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APPARATUS FOR THE FLUOROSCOPY OF NARROW LIMITED PORTIONS OF THE WALLS OF CAVITIES

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FIG. 1

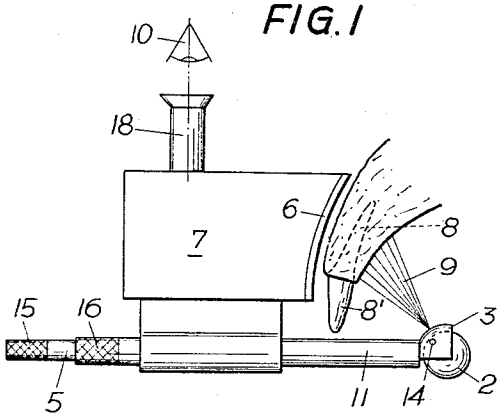

FIG. 2

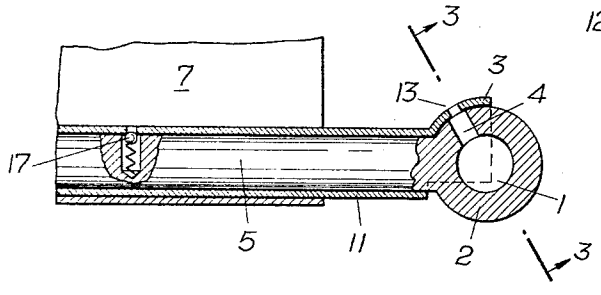

FIG. 3

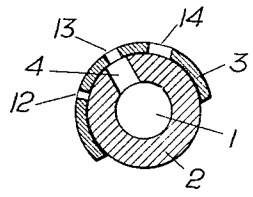

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FIG. 4

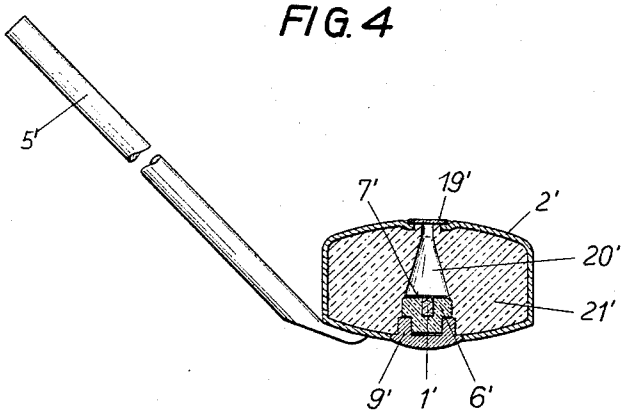
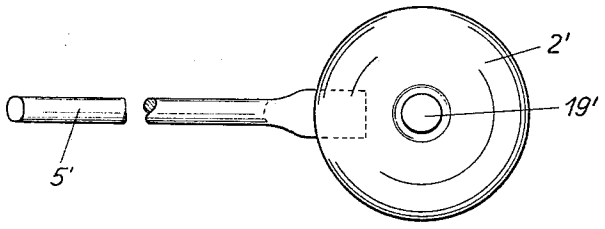


FIG. 5



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APPARATUS FOR THE FLUOROSCOPY OF NARROW LIMITED PORTIONS OF THE WALLS OF CAVITIES

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12 Claims. (Cl. 250—71)

The present invention relates to an apparatus for the fluoroscopy of bodies, in particular of walls of cavities.

It is one object of the present invention to provide an apparatus for the fluoroscopy of bodies, wherein radioactive substances are provided as a radiating source.

It is another object of the present invention to provide an apparatus for the fluoroscopy of bodies, wherein a radioactive radiating source is provided in a housing being secured to the end of a holder.

It is yet another object of the present invention to provide an apparatus for the fluoroscopy of bodies, wherein the radiating source is surrounded by a protective member, which includes means for changing an opening thereof as to size and direction of radiation.

With these and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a side elevation of an apparatus designed in accordance with the present invention;

FIG. 2 is a fragmentary axial section of the member receiving the radiating source;

FIG. 3 is a section along the lines 3—3 of FIG. 2;

FIG. 4 is a side elevation, partly in section, of another embodiment of the apparatus designed in accordance with the present invention; and

FIG. 5 is a top plan view of the embodiment disclosed in FIG. 4.

Referring now to the drawings, and in particular to FIGS. 1–3, the embodiment of the apparatus designed in accordance with the present invention is adjusted to subject one part of the oral cavity to fluoroscopy in order to fluoroscope the root 8 of a tooth 8'.

The apparatus comprises a radiating source 1 disposed in a housing 2, which is rigidly secured to a holder 5, whereby it is possible to insert the radiating source 1 into the oral cavity. The housing 2 is at least partly surrounded by a diaphragm or cover 3, respectively, and by adjustment upon rotation of the holder 5 and proper arrangement of the diaphragm or cover 3 a line of rays 9 is directed towards the part to be fluoroscoped.

A screen 6, for instance, a conventional fluorescent screen, is provided on one side of the apparatus, on which the image enlarged by an image amplifier 7, can be observed, so that the fluoroscoped area can be observed by the human eye from a point 10.

As particularly shown in FIGS. 2 and 3, the holder 5 is surrounded by a sleeve 11, which is preferably integrally formed with the diaphragm 3. The diaphragm 3 has, in the embodiment disclosed in the drawing, three openings 12, 13 and 14 of different sizes. Upon manual rotation of the sleeve 11 relative to the holder 5 by gripping the grooved outer ends 15 and 16 of the holder 5 and the sleeve 11, respectively, one of the openings 12, 13 or 14 can be put into position in front of the radiating source. By rotation and swinging of both, namely the holder 5 and the sleeve 11, the bundle of rays 9 can be directed to any predetermined point. Spring-biased locking means including of a ball urged into complementary recesses can be provided to lock the holder 5 in any one of the

three positions corresponding to the openings 12, 13 and 14. The diaphragm 3 can be rotated such, that an opening 4 provided in the housing 2 is either completely covered or coincides with one of the openings 12, 13 or 14.

Referring now to the embodiment disclosed in FIGS. 4 and 5, it will be readily seen that the apparatus comprises a holder 5' to which an integral housing 2' is secured, in which a radiating source 1' is received. The radiating source 1' is disposed in a carrier 6', which is connected with a cap member 9'. The cap member 9' closes an opening provided at the bottom of the housing 2'. The opening in the bottom of the housing 2' is adapted to receive the carrier 6' together with the radiating source 1'. The latter produces in a suitable absorbing material brake-rays and primary X-radiation.

In the upper face of the housing 2' is disposed a window 19'. In case of a soft X-ray radiation, the window 19' can consist of aluminum and can serve simultaneously as filter for the lowermost energy range of the spectrum. For the collimation of the radiation, a conical passing channel 20' is provided in a protecting material 21' filling up the housing 2'. It is possible by means of the conical passing channel 20' to limit the emerging radiating rays to a small range of the body to be fluoroscoped and to obtain a small effective focal point.

The carrying member 6' is made advantageously of lead, since by such arrangement the radiation passing the window 19' is appreciably amplified. It is known that lead has a larger reflection for the β-radiation and in addition lead-X-ray radiation is excited in the supporting member 6', whereby the supporting member 6' releases a radiation. Furthermore, by the use of lead a favorable protection in rearward direction is provided. A thin foil 7' is arranged above the supporting member 6'. This foil should brake the soft rays and should produce a brake-radiation. For this foil a material of a high order number and a face weight adjusted to the range width of the β-radiation is used, so that a maximum brake-radiation exploitation is assured. Lead and gold have been found as particularly favorable. The foil can serve simultaneously for the protection against emerging of radioactive material.

It is a matter of course, that the surface of the housing 2' can be formed concave or convex. Furthermore, the face opposite the body to be fluoroscoped can be formed as a mirror, which expedient is of particular advantage by use of the apparatus in dental surgery. The present invention is also suitable for an investigation of other cavities of the human body, as well as for material tests of all kinds, as for instance investigation of welding points on pipes and the like.

The radiation penetrating through the walls can be projected onto a receiving screen or luminescent screen and the luminescent light can be amplified by means of an amplifier, so that in a simple manner and without danger to the treating and to the treated person, the location to be investigated can be observed. Due to the small size of the apparatus designed in accordance with the present invention, in case of provision of resilient or bendable or flexible holders, the apparatus can be inserted into very narrow channels. Since the radiation from the radiation source is always directed outwardly and in connection with an image amplifier sources having a small dose output suffice, and appreciably smaller radiation load results than is experienced in connection with the conventional application of X-ray tubes.

The present invention is particularly suitable for the investigation of cavities of the human body. The particular location of the human body to be investigated is projected in form of an image in luminescent light, so that a continuous observation and control of the location to

be investigated is possible, which is of particular advantage during surgical operations. The possibility exists, thereby, to perform the surgical operation during the performing fluoroscopy and to perform treatments of the locations which are fluoroscoped.

An ocular 18 (FIG. 1) is arranged suitably such, that the observing or treating person, as the surgeon, is outside of the possible radiation path. In comparison with known investigations by means of X-ray tubes, the present invention brings about first of all the advantage, that the location of the human body to be investigated can be observed immediately and continuously. The required development time for X-ray pictures is eliminated. The apparatus can be of particularly small size, which leads to obvious advantages.

As radiation sources are suitable particularly radionuclides which provide a soft γ-radiation or brake-radiation. As a radiation source, a β-radiator, for instance known as Tm 147, as Tm 170 or Sr 90 are given, which produce in a suitable absorbing material brake-radiation and primary X-radiation. These mentioned radiation sources have a relatively long half life and can be reactivated very often for an unlimited number of times. The soft γ-radiation permits a high dissolution, whereby the protection strength of the covers can be very small.

While I have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

I claim:

1. An apparatus for the fluoroscopy of bodies, particularly of a narrow limited portion of the walls of cavities, comprising

a housing having a relatively small opening,

radioactive substances received in said housing adjacent said housing opening to constitute a radiation source,

inserting means secured to said housing for inserting the latter into a cavity of which a narrow limited portion of the wall is to be fluoroscoped,

said housing and inserting means adapted to be moved within a substantial operative range within said cavity,

a fluoroscope screen means operatively disposed relative to said radiation source for providing an immediate and continuous image of the narrow limited portion of the walls of the cavity to be observed,

a protective member at least partly surrounding said housing and said housing opening and having at least one protective member opening, and

means for changing the size of and the direction of radiation through said housing opening.

2. The apparatus, as set forth in claim **1**, wherein

said protective member has a plurality of protective member openings of different sizes and which includes

means for changing the position of said protective member in order to render effective selectively any one of said openings for the radiation.

3. The apparatus, as set forth in claim **1**, wherein

said inserting means comprises a rod-shaped holder secured to said housing, and which includes said fluoroscope screen, and

said fluoroscope screen means disposed opposite said protective member opening and receiving an image of the wall of said cavity to be fluoroscoped.

4. The apparatus, as set forth in claim **3**, which includes

an image amplifier cooperating with said fluoroscope screen means.

5. An apparatus for the fluoroscopy of bodies, particularly of a narrow limited portion of the walls of cavities, comprising

a housing having a relatively small opening,

radioactive substances received in said housing adjacent said housing opening to constitute a radiation source,

inserting means secured to said housing for inserting the latter into a cavity of which a narrow limited portion of the wall is to be fluoroscoped,

said housing and inserting means adapted to be moved within a substantial operative range within said cavity, and

a fluoroscope screen means including an image amplifier operatively disposed relative to said radiation source for providing an immediate and continuous image of the narrow limited portion of the walls of the cavity to be observed.

6. The apparatus, as set forth in claim **5**, wherein

said radiation source comprises radioactive substances rendering a soft X-radiation.

7. The apparatus, as set forth in claim **5**, wherein

said housing has a window of aluminum adapted for the emergence of the radiation and to operate as a filter.

8. The apparatus, as set forth in claim **5**, wherein

said housing has a bottom opening, and which includes

a supporting member of lead carrying said radiation source and inserted into said housing through said bottom opening.

9. The apparatus, as set forth in claim **5**, which includes

a foil disposed on top of said radiation source.

10. The apparatus, as set forth in claim **5**, which includes

lead as a protective mass in said housing surrounding said radiation source and defining a conical channel diminishing from said radiation source to the outside of said housing, for the collimation of said radiation.

11. An apparatus for the fluoroscopy of narrow limited portions of cavities, comprising

a housing having a housing opening,

a radioactive substance provided in said housing adjacent said housing opening constituting a radiation source of rays,

a protective member at least partly surrounding said housing and said housing opening and having a plurality of protective member openings, said protective member openings being of different but limited sizes,

means for moving said protective member relative to said housing so that said protective member openings are aligned with said housing opening, so that selected limited and directionalized rays are emitted,

inserting means secured to said housing for inserting said housing into a cavity and for moving said housing so that said rays are directed to the narrow limited portion of the cavity to be observed, and

a fluoroscope screen means including image amplifier operatively disposed relative to said directionalized rays for providing an immediate and continuous image of said narrow limited portion of the cavity to be observed.

12. The apparatus, as set forth in claim **11**, wherein

said inserting means comprises a rod-shaped holder secured to said housing, and

said rod-shaped holder and said housing sufficiently small, so that operation may be conducted within said cavity and simultaneously observed.

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