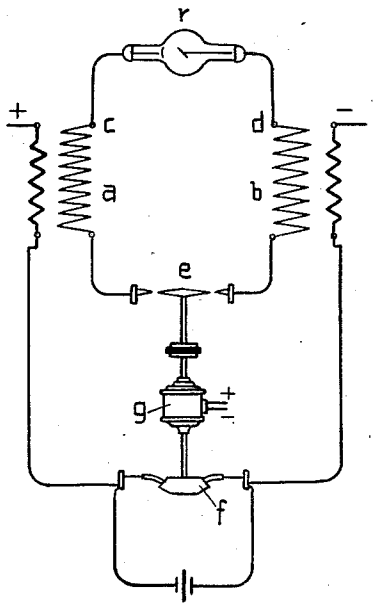
April 13, 1926. 1,580,804

L. BAUMEISTER

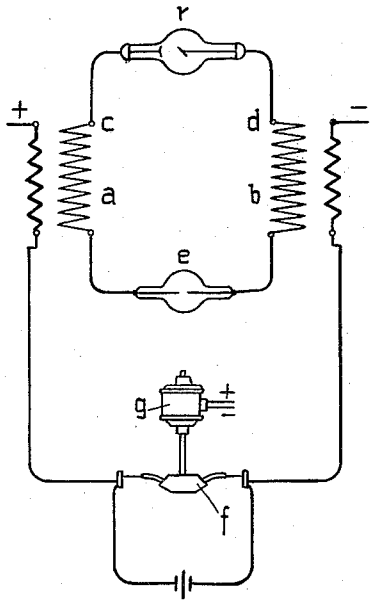
X-RAY SYSTEM

Filed August 29, 1921

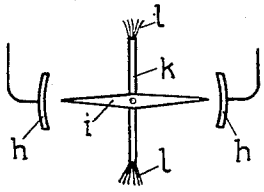
Figur 1.



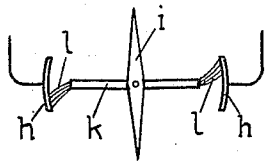
Figur 2.



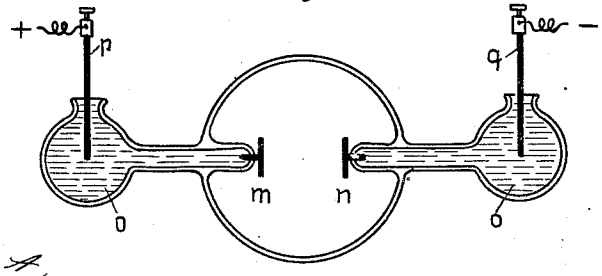
Figur 3.



Figur 4.



Figur 5.



Witnesses:

Herman Fürst,

Franz Günther

Inventor:

Leonhard Baumeister

Patented Apr. 13, 1926. 1,580,804

UNITED STATES PATENT OFFICE.

LEONHARD BAUMEISTER, OF ERLANGEN, GERMANY, ASSIGNOR TO THE FIRM: REINIGER, GEBBERT & SCHALL AKTIENGESELLSCHAFT, OF ERLANGEN, BAVARIA, GERMANY.

X-RAY SYSTEM.

Application filed August 29, 1921. Serial No. 496,616.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, LEONHARD BAUMEISTER, a citizen of Germany, residing at Erlangen, in Bavaria, Germany, have invented a new and useful X-Ray System (for which I obtained Letters Patent in Germany under No. 290,458, February 29, 1916; No. 297,173, March 29, 1917; No. 306,575, July 1, 1918), of which the following is a specification.

My invention relates to a Röntgen ray system and has for its object to provide an improved arrangement, as regards satisfactory working and working security, for the production of Röntgen rays, especially of that kind of rays which, owing to their great hardness, i. e. their penetrating power, are efficient in the medical treatment of diseases by means of such Röntgen rays, the seat of disease being located within the patient's body, at a considerable depth under the skin.

Röntgen ray tubes when in use are liable to become electrically charged, and with the systems of connections now in use these charges remain on the tube and accumulate, and deteriorate the working and reliability of the tube. This is especially the case with the high resistance or hard tubes required for producing hard, i. e. highly penetrating rays.

In an X-ray system arranged in accordance with my invention there are two sources of current, for instance two transformer secondary windings, and directly to one terminal of every one of these sources of current one of the two electrodes of the Röntgen ray tube is connected, the remaining terminals of said secondary coils having between them the valve tube, rotary switch, or other devices that serve to control the supply of current to the Röntgen ray tube. In this manner the Röntgen ray tube is prevented from adopting any harmful electrical charges because it is connected on each side to a conductor (the respective secondary coil) which possesses a greater amount of capacity than the Röntgen ray tube, and which protects the Röntgen ray tube from any rapid oscillations.

In the accompanying drawing, Fig. 1 shows the arrangement of connections in one embodiment, Fig. 2 that in another embodiment of my invention. Figs. 3 and 4 are top plan views of the rotative connecting device shown in Fig. 1, in the position of making and interrupting, respectively, the electrical current circuit of the Röntgen ray tube. Fig. 5 is a view in central longitudinal section of an embodiment of spark gap which may be used in the arrangement as shown in Fig. 2.

The same part is designated by the same reference letter wherever it occurs throughout the several figures.

The Röntgen ray tube r is (Figs. 1 and 2) arranged symmetrically between and connected directly to one end of each of the two secondary coils a and b of two transformers c and d respectively. Electrical impulses of the undesired direction—i. e. every second or even several half waves of voltage are (Fig. 1) done away with in the manner known heretofore by a rotating connecting device e which is rotated by a motor g driving at the same time the interrupter f of the primary circuit. According to my invention the device e is connected to the other ends of the two secondary coils than the Röntgen ray tube r. Instead of making use of two separate transformers c and d, I may provide one single transformer with two secondary coils a and b.

The rotary switch device e in the Röntgen tube circuit may advantageously take the form illustrated in Figures 3 and 4. As there shown, it comprises not only a rotating conductor i which substantially bridges the gap between the stationary conductors h during the time that current is to pass to the tube, as seen in Fig. 3, but also a rotating conductor k which makes conductive connection between the two sources of current, for instance the two secondary windings, in the intervals between the E. M. F. impulses in the secondary circuit. By this means electrical charges are completely eliminated. In order that a good conductive connection may be made, the conductor k carries conductive brushes l which sweep over the surface of the conducting members h (as seen in Fig. 4), and so make good contact with them.

In some cases, I prefer to have the device

controlling supply of current to the Röntgen ray tube take the form of a comparatively long spark gap, its length being so adjusted that it is only broken down by a voltage not far short of the maximum value of the available voltage of supply. By this means the current impulse to the tube is a great deal more sharply limited to the space of time immediately about the maximum of the E. M. F. supplied by the sources of current than was possible with apparatus used hitherto. For, since each of the two sources of current has only to supply half the total E. M. F. necessary to break down the gap and cause current to pass through the tube, the spark gap may be so adjusted that a fairly high E. M. F. is needed to break it down, without detriment to the regularity and certainty of operation of the apparatus; whereas such a spark gap could not be used without ill effects in known constructions. That the spark gap itself should need a fairly high E. M. F. to send current across, even after the current is started, is, in general, of advantage for maintaining a high E. M. F. upon the Röntgen tube even while current is passing; it is of advantage in the production of hard rays; it is especially of advantage when the Röntgen ray tube is supplied through induction coils serving as transformers.

If the two sources of current lying between the Röntgen tube and the spark gap consist, as usual, of windings of considerable self-induction, as when they are the secondary windings of induction coils, any high frequency oscillations which may arise from the spark will be reflected by the windings and thus prevented from reaching and acting deleteriously upon the Röntgen tube.

Since a spark gap adjusted to nearly the maximum E. M. F. of supply serves better than any other means to start and stop the current in the Röntgen tube circuit almost instantaneously, it is natural that the E. M. F. applied to the Röntgen tube does not vary much. This goes far to suppress the slow cathode rays and soft Röntgen rays which occur at low voltages, and therefore conduces to the production of a hard and homogeneous radiation, such as is wanted for many applications of Röntgen rays now to the fore; particularly for the Röntgen ray treatment of deep lying seats of disease.

To increase still further the suddenness of formation and extinction of the spark, use may be made of any of the means already known for this purpose. For instance the spark gap may be immersed in hydrogen-containing gases or vapours; it may be replaced by several spark gaps in series, (forming a series- or multiple-spark gap); or a part of the spark gap electrodes may be caused to rotate in synchronism with the E. M. F. of supply, or may otherwise periodically be made to approach and recede from the remaining electrodes.

Preferably, in the spark gap I use electrodes the capacity of which is as small as possible. By this precaution the suddenness of starting and stopping of the electrical discharge in the spark gap in the X-ray system according to my invention is considerably increased, and, in consequence, harder and more homogeneous Röntgen rays are produced.

Fig. 5 shows an embodiment of that form of spark gap. Only the electrodes m and n of the spark gap consist of metal. Therefore, the capacity of the electrodes m and n is a minimum. The connection of m and n in the circuit is brought about by a liquid o of feeble conductivity, such as diluted sulphuric acid surrounding the outer ends of m and n, and in which the leads, e. g. carbon rods q and p are dipped.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In the combination of a Röntgen-ray tube with two sources of current, the electrodes of said tube being directly connected each with one terminal of the two sources of current, and a device controlling access of the current to the Röntgen-ray tube, said device being arranged between the remaining terminals of the two sources of current.

2. In the combination of a Röntgen-ray tube with two separate transformers, the electrodes of said tube being directly connected each with one terminal of the two transformers, and a device controlling access of the current to the Röntgen-ray tube, said device being arranged between the remaining terminals of the two transformers.

3. In the combination of a Röntgen-ray tube with two sources of current, the electrodes of said tube being directly connected each with one terminal of the two sources of current, and a device controlling access of the current to the Röntgen-ray tube, said device having the form of a switch which, in the intervals between the electro-motive force impulses in the sources of current makes conductive connection between them.

4. In the combination of a Röntgen-ray tube with two separate transformers, the electrodes of said tube being directly connected each with one terminal of the two transformers, and a device controlling access of the current to the Röntgen-ray tube and arranged between the remaining terminals of the two transformers, said device having the form of a switch which, in the intervals between the electro-motive force impulses in the transformers, makes conductive connection between them.

In witness whereof I have hereunto set my hand this fourth day of August, 1921.

LEONHARD BAUMEISTER.