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X-RAY APPARATUS

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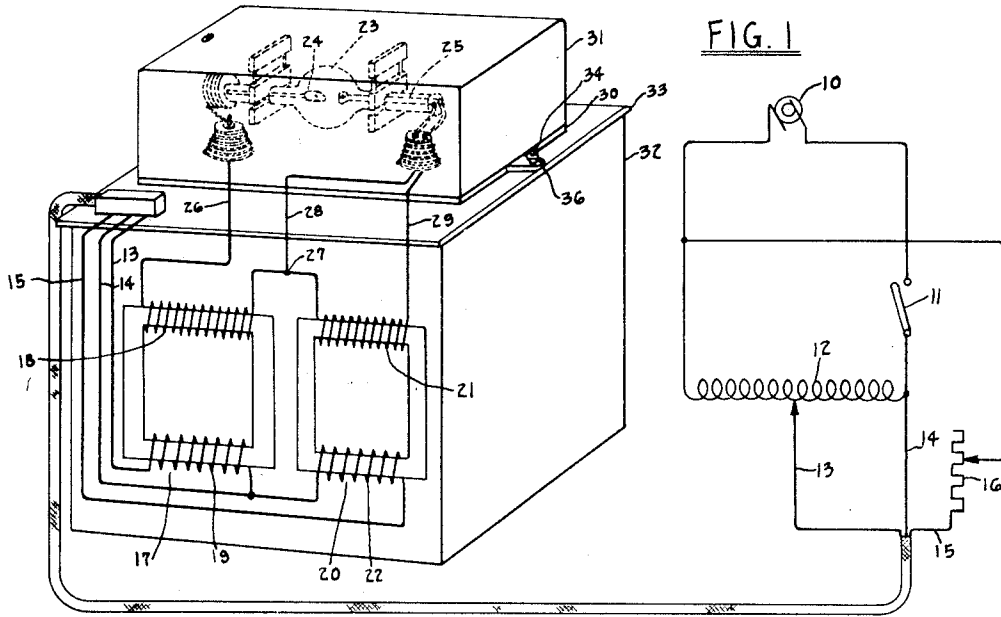


FIG. 2

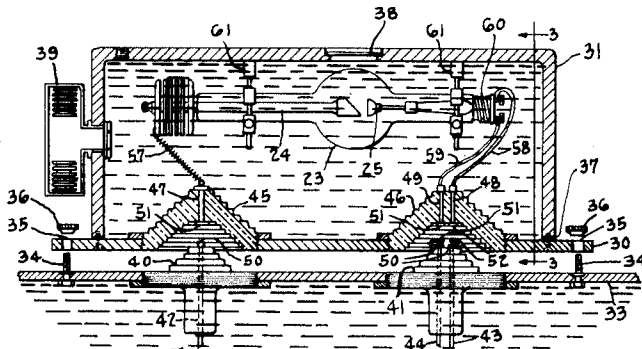


FIG. 3

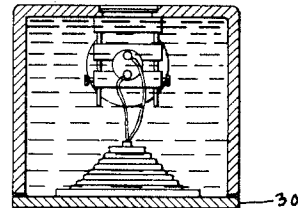


FIG. 4

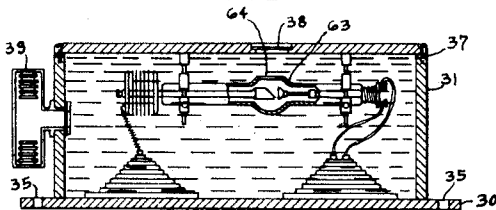
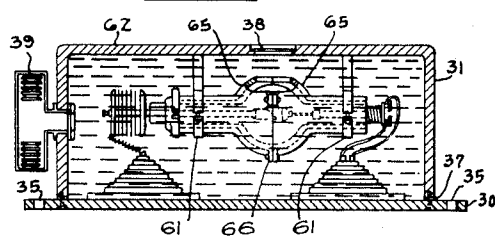


FIG. 5



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X-RAY APPARATUS

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7 Claims. (Cl. 250—34)

The present invention has to do with X-ray apparatus and relates particularly to a new construction for oil-immersed X-ray units.

Primarily, the invention has to do with the provision of oil-immersion or insulation for a tube, the tube and its insulation being disposed in one container, and means for connecting such tube so immersed to a second container, in which is disposed the X-ray tube energizing elements, all of which may be oil-insulated.

The objects of the invention, among others, include the following:

The provision of separate containers for an X-ray tube and for the energizing units therefor, each of the containers being oil-immersed, and in such association that they may be readily attached or detached one from the other;

The provision of independent containers for an X-ray tube and for tube-energizing elements, and means for quickly attaching and detaching said containers whereby to establish or disconnect an electrical circuit intermediate said tube and said tube-energizing elements;

To provide for association with a unit comprising tube-energizing elements, means for mounting a tube quickly detachable therefrom, the apparatus lending itself to the employment of a plurality of tubes each in a different container and each container being readily attachable, one at a time, to the unit comprising said tube-energizing elements;

The provision of novel means for shielding off all but useful X-radiation in an apparatus of the kind hereinabove described;

The provision of improved electrical connections, such connections being particularly adapted to quick attachment and detachment;

The provision in an apparatus of the character hereinabove described of means whereby expansion and contraction of the oil immersion due to the heating and cooling of an X-ray tube is automatically compensated for, and whereby the container for a tube is kept substantially full of insulating oil at all times.

These, and such other objects as may hereinafter appear, are obtained by the novel combination, construction, and arrangement of the several elements constituting the invention, one embodiment of which is illustrated in the accompanying single sheet of drawing, which sheet of drawing shows a plurality of different types of X-ray tubes disposed within the tube-containing apparatus generally employed.

In said single sheet of drawing:

Figure 1 is a general schematic and perspec-

tive outline of the entire device and shows a separable tube holder in position above a transformer container, the transformer elements and other energizing equipment being indicated diagrammatically;

Figure 2 is a sectional elevation of the tube-holder structure shown in Figure 1;

Figure 3 is a section taken along the line 3—3 in Figure 2 viewed in the direction of the arrows;

Figure 4 is another embodiment of the invention in which X-ray protection forms a part of the tube envelope; and

Figure 5 is a further embodiment of the invention and in which the X-ray protection is obtained by mounting the X-ray tubes within an envelope made of X-ray protective material.

Like reference characters are used to designate similar parts in the drawing and in the specification.

Reference should be had first to Figure 1, which is in part schematic.

A source of power is indicated by the numeral 10. Conduits lead from such source of power 10. There is disposed in association with said conduits a main switch 11 which is adapted to control the energizing of the apparatus from the source of power.

Any suitable control means may be employed, and in the present instance an auto-transformer 12 is connected across the lines from the source of power 10. A wire forming a variable tap on said auto-transformer 12 is designated 13, and it is through the adjustment of this variable tap that the potential across the primary of a high-tension transformer, hereinafter to be referred to, may be varied.

A common connector 14 forms a return circuit for the energizing of both a high-tension and a filament transformer. A conduit 15 connected at one end to a rheostat 16 and at the other end to one terminal of the primary of a filament current transformer is disclosed.

Said rheostat 16, or any other regulatory device which may be substituted therefor, is intended to provide means for varying the potential across the primary of such filament transformer, said variations to control the amount of current passing through an X-ray tube later to be mentioned in a manner well known in the art.

A high-tension transformer 17 is disclosed. It comprises a high-tension transformer secondary 18, and a high-tension transformer primary 19. There is also provided a filament transformer 20, comprising a secondary 21 and a primary 22.

An X-ray tube is shown at 23, the numeral 24 being used to indicate the anode of such X-ray tube, and 25 the cathode thereof.

The connections from the secondary of the high-tension transformer to the anode of the tube 23 is designated 26, while a common connection between the secondary 18 of said high-tension transformer 17, and the other terminal thereof, and one terminal of the secondary of said filament transformer, is designated 27. A conduit 28 is connected between wire 27 and one terminal of the cathode 25 of the X-ray tube. A second wire between said cathode 25 and the filament transformer secondary, is designated 29.

About the X-ray tube 23 is a housing or box. This may comprise a base 30, which base should be opaque to X-light. Secured to the said base 30 in any suitable manner but with sufficient closeness as to prevent oil-seepage, is a cover or container 31 which with the said base 30 completely encloses the X-ray tube 23, and provides means for containing the oil insulation to be used in association with such tube. A seal between base 30 and cover 31 is provided and for convenience such seal is marked 37.

About the transformers 17 and 20 is a second container 32, having a cover 33. In said cover 33 are studs 34 which are employed for the purpose of positioning the tube-container or tube-container base 30 hereinabove referred to. In said tube-container base 30 are apertures 35 to receive the studs 34. Thumb nuts for locking the tube-container in position upon the transformer container are shown at 36.

Within the container 31, is a window 38 transparent to X-light, but which is oil-tight. Such window 38 may be formed in a number of ways. It may be produced as is shown in the present instance by cutting an aperture in the case 31 and placing therein a material transparent to X-light. In other instances, it may be made by reducing the cross-section of material forming the case 31 to such a thinness that it is transparent to X-light. Divers other means may be employed for producing such a window.

At one end of said container 31 is a sylvon device 39 which is adapted to take up the expansion of the oil in container 31 and surrounding the tube 23. The heat of such tube is transmitted to the oil within the container 31 through the anode 24 of the tube, and shortly there is a marked expansion of such oil so that a means for compensating for such expansion is necessary.

An anode insulator 40 is used upon cover 33 for the container 32. A somewhat similar but not identical cathode insulator 41 is also employed upon said cover 33. The anode lead from the high-tension transformer as it passes through said insulator is designated by the numeral 42 when passing through the insulator 40, and the cathode lead-in wires 43 and 44 are so designated when passing through said cathode insulator 41. Each of these insulators 40 and 41 is of the conical type, and made by a plurality of corrugations to increase creepage distance across the insulator.

Said insulators 40 and 41 should be accurately placed upon said cover 33 and should bear a definite and fixed relation to the studs 34.

Within the bottom of base 30 is an anode insulator 45, and a cathode insulator 46. Said insulators are accurately disposed and bear a complementary relation to the insulators 40 and 41 upon the top 33. When brought together, that is, when the base 30 is pressed downwardly upon the cover

33 with the studs 34 registering within the apertures 35, the insulators 40 and 41 and 45 and 46 hereinabove referred to should register closely one with another.

Through the anode insulator 45 is a conductor 47, having at its underside a button or contact plate 51. Through the insulator 46 are two conductors 48 and 49, each of which has at its end contact plates 51. At the head of lead-in conductors 42, 43, and 44, are contact points or plates 50, each one of which is adapted to properly register with the proper plate or contact 51 in the opposed insulating member.

It will be noted that the contact 50 in association with the conduits 43 and 44 has in association therewith a spring member 52 whereby a resilient connection intermediate the conductors 43 and 44 and the conductors 48 and 49 through the plates 50 and 51 is obtainable. This is necessary in view of the low voltage impressed thereacross for the filament current is of low voltage, say about ten volts.

From the connector 47 to the anode 24 is a conductor 57. Intermediate the conductors 43 and 49 and the cathode 25 of the tube 23 are two conductors 58 and 59 for carrying the filament current, one of said conductors, 58 or 59, also forming a conductor for the high-tension current which is impressed across the tube 23.

For convenience in making the connections hereinabove described, a screw-on cathode terminal may be employed upon the tube 23, such screw-on terminal being designated 60. Such a terminal has properly disposed therein and insulated one from the other two binding posts, which posts facilitate rapid connection intermediate the conduits 58 and 59 and the tube.

Within the container 31 are disposed brackets 61, generally depending from the casing 31. These form a support for the X-ray tube 23 whereby it is held in an adjusted position properly removed from the walls of the casing 31 and the base 30.

The clamps 61 are common in the industry and are generally of some dielectric material, such as wood, bakelite, or fiber.

In Figures 2 and 3 is shown a housing comprising a material opaque to X-ray. In such housing, any tube may be employed. In Figure 4, a material transparent to X-light is shown. The tube 23 in such instance comprises a bulb of lead glass 63, having therein a window 64 made of lime glass whereby to permit the passage of X-rays. The window 64 is arranged to register with window 38 in casing 31.

In Figure 5, a container of similar material, transparent to X-light, is disclosed. The tube 23 in such instance is completely encased, except for an opening registering with the window 38, in lead glass shields designated 65, such shields comprising two parts adapted to be fastened together through flanges arranged at their greatest diameter, such shields now being more or less common in the X-ray industry.

The clamps 61 instead of coming in direct contact with the tube 23, surround the lead glass shield 65, the shape of such shield corresponding substantially to the shape of the tube 23 except for the flat portion thereof adjacent the window 38. Flanges through which fastening members pass are shown at 66 on the inner ends of such shields.

It is manifest that an automatic connection is established intermediate the tube-energizing elements contained in the housing 33, and a tube

contained in the housing 31, as an incident to causing said opposed insulators to register one with another. In order to insure such registration, the container 31 by its base 30 is affixed to the cover 33 by registration of the apertures in 33 with the studs 34 upon the transformer casing 33.

When so registering, the thumb nuts 36 may be screwed into position, and the device secured in electrically connected position. A tube may be quickly changed, when desired, by releasing such thumb nuts and removing the casing 31 with its contents, another tube 23 contained in another casing 31 being adapted to be instantly substituted for the first-referred to housing.

In this way a plurality of tubes of different characteristics may be employed and a great variety of uses secured while employing but a single energizing unit, such as the one contained in container 32. It is quite apparent that the device has a wide use, and that it has many advantages over a unit comprising a tube and tube-energizing elements all contained within a single vessel.

I claim:

1. In X-ray apparatus, two independent containers including complemental walls, one container enclosing an X-ray tube, another container enclosing X-ray tube energizing instrumentalities, and complemental contacts on said containers whereby said X-ray tube and said X-ray tube energizing instrumentalities are electrically connected when said complemental walls are in physical contact, the contacts on the X-ray tube container being electrically connected to the anode and cathode of said tube and the contacts on said tube energizing instrumentalities enclosing container being electrically connected to said tube energizing instrumentalities.

2. In X-ray apparatus, two independent containers including complemental walls, adapted to be brought into substantial engagement when said apparatus is in operable condition, one container enclosing an X-ray tube, another container enclosing tube energizing instrumentalities, and contacts upon each of said containers, the contacts on one container being adapted to engage upon the contacts of the other container when said complemental walls are in substantial engagement, the contacts on the X-ray tube container being electrically connected to the anode and cathode of said tube and the contacts on said tube energizing instrumentalities enclosing container being electrically connected to said tube energizing instrumentalities.

3. X-ray apparatus comprising an X-ray tube, a vessel enclosing said tube and filled with insulating oil, tube energizing instrumentalities, a vessel enclosing said tube energizing instrumentalities and filled with oil, said vessels including complemental walls adapted to be brought into substantial engagement one with another and complemental contact means intermediate said vessels when said complemental walls are in substantial engagement, the contact means on the X-ray tube container being electrically connected to the anode and cathode of said tube and the contact means on said tube energizing instrumentalities enclosing

ing container being electrically connected to said tube energizing instrumentalities.

4. X-ray apparatus comprising two independent containers including complemental walls adapted to be brought into substantial engagement preliminary to the operation of said X-ray apparatus, one of said containers enclosing an X-ray tube, another of said containers enclosing tube energizing instrumentalities, complemental contacts on said containers, said contacts being operable to establish electrical connection between said tube and said tube energizing instrumentalities when said complemental walls are in substantial engagement, and means upon one of said containers engaging the other container for securing said containers one to another with said complemental walls in engagement, the contacts on the X-ray tube container being electrically connected to the anode and cathode of said tube and the contacts on said tube energizing instrumentalities enclosing container being electrically connected to said tube energizing instrumentalities.

5. X-ray apparatus comprising two independent containers, one of said containers enclosing an X-ray tube, another of said containers enclosing tube energizing instrumentalities, contacts on said containers, the contacts on the X-ray tube enclosing container being electrically connected to conduits leading to said tube, and the contacts on said tube energizing instrumentalities container being electrically connected to conduits from said tube energizing instrumentalities, spring means upon certain of said contacts, and means cooperating with said containers for securing said containers in engagement with said spring means compressed.

6. X-ray apparatus comprising a plurality of containers, an X-ray tube in one of said containers, tube energizing instrumentalities in another of said containers, contacts on said containers, there being conduits between the contacts on said X-ray tube container and said X-ray tube and conduits in electrical connection with the contacts on said tube energizing instrumentalities container and the tube energizing instrumentalities therein, and complemental means on said containers for guiding one of said containers into contact contacting position upon the other of said containers.

7. X-ray apparatus comprising a plurality of containers, an X-ray tube in one of said containers, tube energizing instrumentalities in another of said containers, complemental guide means on said containers, and complemental contacts on said containers, the contacts on said X-ray tube container being electrically connected to conduits leading to said X-ray tube and the contacts upon said tube energizing instrumentalities container being in electrical connection with conduits leading to said tube energizing instrumentalities, the engagement of said complemental guide means positioning one of said containers on the other thereof with said complemental contacts disposed for electrical connection therebetween.

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