No. 646,362. Patented Mar. 27, 1900.

J. M. DAVIDSON.

ROENTGEN RAY APPARATUS.

(Application filed Sept. 22, 1899.)

(No Model.) 3 Sheets—Sheet 1.

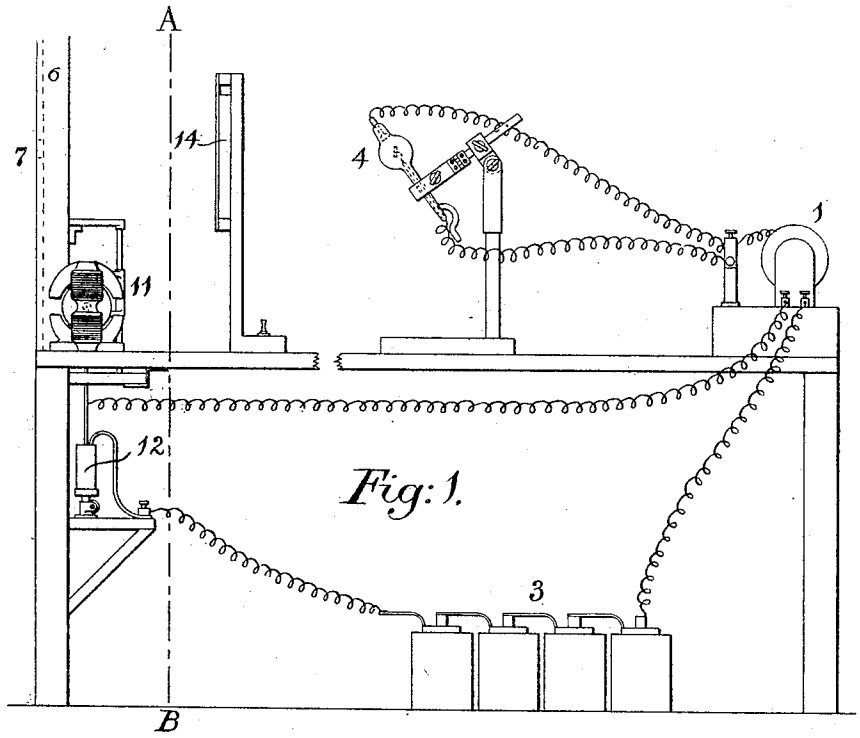
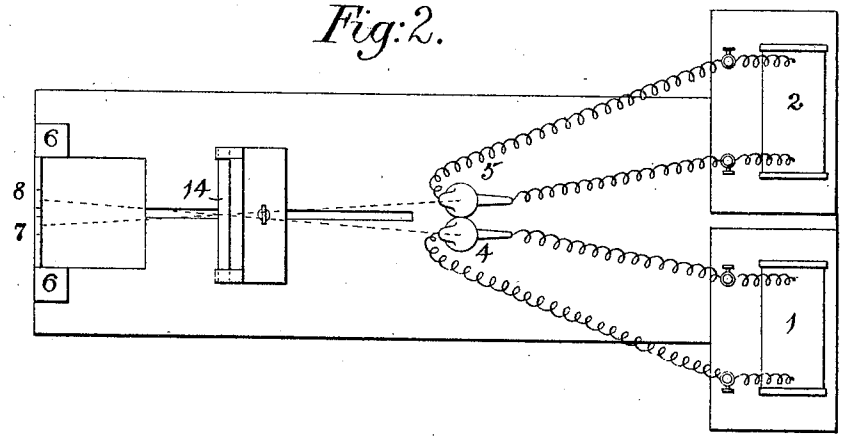


Fig: 1.

Fig: 2.



Witnesses:
A. M. Parkins.
E. A. Bullock.

Inventor:
James M. Davidson,
by his Attorneys,
Dodson Davidson & Wright

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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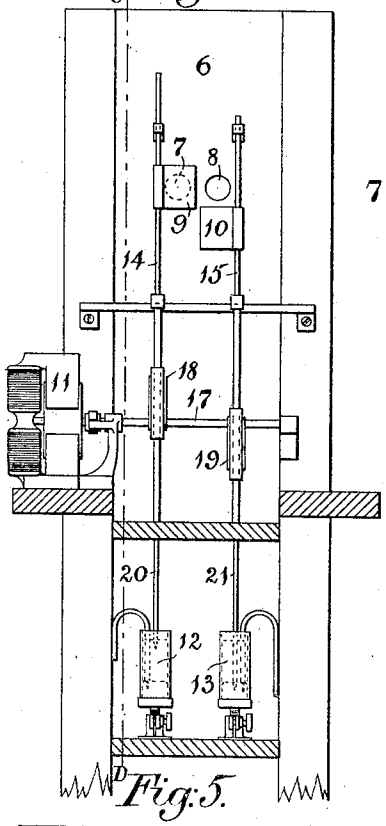
(No Model.) 3 Sheets—Sheet 2.

Fig:3.



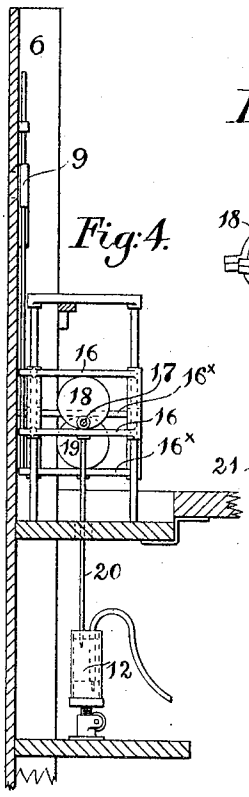


Fig:4.

Fig:7.

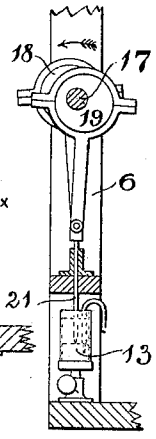


Fig:5.

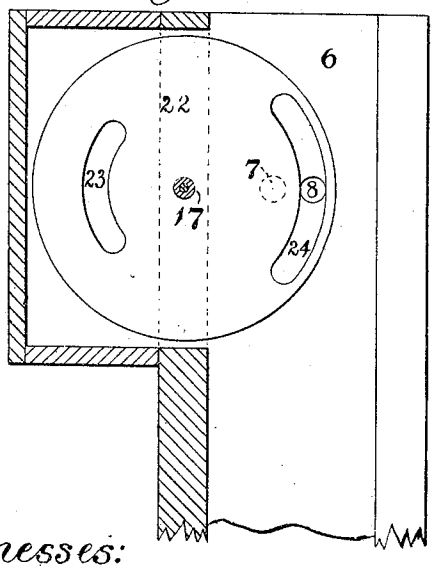
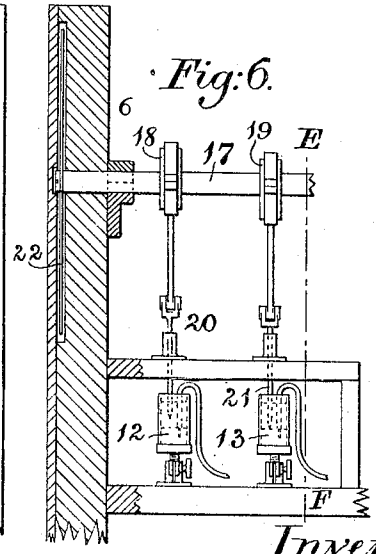


Fig:6.



Witnesses:
A. M. Parkins.
E. A. Bullock

Inventor:
James M. Davidson,
By his Attorneys,
Dickson Davison & Wyld

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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(No Model.) 3 Sheets—Sheet 3.

Fig:10.

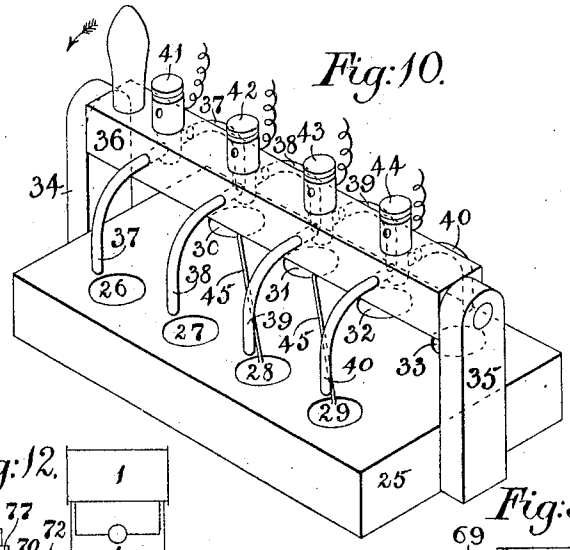


Fig:12.

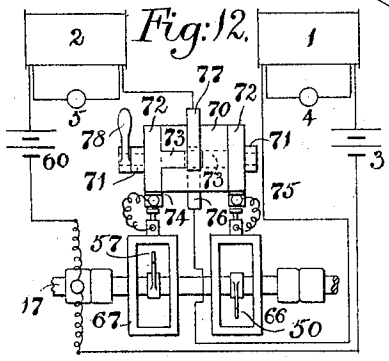


Fig:9.

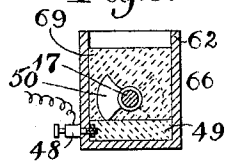


Fig:8.

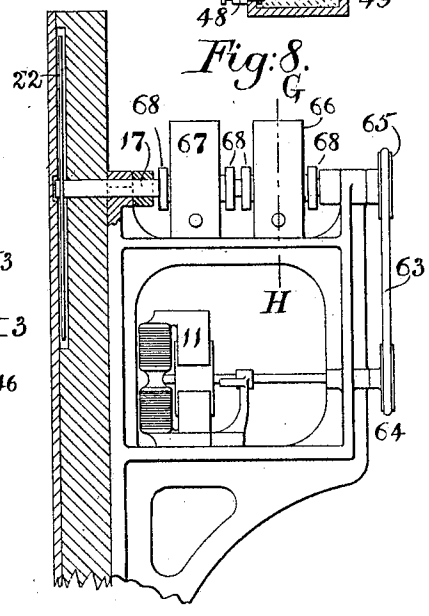
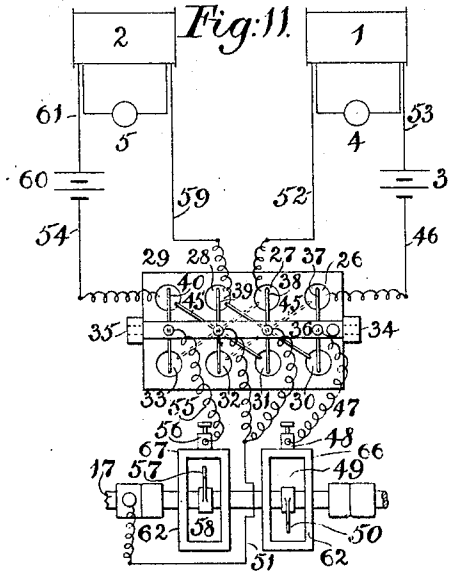


Fig:11.



Witnesses:
A. M. Parkins.
E. A. Bullock

Inventor:
James M. Davidson,
By his Attorneys
Roberson, Davidson & Wright

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JAMES MACKENZIE DAVIDSON, OF LONDON, ENGLAND.

ROENTGEN-RAY APPARATUS.

SPECIFICATION forming part of Letters Patent No. 646,362, dated March 27, 1900.

Application filed September 22, 1899. Serial No. 731,287. (No model.)

To all whom it may concern:

Be it known that I, JAMES MACKENZIE DAVIDSON, a subject of Her Majesty the Queen of Great Britain, residing at London, in the county of Middlesex and Kingdom of England, have invented certain new and useful Improvements in and Relating to Roentgen-Ray Apparatus, of which the following is a specification.

My invention relates to Roentgen-ray apparatus, and has for its object to provide means that will produce stereoscopic images on a fluorescent screen. The apparatus is more particularly designed for surgical uses; but obviously it may be employed for other purposes.

It is well known that if a Crookes tube be displaced to a suitable distance—say, for example, six centimeters—and two skiagrams of an object be taken on two separate photographic plates the two resulting skiagrams properly mounted and viewed will be seen in stereoscopic relief.

My invention is to enable the shadow of an object to be seen on the fluorescent screen in stereoscopic relief.

In the accompanying drawings, which are mainly diagrammatic, Figure 1 shows in elevation, and Fig. 2 in plan, an arrangement for effecting my purpose. Fig. 3 is a transverse section on the line A B, Fig. 1, and Fig. 4 is a sectional elevation on the line C D, Fig. 3. Figs. 5 and 6 are similar views to Figs. 3 and 4; and Fig. 7 is a sectional elevation on the line E F, Fig. 6, illustrating a modification hereinafter referred to. Fig. 8 is a similar view to Fig. 6, illustrating a further modification; and Fig. 9 is a sectional elevation on the line G H in Fig. 8, showing another form of interrupter. Fig. 10 is a perspective view of one form of reversing-key. Fig. 11 shows diagrammatically the electrical connections thereof, and Fig. 12 is another diagram illustrating an alternative form of reversing-key and its connections.

In carrying out my invention I generally employ two induction-coils 1 and 2 or equivalent generators, each joined up, respectively, to a battery, one of which is shown at 3, or other source of electrical energy and to a Crookes or other vacuum tube 4 or 5. The two tubes 4 and 5 are placed side by side, so that the points on their respective anodes from which the Roentgen rays originate are in a horizontal line at a distance of six centimeters or more from each other. On the same horizontal level and in a parallel plane I form in a suitable framework structure 6 two sight-holes 7 and 8, in front of which two appropriately-mounted shutters 9 and 10 are reciprocated or otherwise moved by an electromotor 11 or other operating mechanism in such manner that when one sight-hole is open the other is closed. Attached to these shutters 9 and 10 or to the apparatus which operates them are two mercury contact-breakers or other interrupters 12 and 13, and the arrangement is such that when one sight-hole (say the one marked 8) is open one of the said tubes (say the one marked 4) will be momentarily illuminated and if a fluorescent screen 14 be interposed in the usual way with an object against it a shadow of the object will result from the illumination of this one tube. Then the said sight-hole 8 will be closed and the one 7 will be opened and the tube 5 illuminated. If the machine be made to operate at such rate that the shutters opposite each eye are opened and closed not less than ten times per second, the images seen by each eye become continuous and the brain fuses the image from each eye, with the result that a shadow picture in striking stereoscopic relief is produced.

In Figs. 3 and 4 the shutters 9 and 10 are shown as being carried upon rods 14 and 15. A shaft 17 is driven by the electromotor 11, and upon this shaft are two eccentrics 18 and 19, which respectively come in contact with the upper and lower cross-bars of two frames 16 and $16^{\times}$ and by means of which the said rods 14 and 15 are reciprocated. Also attached to the said frames and operated by the said eccentrics are two rods 20 and 21, which alternately enter and leave the said mercury-cups 12 and 13.

Instead of employing reciprocating shutters I may, as shown in Figs. 5 and 6, alternately open and close the sight-holes by means of a rotating disk 22. This disk is provided with two slots 23 and 24, 23 being in register with the sight-hole 7 and 24 with the one 8.

The disk may be mounted directly upon the shaft 17 of the motor, and the same shaft will, as before, carry the two eccentrics 18 and 19 and rods 20 and 21 for making and breaking contact.

In Fig. 8 is shown an alternative means of effecting the make and break in the primaries of the induction-coils 1 and 2, employing two interrupters 66 and 67, each of which consists of a vessel 62, composed of insulating materials. The vessels are provided, respectively, with a connection 48 and 56, adapted to make contact with a quantity of mercury 49 and 58. These vessels 62 are respectively provided with a rotary contact 50 and 57, carried by the shaft 17 at a slight distance above the level of the mercury, into which the said rotary contacts are alternately dipped and withdrawn at every half-revolution. The shaft 17 enters the vessels 62 through glands 68 and rotates in a suitable insulating fluid 69, which enables an effective "make and break" to be accomplished without violently agitating the mercury.

In some cases I may, by employing a suitable reversing-key, change over the electrical connections, so that at will either the sight-hole 7 is open at the time that the tube 5 is illuminated, and vice versa, as indicated by the dotted lines in Fig. 2, or while the sight-hole 7 is open the tube 4 may be illuminated, and vice versa. In the first instance—that is to say, as indicated by the dotted lines in Fig. 2—the shadow will be seen in true stereoscopic relief, and in the latter case a pseudo-stereoscopic shadow will, in accordance with the laws of binocular vision, be produced. This reversal of appearance at will is of great utility in determining the exact location of an object.

Fig. 10 shows in perspective one form of reversing-key adapted for the purpose, and the complete electrical connections can be traced from the diagram Fig. 11. Carried on an insulating-base 25 are cups 26, 27, 28, 29, 30, 31, 32, and 33 containing mercury. Mounted between uprights 34 and 35 is a pivoted member 36. This pivoted member 36 carries dependent insulated bifurcated contact-pieces 37, 38, 39, and 40 and attached binding-posts 41, 42, 43, and 44. As will be seen by Fig. 11, there are electrical connections 45 between the cups 26 and 32, 27 and 33, 28 and 30, and 29 and 31, respectively. Assuming the pivoted member 36 to be canted in the direction indicated by the arrow, so as to dip the insulated contact-pieces 37, 38, 39, and 40 into the mercury-cups 26, 27, 28, and 29, respectively, a circuit will be closed through the primary of the induction-coil 1 by way of the conductor 46, mercury-cup 26, insulated contact-piece 37, binding-post 41, conductor 47, binding-post 48, mercury 49, rotating contact 50, shaft 17, conductor 51, binding-post 42, insulated contact-piece 38, mercury-cup 27, conductor 52, the said primary coil 1, and back to the battery 3 through conductor 53, while the primary of the other induction-coil 2 will receive its current by way of the conductor 54, mercury-cup 29, insulated contact-piece 40, binding-post 44, conductor 55, binding-post 56, mercury 58, rotating contact 57, shaft 17, conductor 51, binding-post 43, insulated contact-piece 39, mercury-cup 28, conductor 59, the said primary coil 2, and back to the battery 60 through the conductor 61. In this way it will be seen that the action of the induction-coil 1 is controlled by the rotating contact 50, while the other induction-coil 2 is controlled by the contact 57. When it is desired to effect a reversal of the appearance, the action of the induction-coil 1 is controlled by the contact 57 and the action of the induction-coil 2 by the contact 50 by canting the pivoted member 36, so that the insulated contacts 37, 38, 39, and 40 dip into the mercury-cups 30, 31, 32, and 33, respectively. When the parts are in this position, the energizing-current of the primary of the induction-coil 1 is conducted from the mercury-cup 26 to the mercury-cup 32 through the connection 45, thence through the insulated contact 39, binding-post 43, conductor 51, shaft 17, thence through the rotating contact 57, the mercury 58, binding-post 56, conductor 55, binding-post 44, insulated contact 40, mercury-cup 33, and connection 45 to the mercury-cup 27. In the same way it will be seen that the energizing-current of the primary of induction-coil 2 may be traced to the rotating contact 50.

The reversing-key shown in Fig. 12 consists of a drum of insulating material 70, journaled in uprights 71 and provided at each end with a metallic ring 72, each having at diametrically-opposite points a lateral finger 73, extending slightly beyond the central zone of the drum. Coöperating with these parts are four brushes, two of which, 74 and 75, are continuously in contact with the rings 72, respectively, while the other two, 76 and 77, are caused to complete the circuit through one or other of the lateral fingers 73, according to the position of the drum 70, whereby the induction-coils 1 and 2 are actuated by the interrupters 66 and 67, respectively, or vice versa, as is clearly shown in the drawings.

By means of the arrangement last described both the coils 1 and 2 may be cut out by turning the drum 70 by its handle 78 into a central position.

In some cases I may employ the Wehnelt electrolytic break, in which case the mercury contact-breakers hereinbefore referred to act as ordinary make-and-break contacts.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a Roentgen-ray apparatus, the combination, with a fluorescent screen and a framework structure having two sight-holes, of means serving to project upon the said screen intermittent and rapidly-alternating shadows, and further means serving to alternately open and close the sight-holes of the

apparatus so as to enable the shadow of an object to be seen on the fluorescent screen in stereoscopic relief.

2. A Roentgen-ray apparatus, comprising, in combination, a fluorescent screen, two vacuum-tubes, and a battery induction-coil and interrupter associated with each tube, a framework structure with two sight-holes, alternately-operating shutters in front of said sight-holes, and means serving to operate said shutters and interrupters whereby the said vacuum-tubes are intermittently illuminated and a stereoscopic image produced on the fluorescent screen.

3. A Roentgen-ray apparatus, comprising, in combination, a fluorescent screen, two vacuum-tubes, and a battery induction-coil and interrupter associated with each tube, a framework structure with two sight-holes, alternately-operating shutters in front of said sight-holes, means serving to operate said shutters and interrupters whereby the said vacuum-tubes are intermittently illuminated and a stereoscopic image produced on the fluorescent screen, and further means serving to change over the electrical connections so that at will the shadow of an object may be produced either in true or in pseudo-stereoscopic relief.

In testimony whereof I have hereunto subscribed my name.

JAS. MACKENZIE DAVIDSON.

Witnesses:
A. F. SPOONER,
J. SUTTON.