Jan. 5, 1937. L. F. EHRKE 2,067,139

SHOCKPROOF X-RAY APPARATUS

Filed Dec. 1, 1934 2 Sheets-Sheet 1

Fig. 1.

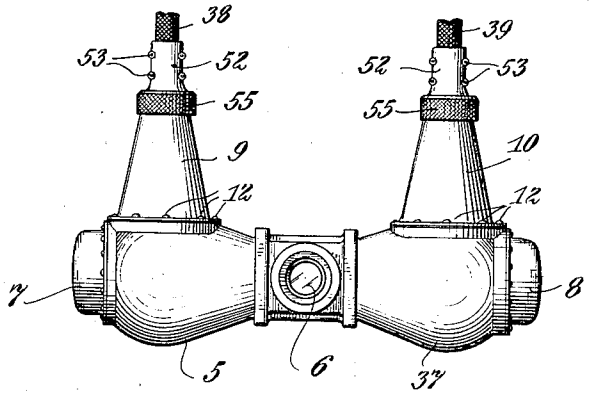


Fig. 3.

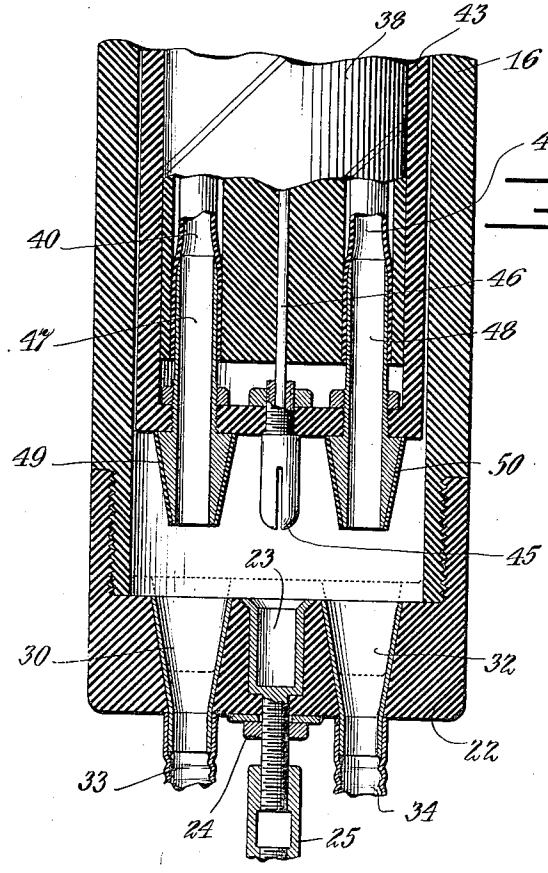
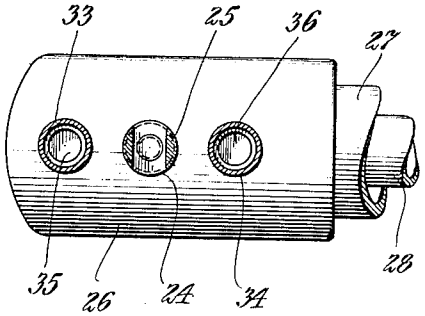


Fig. 4.



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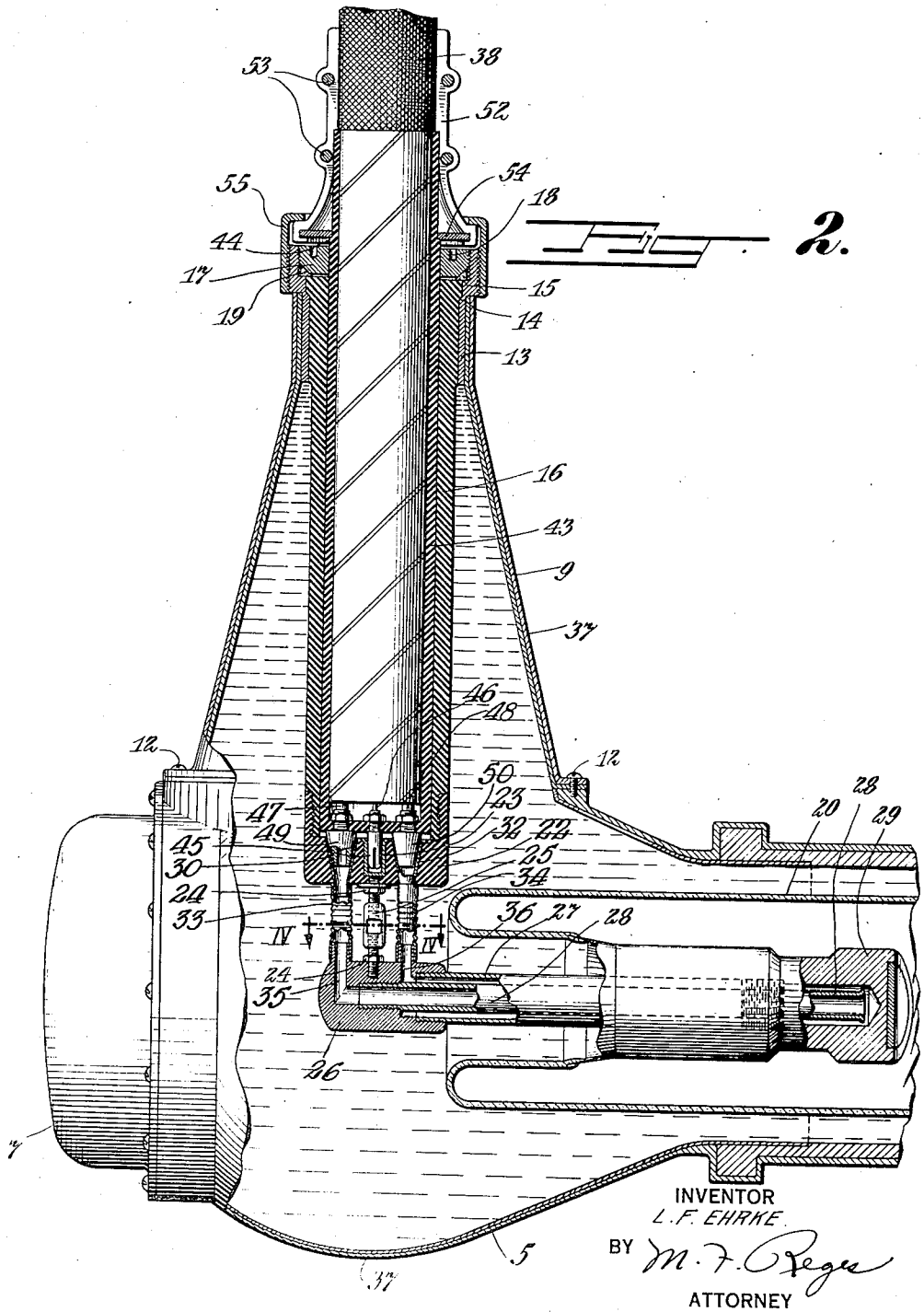


Fig. 2.

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UNITED STATES PATENT OFFICE

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SHOCKPROOF X-RAY APPARATUS

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Application December 1, 1934, Serial No. 755,563

3 Claims. (Cl. 250—34)

My invention relates to shockproof X-ray apparatus operable for prolonged periods of time as in the administration of therapeutical treatments for diseases and industrial radiography, and has particular reference to such a unit wherein the energy for the anode of the tube, as well as a cooling and insulating material for cooling the anode during operation of the tube, is supplied through a single grounded metallic sheathed cable.

In such apparatus of the prior art it has been customary to supply the energy for the tube through grounded metallic sheathed cables and to cool the anode during operation of the tube by circulating a cooling and insulating material therethrough. However, the conduits for the circulation of such material extend through the usual metallic casing wherein the X-ray tube is immersed in a cooling and insulating material thus not only requiring an additional oil tight seal between the casing and these conduits but in addition the latter restrict the rotation of the unit and the ready manipulation thereof for adjusting to various portions of the anatomy.

It is accordingly an object of my present invention to provide a shockproof X-ray unit wherein the high potential energy for the anode as well as a cooling and insulating material are supplied through a grounded metallic sheathed cable which is connected to the casing and to the anode terminal in such manner as to form a fluid tight detachable connection.

Another object of my present invention is the provision of a shockproof X-ray unit wherein the X-ray tube is immersed in a cooling and insulating material within a metallic casing with the energy for the tube and a cooling and insulating material for the anode being supplied through a grounded metallic sheathed cable connected to the casing to ground the same and so connected to the anode as to form a detachable fluid tight connection.

A further object of my present invention is the provision of a shockproof X-ray unit having an X-ray tube immersed in a cooling and insulating material within a metallic casing and wherein the casing is provided with an insulated oil tight bushing having an electrical terminal connected to the anode of the X-ray tube as well as tapered receptacles in fluid conductive communication with the anode, and a grounded metallic sheathed cable is detachably connected to the casing and to the terminal and receptacles of the bushing in such manner as to supply electrical energy to the anode and form a fluid tight joint to enable a cooling and insulating material to be circulated through the anode to cool the same during operation of the tube.

Still further objects of my present invention will be obvious to those skilled in the art by reference to the accompanying drawings wherein,

Figure 1 is an elevational view of a shockproof unit constructed in accordance with my present invention,

Fig. 2 is a sectional view on an enlarged scale of the unit shown in Fig. 1 with parts thereof broken away to better illustrate the device,

Fig. 3 is a sectional view on a still further enlarged scale of a portion of the apparatus as shown in Fig. 2, and

Fig. 4 is a sectional view taken on the line IV—IV of Fig. 2.

Referring now to the drawings in detail I have shown in Fig. 1 a shockproof unit in many respects identical to that shown in the copending application of Alfred Simon, Serial No. 739,081, filed August 9, 1934.

The device comprises a metallic casing 5 formed of two substantially spherical end portions joined together with a cylindrical section provided with an X-ray pervious window 6. Each of the end portions of this casing are in turn provided with closure members 7 and 8 secured thereto in an oil tight manner and may enclose an expansion bellows or diaphragm (not shown) to compensate for expansion of oil within the casing.

A pair of angularly extending tubular sections 9 and 10 of the same material as the casing 5 extend from the spherical ends of the casing and are secured to the latter, such as by screws or the like 12 (Fig. 2) to likewise form a fluid tight seal. The outer ends of these respective tubular sections are each provided with a metallic sleeve 13, welded or otherwise affixed thereto, which has a portion thereof of increased diameter threaded internally and externally and forming a pair of annular shoulders 14 and 15. An insulating bushing 16 forming a part of the casing 5 extends inwardly of the tubular metallic section 9 and has a portion thereof of slightly increased diameter which is adapted to be held in firm engagement with the shoulder 14, by means of an annular threaded ring 17, engaging the internally threaded portion of the sleeve 13. This latter ring 17 is screwed in place by a suitable tool which may be inserted in recesses 18 provided therein and in order to form an oil tight connection a suitable gasket or packing 19 may be interposed between

the bushing 16 and the ring 17 which bears against the shoulder 15.

The construction of both the tubular sections 9 and 10 are identical in most respects with the exception of the manner in which the anode end of the X-ray tube 20, partially shown in Fig. 2, is supported by the insulating sleeve carried by the tubular section 9. This may be supported in any suitable manner such for example as that shown and described in the copending application of Clayton T. Ulrey et al. Serial No. 713,462, filed March 1, 1934, and as my present invention is primarily concerned with the anode end of the X-ray tube further detailed description will be hereinafter more or less restricted thereto.

The lower end of the insulated bushing 16 is provided with a threaded portion of slightly reduced diameter to which is secured an insulating cap 22 forming an oil tight end closure therefor. A recessed metallic terminal 23 is concentrically disposed relative to this end cap 22 and is adjustably connected by suitable means, such as locknuts 24 and a turn buckle 25 or like construction, to a metallic member 26 constituting the anode electrode terminal. This anode terminal is in turn threadedly engaged by a pair of concentric metallic conduits 27 and 28 secured to the anode 29 of the X-ray tube 20 and forming a part of the latter and thus serves to support the anode end of the tube when the same is inserted through the opposite end of the casing 5 upon removal of the closure member 8.

A pair of tapered receptacles 30 and 32 are likewise provided in the end cap portion 22 of the bushing 16 and are in fluid conductive communication with the concentric conduits 27 and 28 and thus connected with the anode 29 through the intermediary of short flexible metal tubes 33 and 34.

These latter tubes 33 and 34 are secured to the protruding portion of the receptacles 30 and 32 to form an oil tight seal, such as by soldering or the like, and are similarly connected to protruding portions of the anode terminal 26, as shown more clearly in Fig. 2, in alignment with passages 35 and 36 which communicate with the respective metallic conduits 27 and 28. This accordingly electrically connects the terminal 23 directly to the anode 29 as well as the tapered receptacles 30 and 32 so that to all intents and purposes the terminal and receptacles may be considered as a part of the anode 29.

The X-ray tube 20 is disposed in spaced relation relative to all parts of the casing 5, as can be appreciated from Fig. 2, and in order to enable the utilization of a tube having a foreshortened length than a tube operating in air at the same applied voltage the tube is immersed in a cooling and insulating material, such as oil, having a higher dielectric strength than air. Moreover, in order to render the casing X-ray proof except in the vicinity of the pervious window 6 it may be lined with a material of high atomic weight, such as lead 37.

For the purpose of supplying electrical energy to the X-ray tube a pair of grounded metallic sheathed cables 38 and 39 extend from a suitable source of high potential electrical energy (not shown) and have their conductors connected to the electrodes of the X-ray tube while their grounded metallic sheathing is connected to the casing in order to ground the latter. In addition to supplying electrical energy to the anode 29 of the X-ray tube the cable 38 is provided with ducts 40 and 42, as shown in Fig. 3, for a purpose to be hereinafter described.

The metallic sheathing is removed from the cable 38 for a short distance of its length and is surrounded with an insulating sleeve 43, which is cemented or otherwise affixed thereto in order to make the same an integral part of the cable. This sleeve 43 is concentrically disposed relative to the insulating bushing 16 and extends longitudinally thereof through the annular ring 17 being provided near its upper extremity with a portion of slightly reduced diameter forming a shoulder 44.

The lower end of the insulating sleeve 43 is provided with a metallic plug 45 rigidly secured thereto and connected to the conductor 46 of the cable 38, as shown more in detail in Fig. 3, and when in position within the bushing 16 the plug 45 detachably engages the recessed anode terminal 23 in order to supply energy directly to the anode of the X-ray tube. Similarly a pair of metallic thimbles 47 and 48 are rigidly secured to the end of the insulating sleeve 43 which extend into the ducts 40 and 42 and are secured thereto in a fluid tight manner, as by cementing or the like.

These thimbles protrude exteriorly of the lower end of the sleeve 43 and are surrounded with flexible tapered ends, which may be in the form of stoppers 49 and 50 composed of rubber or a rubber composition not readily deteriorated by the cooling and insulating fluid, and when the cable 38 together with its integral sleeve 43 is positioned within the bushing 16 these tapered ends 49 and 50 are forced into a detachable fluid tight engagement with the tapered recesses 30 and 32. These latter receptacles, as before stated, being directly in fluid conductive communication with the anode 29 of the X-ray tube, thus enable a cooling and insulating medium, such as oil, to be circulated from a suitable reservoir (not shown) through the ducts 40 and 42 provided in the cable 38 and through the anode for the purpose of cooling the same during operation of the tube in addition to the cable 38 supplying electrical energy to the anode.

In order to connect the grounded metallic sheathing of the cable 38 to the casing 5 as well as maintain the sleeve 43 in position within the bushing 16 so that the plug 45 and tapered ends or stoppers 49, 50 are forced into the metallic terminal 23 and receptacles 30, 32 a clamp 52 formed of two semi-cylindrical sections secured together by suitable screws 53 is adapted to firmly engage the metallic sheathing of the cable 38 and the upper extremity of the insulating sleeve 43. This clamp flares slightly outward and is then bent inwardly to form a groove for retaining a metallic ring 54 against the shoulder 44 formed by the reduced diameter portion of the insulating sleeve 43. An annular collar 55 fits around the lower part of this clamp 52 which is adapted to threadedly engage the externally threaded portion of the metallic sleeve 13 thus forcing the ring 54 against the shoulder 44 and the insulating sleeve 43 inwardly of the bushing 16. Accordingly the metallic plug 45 is in turn forced into the terminal recess sleeve 23 and the plugs or stoppers 49 and 50, due to their slight flexibility, are not only forced into the receptacles 30 and 32, but also form a fluid tight detachable connection therewith.

It thus becomes obvious to those skilled in the art that I have provided a shockproof X-ray apparatus wherein an X-ray tube of a foreshortened length than a tube operating in air at the same applied voltage is immersed in a cooling and insulating medium within a metallic

container. Moreover, the high potential energy for the anode of the X-ray tube is supplied by a grounded metallic sheathed cable connected to the casing and to the anode in such manner as to form an oil tight seal so that possibility of leakage of the material immersing the X-ray tube is eliminated.

In addition the cable which supplies the high potential energy also supplies a cooling and insulating medium for circulation through the anode for cooling the same during operation of the tube and forms a detachable though fluid tight connection with the anode.

Although I have shown and described one embodiment of my invention I do not desire to be limited thereto as various other modifications thereof may be made without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a shockproof X-ray unit, the combination of a metallic casing, an X-ray tube in said casing immersed in a cooling and insulating material and provided with an anode which becomes heated during operation of said tube, a bushing secured to said casing to form a fluid tight seal therewith having a terminal electrically connected to the anode of said X-ray tube and provided with tapered concave receptacles in fluid conductive communication with said anode, and means connected to said casing to ground the same and provided with a conductor detachably connected to said terminal for supplying electrical energy to the anode of said X-ray tube and having complementary members detachably engaging said tapered receptacles and forced into frictional engagement therewith by the engagement of said means with said casing to form a fluid tight connection for the purpose of circulating a cooling and insulating material through said anode during operation of said X-ray tube.

2. In a shockproof X-ray unit, the combination of a metallic casing, an X-ray tube in said casing immersed in a cooling and insulating material and provided with an anode which becomes heated during operation of said tube, a bushing secured to said casing to form a fluid tight seal therewith having a terminal electrically connected to the anode of said X-ray tube and provided with tapered concave receptacles in fluid conductive communication with said anode, and a grounded metallic sheathed cable connected to said casing to ground the same having a conductor detachably connected to said terminal to supply electrical energy to said anode and provided with yieldable complementary members detachably engaging said tapered concave receptacles and forced into fluid tight engagement therewith by the connection of said cable to said casing to form a fluid tight connection for the purpose of circulating a cooling and insulating material through said cable and said anode to cool the latter during operation of said X-ray tube.

3. In a shockproof X-ray unit, the combination of a metallic casing, an X-ray tube in said casing provided with an anode which becomes heated during operation of said tube, an insulated bushing secured to said casing having a recessed metallic terminal connected to the anode of said X-ray tube and provided with recessed tapered receptacles in fluid conductive communication with said anode and transversely spaced from said terminal, a grounded metallic sheathed cable connected to said casing to ground the same having a metallic terminal telescopically engaging said recessed metallic terminal for conducting electrical energy to said anode, and said cable being provided with transversely spaced fluid conducting ducts terminating in complementary yieldable members forced into fluid tight connection with said recessed tapered receptacles by the connection of said cable with said casing for the purpose of circulating a cooling and insulating material through said cable and said anode to cool the latter during operation of said X-ray tube.

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