation of the piston assemblage 48 to enable the tab 110 to project outwardly therefrom to serve as indication that the source capsule 12 is in its operative position at the radiation emergence aperture 66. Upon return of the piston assemblage 48 to its repose position in which it is shown in the drawing, the tab 110 will become disposed within cover 108 to indicate that the source capsule 12 is disposed in its fully shielded inoperative position. The tab 110, when in its extended position within slot 114, may also serve as a means whereby force can be applied to the piston member 48 to effect return of the source capsule 12 to its repose position within housing 10 in the remote event that the spring assemblage 69 should fail in this regard.

The spring assemblage 69, in addition to its normal piston-returning function, represents a fail-safe arrangement to assure return of the piston assemblage 48 automatically, should pressure of fluid in the source (not shown) supplying chamber 21 become depleted accidentally at a time when the piston assemblage 48 was positioned for registry of source capsule 12 with the emergence aperture 66. In addition, should it be found impossible to effect release of fluid under pressure from the chamber 21 by way of the conduit 24 and fitting 26, due, for example, to a stuck control valve (not shown), at a time when the piston member 48 is disposed for registry of the capsule 12 with the emergence aperture 66, in accord with additional fail-safe feature of the invention, fluid under pressure in the chamber 21 will leak past the somewhat loosely fit piston rings 49 and the piston assemblage 48 through the cylindrical member 28 to the atmosphere by way of such as emergence aperture 66, and thereby permit the spring assemblage 69 to automatically return the piston assemblage 48 and source capsule 12 to its fully shielded repose position.

Certain features of the present invention are disclosed but not claimed in copending U.S. patent application Serial No. 748,350, filed July 14, 1958, entitled "Teletherapy Device," by Robert L. Guentner and Edward F. Moran, which application is assigned to the assignee of the present application.

Since changes may be made in the abovedescribed construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a radiation source material holder, the combination of means defining a cylindrical guideway, a fluid pressure actuated piston assemblage slidably mounted in said guideway for conveying a radioactive source material from a fully-shielded position to an active position for emission of radiation from such holder, spring means biasing said piston means toward its fully shielded position, said piston assemblage having radial clearance with respect to the wall of said guideway whereby fluid under pressure will leak past said piston assemblage at a controlled rate to permit said spring means to automatically return same to its fully shielded position in the event fluid under pressure ahead of said piston assemblage cannot be released in a normal manner.

5

2. A radioactive source material holder comprising shielded enclosure means having a radiation emergence aperture therein, a radioactive source material capsule, a light bulb, and conveying means within said enclosure means carrying said radioactive source material capsule and said light bulb for selective registration with said emergence aperture.

3. A radiation source material holder comprising a first shielded portion having a cavity therein open to its exterior; a second shielded portion having an opening in registration with said cavity and a radiation emergence aperture extending radially outward therefrom; and piston means having a radioactive source carrying end normally disposed at the inner end of said cavity, a focusing-light carrying end normally disposed in registry with said radiation emergence aperture, and an intermediate radiation shielding portion, said piston means being actuable by fluid under pressure along said cavity and along said opening to disestablish and establish registry with said radiation emergence aperture of said focusing-light carrying end and said radioactive source carrying end, respectively.

4. A radioactive source material holder comprising shielded enclosure means defining a cylindrical guideway with oppositely-arranged radiation emergence and loading apertures extending radially outward therefrom to the exterior of such holder, and piston means slidably disposed in said guideway for conveying a radioactive source material from a fully shielded position to a position in registry with said apertures, said piston means having a cavity formed therein for registry with the loading aperture to receive a radioactive source material capsule thereby, and having a port opening into said cavity for registration with said radiation emergence aperture to facilitate radiation from such source capsule.

5. A radioactive source material holder comprising a first shielded enclosure; a second shielded enclosure having oppositely-arranged radiation emergence and loading apertures extending outward therefrom to its exterior, said second shielded enclosure being rotarily mounted on said first enclosure for rotary movement of said apertures about an axis with respect to which said apertures extend radially; piston means for conveying a radioactive source capsule material along said axis from a fully shielded position within said first shielded enclosure to an active position within said second shielded enclosure, said piston means having a cavity formed therein for registry with said loading aperture to receive and exit said source material capsule thereby, and having a port opening into said cavity for registration with said radiation emergence aperture; and means for effecting turning movement of said piston means correspondingly with turning movement

6

of said second enclosure to maintain proper alignment for establishment of the aforesaid registries irrespective of the rotary position of said second enclosure.

6. A radiation source material holder comprising enclosure means defining a shielded cylindrical guideway, piston means normally operated by fluid under pressure and slidably mounted in said enclosure means for conveying a radioactive source material along said guideway between fully shielded and partially shielded positions, return spring means for said piston means, and rigid means attached to said piston means and extending to the exterior of said enclosure means whereby said piston means may be actuated manually to convey said source material to its fully shielded position in event of failure of the normally operative means for actuating said piston means.

7. A radioactive source material holder comprising a first shielded enclosure; a second shielded enclosure having oppositely-arranged radiation emergence and loading apertures extending outward therefrom to its exterior, said second shielded enclosure being rotarily mounted on said first enclosure for rotary movement of said apertures about an axis with respect to which said apertures extend radially; piston means for conveying a radioactive source capsule material along said axis from a fully shielded position within said first shielded enclosure to an active position within said second shielded enclosure, said piston means having a cavity formed therein for registry with said loading aperture to receive and exit said source material capsule thereby, and having a port opening into said cavity for registration with said radiation emergence aperture; means for effecting turning movement of said piston means correspondingly with turning movement of said second enclosure to maintain proper alignment for establishment of the aforesaid registries irrespective of the rotary position of said second enclosure, and manually operable means including handwheel and gear means cooperable between the aforesaid first and second shielded enclosures for effecting rotary movement of the latter with respect to the former.

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