

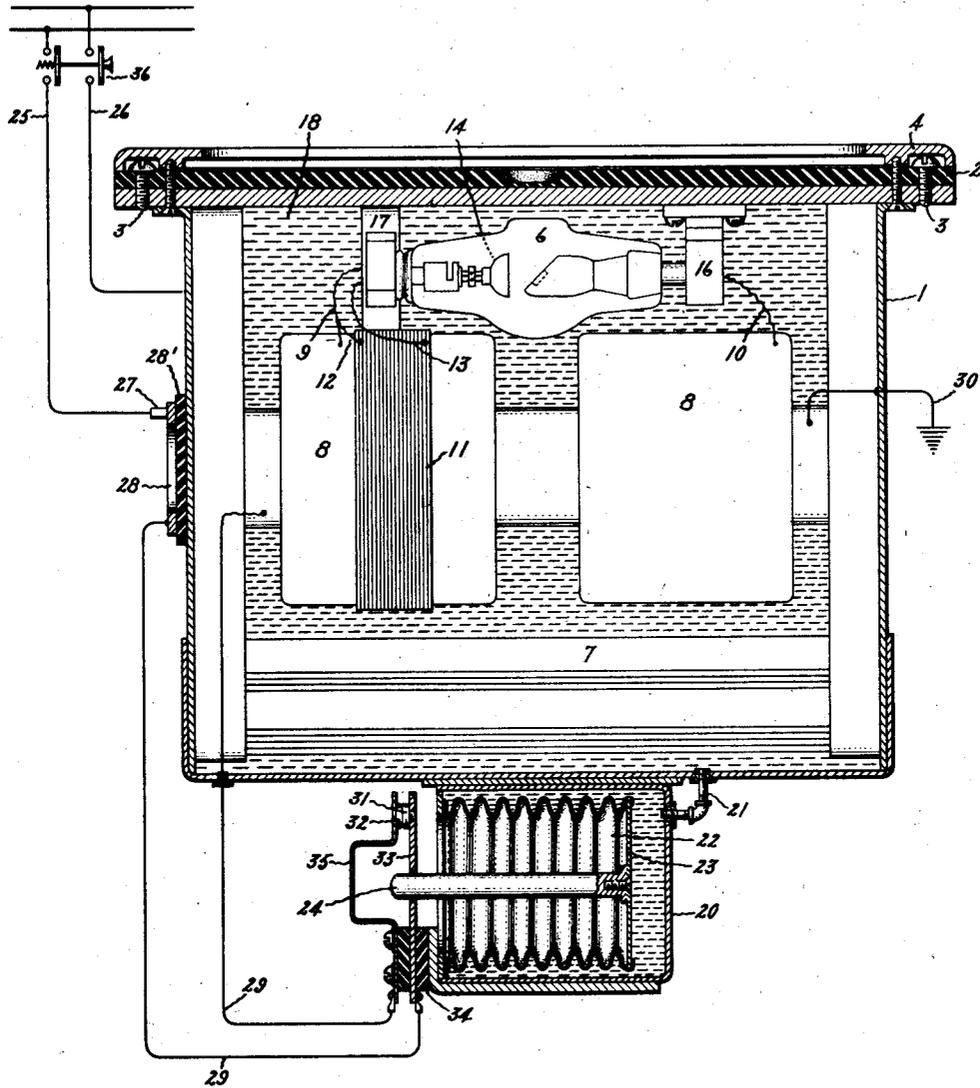
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W. D. COOLIDGE

X-RAY APPARATUS

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Inventor:  
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# UNITED STATES PATENT OFFICE.

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## X-RAY APPARATUS.

Application filed January 18, 1922. Serial No. 530,198.

*To all whom it may concern:*

Be it known that I, WILLIAM D. COOLIDGE, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in X-Ray Apparatus, of which the following is a specification.

The present invention relates to electric devices having a load device, as for example, an X-ray tube operating in a sealed receptacle containing an oil or other insulating fluid.

In my prior Patent No. 1,394,143, I have described an X-ray apparatus comprising an X-ray tube and a transformer contained in an oil bath in a closed receptacle, an expansion chamber partly filled with gas being provided within the receptacle to permit changes in volume of the oil during the operation of the X-ray tube.

When the oil becomes heated and expands, some of it is forced into the expansion chamber, compressing the air, or whatever gas is contained therein. This arrangement works satisfactorily but necessarily the pressure upon the oil increases markedly with an increase of temperature, particularly so as the gas also expands with an increase of temperature. The heated oil which is highly fluid is confined with considerable difficulty by mechanical seals when under the pressure necessary to compress the gas in the expansion chamber.

In accordance with my present invention, I have provided a light, compact, oil-immersed X-ray apparatus constructed to compensate for expansion of the oil with a materially less increase of pressure than required to compress a confined gas. In accordance with one of the features of my invention automatic means is provided for opening the supply circuit when a predetermined rise of temperature has occurred. The novel features of my invention will be pointed out with particularity in the appended claims.

The accompanying drawing shows a vertical section of a preferred embodiment of my invention.

Referring to the drawing, the device illustrated comprises a main receptacle 1 consisting mainly of copper, iron or other suitable metal, and having a cover 2 of bakelite or other material relatively transparent to

X-rays, the cover being conveniently secured by screws 3, the heads of which are covered by a ring 4. Within the receptacle 1 is an X-ray tube 6 and a transformer 7, having a secondary winding 8 connected directly to the terminals of the X-ray tube by conductors 9, 10. The cathode of the tube is heated conveniently by a section 11 of the transformer secondary. Conductors 12, 13 lead to the filament constituting the cathode, which has not been shown as it is hidden by the surrounding focusing device 14. As X-ray tubes of the incandescent cathode type are well known the X-ray tube will not be described in detail. The X-ray tube conveniently is supported upon insulating holders 16, 17 secured to the cover 2. A body of oil 18 completely fills the space in the receptacle about the transformer and X-ray tube.

In any suitable position, immediately adjacent the receptacle 1, is an auxiliary receptacle 20 connected to the main receptacle by a tube 21. One wall of the receptacle 20 is constituted by a reentrant diaphragm 22 constituted of sylphon metal, or other suitable yielding material. A rigid plate 23 is secured to and closes the mouth of the diaphragm. Mounted on this plate is a rod 24 which is moved outwardly by the compression of the diaphragm 22 due to the pressure of the oil, which expands and flows into the receptacle 20 from the main receptacle when the temperature rises. The pressure required to compress the diaphragm in order to compensate for a given volume increase of the oil is about one-fifth or less the pressure required to compress a gas confined within the receptacle.

The electrical supply circuit for the transformer 7 is constituted by the conductors 25, 26. The conductor 25 is connected to a contact brush 27 bearing upon a conductive ring 28 mounted upon the receptacle 1 but insulated therefrom electrically by a non-conductor 28'. This arrangement permits the X-ray device to be rotatably supported. From the ring 28 a conductor 29 is led through the wall of the main receptacle to the transformer primary, the opposite primary terminal being connected to the metal tank which is grounded as indicated at 30.

The circuit 29 contains relatively movable contacts 31, 32 constituting a circuit making and breaking device, which I will herein-

after briefly refer to as a switch. The contact 31 is mounted upon a stiff plate 33 attached by suitable insulation 34 to the receptacle 20 and provided with an opening to permit the plunger 24 to pass freely there-through. The contact 32 is carried by a flexible support 35 also mounted upon and insulated from the receptacle 20. The support 35 is engaged by the rod 24 when the latter is pushed out by the compression of the diaphragm 22. The support 35 is shaped to permit considerable extension of the rod 24 before the switch 31, 32 is opened. Preferably the parts of the circuit-breaking mechanism are proportioned to permit the temperature of the oil to rise to some predetermined value, say, to about 50° C., before the circuit is broken. When the oil has cooled by radiation of heat from the receptacle 1, the switch 31, 32 is closed automatically. Under ordinary circumstances, when the X-ray tube is used intermittently, the rise in temperature of the oil is not sufficient to open the circuit, but should the energy input exceed the heat dissipation so as to cause sufficient accumulation of heat to cause a rise of temperature above the predetermined limit, then the automatic pressure-responsive switch will open the circuit. Overheating therefore, can not occur.

Ordinarily the generation of X-rays is controlled by a manually operated switch 36 which automatically opens when released, but should it be desired for any purpose to generate X-rays intermittently, then the switch 36 can be arranged to remain closed

and the X-ray circuit will be alternately opened and closed automatically by the switch 31, 32 as the temperature of the device alternately rises above and falls below the temperatures at which the switch 31, 32 is set to open and close.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. An X-ray apparatus comprising a sealed tank, a transformer contained therein, an X-ray tube in said tank connected to said transformer, an insulating liquid completely filling said tank, make and break contacts in circuit with said transformer, means for compensating the cubical capacity of said tank to volume changes of the contained liquid and means operated thereby to open said contacts when the volume exceeds a predetermined value and to close said contacts when the volume becomes less than said value.

2. An X-ray apparatus comprising a main sealed receptacle, a transformer contained therein, an X-ray tube also contained therein and being connected to said transformer, an auxiliary expansion chamber carried by the main receptacle and communicating therewith, a yielding diaphragm forming part of the wall of said expansion chamber, a circuit breaker having contacts in circuit with said transformer and means for operating said circuit breaker by the movement of said diaphragm.

In witness whereof, I have hereunto set my hand this 12th day of January, 1922.

WILLIAM D. COOLIDGE.