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ARTICULATED RADIOACTIVE SOURCE

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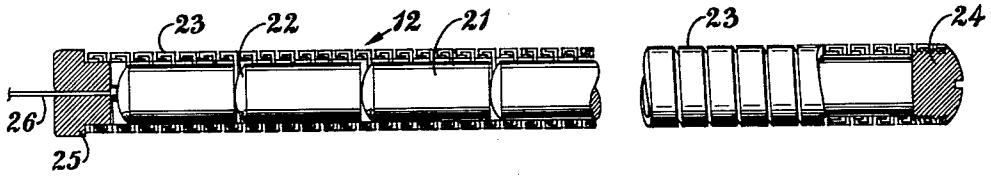

Fig. 1

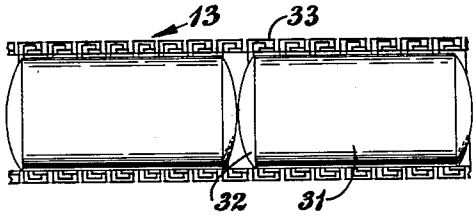

Fig. 2

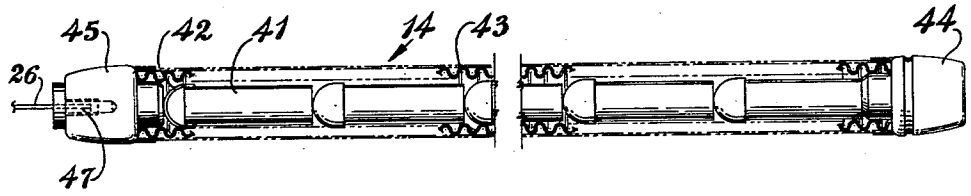

Fig. 3

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ARTICULATED RADIOACTIVE SOURCE

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This invention relates to a radioactive source for use in apparatus for shielding and exposing radioactive material.

For many applications it is desirable to expose materials to rays from radioactive material. This can be accomplished by opening and closing a shield behind which is located a radioactive source. For this purpose it is necessary to have the object to be irradiated close to the shield.

It frequently is desirable to be able to convey the radioactive materials between positions wherein they may be used for subjecting objects to irradiation and other positions wherein the radioactive materials are completely shielded. As illustrative examples of some of the uses of radioactive materials wherein it is desirable to be able to move the radioactive material between exposed and shielded positions, there may be mentioned industrial radiography, food irradiation and sterilization, and medicinal uses.

For maximum flexibility in the operation of the types of apparatus referred to above, the exposed position and the shielded position may be interconnected by means of a tortuous conduit or a flexible conduit. Some such applications require the use of relatively low levels of radioactivity, which low levels of radioactivity can be provided by a radioactive source of relatively small dimensions. In other of such applications, relatively high levels of radioactivity are required which necessitates relatively large volumes of radioactive materials being placed in sources of relatively large dimensions.

Previous to this invention, the requirement of a tortuous conduit or flexible conduit interconnecting the exposing and the shielding positions and the requirement for a relatively high level of radioactivity have been incompatible, and alternate procedures had to be used. Such alternate procedures, such as use of remote handling equipment and shielded rooms, or rigid linear conduits interconnecting the shielding and exposing positions, have their well-known and obvious drawbacks.

It is an object of the present invention to provide a radioactive source which may be moved between a position for exposing objects to the radioactive rays and a position wherein the radioactive source is completely shielded.

It is a further object of this invention to provide a radioactive source having a relatively high level of radioactivity and which is capable of being moved through a tortuous passageway.

With the above object in view, the present invention mainly consists of a radioactive source capable of being transferred through a tortuous conduit comprising a plurality of aligned, relatively small, radioactive sources flexibly secured together.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read with the accompanying drawings in which:

FIGURE 1 is a partially sectional view of a radioactive source incorporating the principles of this invention;

FIGURE 2 is a partial sectional view of another radioactive source incorporating the principles of this invention; and

FIGURE 3 is a partially sectional view of still another radioactive source according to this invention.

Referring to the drawings and more particularly to FIGURE 1, there is shown a flexible radioactive source 12 which comprises generally a length of flexible conduit 23 having a plurality of aligned relatively small radioactive sources 21 contained therein. Depending upon the strength of radioactive source desired, any number of small radioactive sources 21 may be placed within a flexible conduit 23 of appropriate length.

Flexible conduit 23 is provided with end closures 24 and 25 to retain small radioactive sources 21 within flexible conduit 23. It will be noted that end closure 25 has an outside diameter larger than the outside diameter of flexible conduit 23. The outside diameter of end closure 25 is made only slightly smaller than the inside diameter of the tortuous passageway through which flexible source 12 is to be moved.

To one of the end closures 25, may be affixed a cable 26. Each of the radioactive sources 21 has an arcuate end portion 22 which abuts the next adjacent radioactive source 21 in the line.

When flexible radioactive source 12 is moved through a tortuous passageway, it is permitted to flex so as to follow within the contour of said passageway. Arcuate portions 22 permit the relative angular motion of radioactive sources 21 within flexible conduit 23 which permits radioactive source 12 to follow such tortuous passageways.

If the flexible source 12 is to be transported through the tortuous passageway by mechanical means, cable 26 is utilized. The end of flexible cable 26 remote from end closure 25 may be pushed and/or pulled by any suitable conventional mechanism (not shown).

If flexible source 12 is to be transported through the tortuous passageway by the use of differential fluid pressure, such as air pressure or vacuum, the oversize portion of end closure 25 coacting with the internal diameter of the tortuous passageway enables the flexible source 12 to act as a piston within the substantially constant diameter cylinder of the surrounding tortuous passageway. This assures positive motion and most efficient utilization of the differential fluid pressure.

Flexible source 12 may be transported by use of fluid pressure for pushing and by mechanical means acting through cable 26 for retracting. Of course, if fluid pressure alone is used, cable 26 may be omitted.

Referring next to FIGURE 2 there is shown a portion of a flexible source 13 which comprises generally a flexible conduit 33 containing therein a plurality of small radioactive sources 31 positioned therein. Each of said radioactive sources 31 is provided adjacent each end with an arcuate portion 32. The remainder of the description of the flexible source partially illustrated in FIGURE 2 (particularly those portions of the flexible source of FIGURE 2 which have been cut away), is the same as for FIGURE 1, and therefore is not repeated.

The use of arcuate end portions 32 on each end of each source 31 slightly improves the flexibility of source 13, but, more important, it eliminates the possibility of inadvertently inserting an adjacent pair of small sources 31 into flexible conduit 33 with flat abutting portions. Thus, a possible cause of impaired flexibility of the flexible source 12 (of FIGURE 1) due to error in assembly is eliminated.

In FIGURE 3 another embodiment of a flexible radioactive source is illustrated. The flexible radioactive source 14 is composed of a plurality of small radioactive sources 41 of cylindrical configuraton, each of which is provided

with at least one hemispherical cap 42, all aligned within flexible conduit 43. Flexible conduit 43 is provided at one end with nose piece 44 and at the other end with tail piece 45, which nose piece and tail piece serve as end closures.

Tail piece 45 is provided with attachment means 47 for attaching cable 26 thereto. Nose piece 44 and tail piece 45 each have external diameters only slightly smaller than the internal diameters of the tortuous passageway through which the flexible source 14 is to be moved. They thereby act as pistons so that fluid pressure may be used to propel flexible radioactive source 14 from a shielded position to an exposing position in a tortuous passageway.

The various advantages and reasons for the constructional features given in discussing flexible source 12 of FIGURE 1 also apply to flexible source 14 of FIGURE 3. However, the structure of flexible source 14 also has some additional advantages.

By the use of two portions of enlarged diameter (viz., nose piece 44 and tail piece 45), better utilization of the differential fluid pressure is achieved and more of the flexible conduit 43 is protected from abrading on the inside walls of the tortuous passageway during movement therethrough. As a further continuation along this concept, flexible conduit 43 may be provided with enlarged portions spaced along its length (in the nature of piston rings) to still further protect the relatively thin walls of flexible conduit 43 from abrasion.

By the use of hemispherical caps 42 secured to one or both ends of the relatively small radioactive sources 41, standard cylindrical sources 41 may readily be converted to provide more flexible bearing surfaces.

Such a flexible radioactive source is especially useful in an apparatus such as is illustrated in copending application No. 829,577, filed July 27, 1959, now U.S. Patent No. 3,088,032, by D. Brunton and assigned to the assignee of this application.

While the invention has been illustrated and described as embodied in a radioactive source, it is not intended to be limited to the details shown, since various modifications and changes may be made without departing in any way from the spirit of the present invention as defined in the claims.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should be and are intended to be comprehended within the meaning range of equivalents of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An articulate radioactive source capable of being transferred through a tortuous conduit of substantially constant internal diameter comprising, a length of flexible conduit having an external diameter smaller than the internal diameter of said tortuous conduit; a plurality of relatively small radioactive sources positioned within said length of flexible conduit in an end-to-end relationship; and end closures secured to said flexible conduit, at least one of said end closures having an external diameter only slightly smaller than the internal diameter of said tortuous conduit so that upon the application of fluid pressure to one end of said tortuous conduit, said radioactive source may be moved therethrough.

2. An articulate radioactive source capable of being transferred through a tortuous conduit of substantially constant internal diameter comprising, a length of flexible conduit having an external diameter smaller than the internal diameter of said tortuous conduit; a plurality of relatively small radioactive sources positioned within said length of flexible conduit in an end-to-end relationship; end closures secured to said flexible conduit, said closures having an external diameter only slightly smaller than the internal diameter of said tortuous conduit so that upon the application of fluid pressure to one end of said tortuous conduit, said radioactive source may be moved therethrough; and means operatively connected to one of said end closures for applying a force to said radioactive source in a direction opposite to the direction of movement of said source under the influence of said fluid pressure.

3. An articulate radioactive source capable of being transferred through a tortuous conduit of substantially constant internal diameter comprising, flexible conduit means having an external diameter smaller than the internal diameter of said tortuous conduit, at least a portion of said flexible conduit means having an external diameter only slightly smaller than the internal diameter of said tortuous conduit so that upon application of fluid pressure to one end of said tortuous conduit, said radioactive source may be moved therethrough; a plurality of relatively small radioactive sources positioned within said flexible conduit means in an end-to-end engagement; and means operatively connected to said flexible conduit means for applying a force to said radioactive source in a direction opposite to the direction of movement of said source under the influence of said fluid pressure.

4. An articulate radioactive source capable of being transferred through a tortuous conduit of substantially constant internal diameter comprising, flexible conduit means having an external diameter smaller than the internal diameter of said tortuous conduit, at least a portion of said flexible conduit means having an external diameter only slightly smaller than internal diameter of said tortuous conduit so that upon application of fluid pressure to one end of said tortuous conduit, said radioactive source may be moved therethrough; and a plurality of relatively small radioactive sources positioned within said flexible conduit means in an end-to-end relationship.

5. An articulate radioactive source capable of being transferred through a tortuous conduit comprising a plurality of aligned, relatively small, radioactive sources incased in a flexible incasement in an end-to-end relationship, said radioactive sources being provided with arcuate portions at the regions of contact with each other.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 24,544	Morganstern	Sept. 30, 1958
2,750,517	Baum	June 12, 1956
2,798,164	Untermyer	July 2, 1957
2,821,636	Jefferson	Jan. 28, 1958
2,964,628	Ohmart	Dec. 13, 1960