Feb. 6, 1934. W. K. KEARSLEY 1,946,286

X-RAY EQUIPMENT

Filed Sept. 19, 1929

Fig. 1.

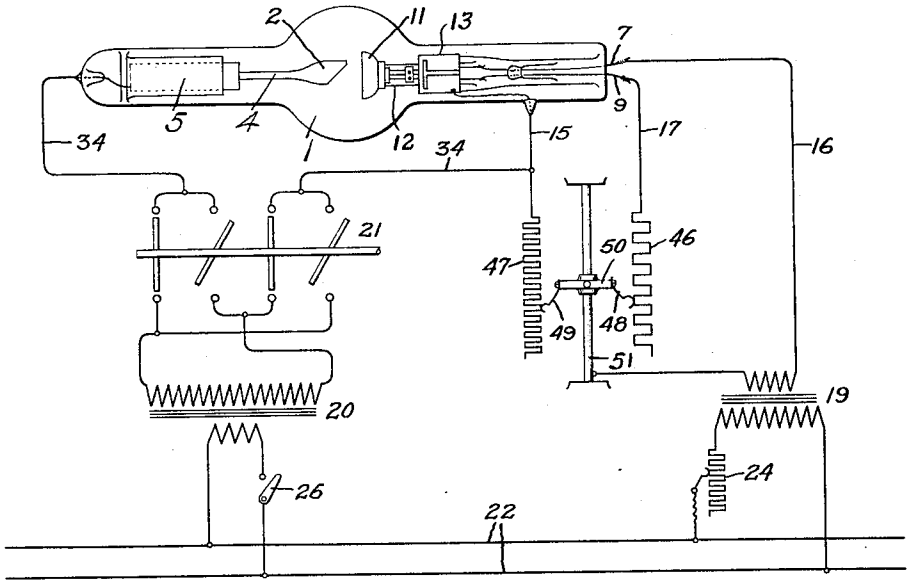
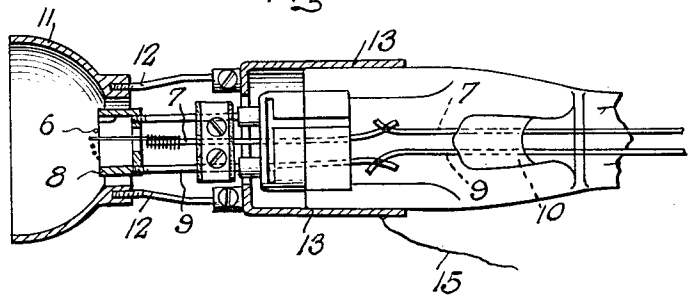


Fig. 2.



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X-RAY EQUIPMENT

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Serial No. 393,819

3 Claims. (Cl. 250—34)

The present invention comprises a new combination of X-ray generator, or X-ray tube, and an electric supply system therefor, whereby the focusing of the electrons on the anode is automatically controlled during operation to give the most favorable results.

Heretofore, it has been common practice to so construct X-ray tubes that the impingement of the electrons, or cathode rays, on the anode or target, takes place on a spot of fixed area,—the focal spot. Only a certain amount of energy input can be safely used for a given size of focal spot as otherwise the metal of the anode becomes fused or even vaporized, thereby injuring or even destroying the X-ray tube. To secure sharp definition in radiographs the size of the focal spot must be small. When large X-ray output is desired some sacrifice in definition is required as a larger focal spot necessarily must be used to avoid overheating.

As the requirements of the radiographer in definition of radiographs and intensity of X-ray production, are variable, a well-equipped radiographer heretofore kept in stock ready for use several different kinds of X-ray tubes, some constructed to operate with a small focal spot and others with a larger focal spot.

As a consequence of my invention, I have provided an improved X-ray equipment containing suitably interlocked current and focus control means whereby the size of the focal spot is automatically determined by a choice of energy supply for the X-ray tube, so that with an increase in energy the size of the focal spot is increased in corresponding degree and vice versa, thereby always securing for the use of the radiographer the most favorable focusing conditions.

Fig. 1 of the accompanying drawing illustrates an embodiment of my invention in which a double rheostat is employed to simultaneously regulate the discharge in the X-ray tube and the focusing of such discharge; and Fig. 2 illustrates on a larger scale and partly in section the cathode structure of the X-ray tube shown in Fig. 1.

In the system shown in Fig. 1 there is included an X-ray tube or generator comprising a bulb 1 having oppositely extending electrode arms and containing an anode 2 and a cathode 3 (here shown diagrammatically) which do not differ essentially in construction from the electrodes ordinarily employed in one form of thermionic X-ray tubes. The anode comprises a mass of highly refractory metal, preferably tungsten. The anode stem 4 is sealed into a support 5 of the usual construction. The cathode, as best shown in Fig. 2, comprises a spiral filament 6, also preferably consisting of tungsten. This filament is connected at one end to a conductor 7 and at its opposite end to a ring 8, carried by a conductor 9. The cathode conductors are sealed into a stem 10 and lead to external contact devices (not shown). Surrounding the cathode filament 6 is a focusing device consisting of a dished tubular member 11 which is supported by the conductors 12, 12, in turn mounted upon a split metal tube 13 carried by the glass tube 14 which forms with the stem 10 a reentrant member in the cathode arm of the envelope. A conductor 15 contacting with the tube 13 is sealed through the envelope of the X-ray tube to an external circuit described hereinafter.

In the system illustrated in Fig. 1 of the drawing a rheostat 46 is provided in the filament heating circuit 16, 17 which is supplied with an alternating current from a transformer 19 fed from the main 22 through a variable rheostat 24. Included in the circuit 17, 46 and 15, between the cathode of the X-ray tube and the focusing device 11 (see Fig. 2), there is also included a variable resistor 47. Movable contacts 48 and 49 are mounted on a common switch 50 sliding on a supporting conductor 51 whereby the value of the resistors 46 and 47 may be simultaneously varied. The X-ray tube receives high potential current to produce X-rays from the transformer 20 through a mechanical rectifier 21 and a high potential secondary circuit 34. In the system illustrated in Fig. 1 it is to be understood, of course, that any other suitable rectifier, as for example a thermionic or electrolytic device may be substituted for the mechanical rectifier 21. It will also be evident that, if desired, the rectifying arrangement may be omitted entirely in the event the X-ray tube is of the self-rectifying type. In the arrangement illustrated in Fig. 1, when the resistance 46 in the filament heating circuit is decreased thereby increasing the electron emissivity of the filament cathode then due to the mechanical interlocking of the contacts 48 and 49 the value of the resistance 47 is simultaneously decreased. The consequent decrease of the negative bias of the focusing device 11 broadens the cathode spot simultaneously with the increase of current through the X-ray tube.

In a copending application Serial No. 430,418 filed February 21, 1930, as a continuation in part of the present application claims are made relating to other features of the present invention and in particular to X-ray systems employing

a vacuum tube in the circuit of the focusing device of an X-ray tube.

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

1. An X-ray apparatus comprising the combination of an X-ray tube having a thermionic cathode, conductors connected to said cathode for conveying a current to heat the same, a resistor operatively included in said conductors, main high potential supply conductors connected to the electrodes of said tube, means for focusing X-rays in said tube, a resistor in one of said main supply conductors and connected between said cathode and said focusing means and interlocked resistance-varying means for said respective resistors.

2. An X-ray apparatus comprising the combination of an X-ray tube having a thermionic cathode, a focusing device cooperating therewith to restrict the area of impact of electrons from said cathode upon the anode of said tube, a high tension circuit including said anode and said cathode, means in said circuit and connected to the focusing device for controlling potentials impressed upon said focusing device, a cathode heating circuit, means in said heating circuit for controlling the electron emission of said cathode, and a mechanical interlock for said two control means.

3. An X-ray apparatus comprising the combination of an X-ray tube having a thermionic cathode, a focusing device therefor, main high potential supply conductors connected to the electrodes of said tube, auxiliary low potential supply conductors connected to the cathode of said tube, an impedance device in one of said main conductors, a tap connection between said focusing device and said impedance device, a second impedance device in one of said auxiliary conductors and interlocked means for varying the effective value of said impedances.

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