

APPLICATION FILED JAN. 16, 1912.

Patented May 13, 1913.

2 SHEETS—SHEET 1.



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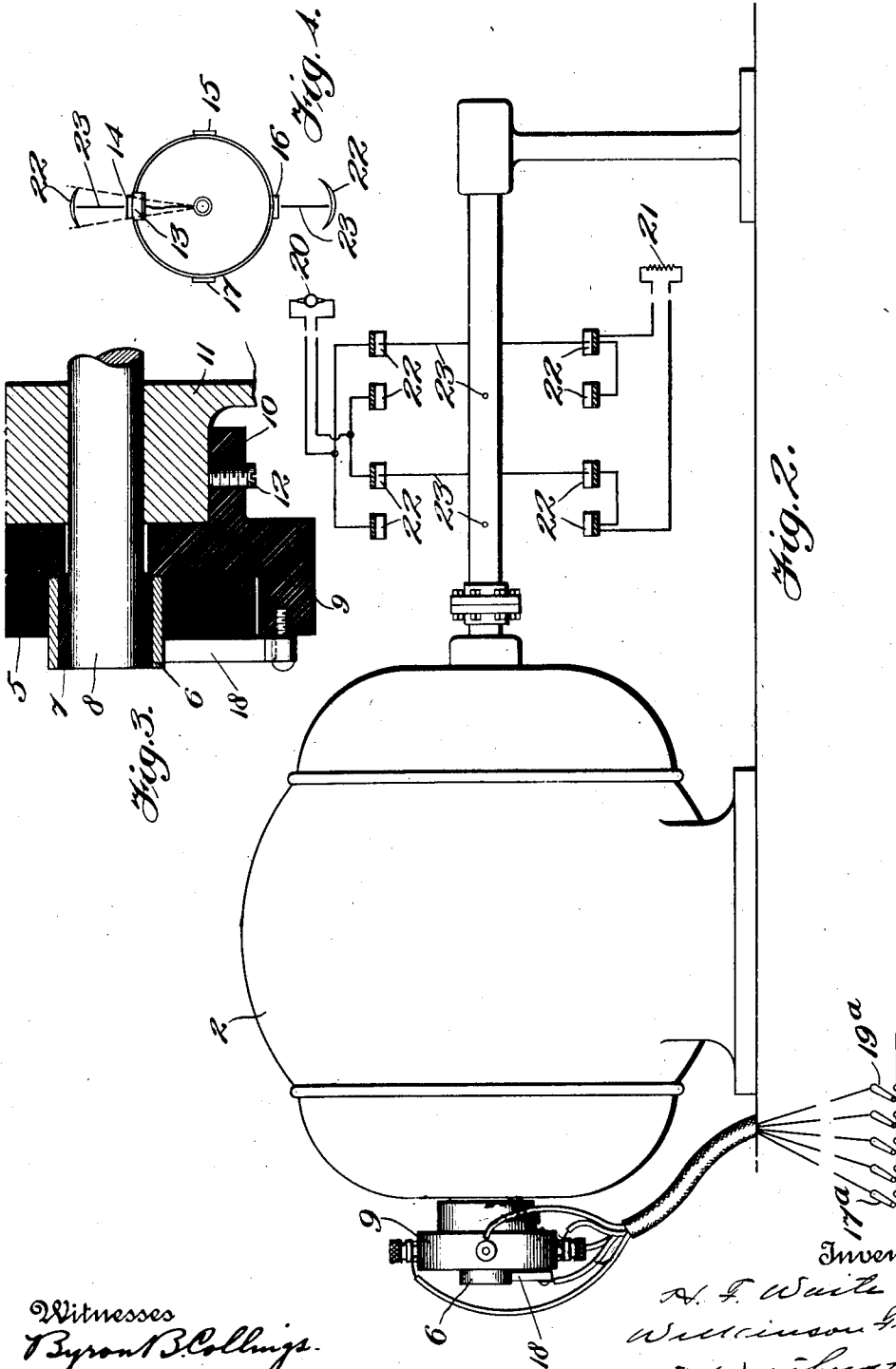
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1,061,428.



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# UNITED STATES PATENT OFFICE.

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## X-RAY SYSTEM.

1,061,428.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, HARRY F. WAITE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in X-Ray Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in X-ray systems, and it consists in the constructions, combinations and arrangements herein described and claimed.

An object of my invention is to provide an improved X-ray system adapted to operate with a minimum of power and wear, and which can be readily adjusted to produce rays of the various different intensities and characters suitable for different uses, such as fluoroscopic work, X-ray treatment, etc. For example, in fluoroscopic work it is desired to obtain the current for the shortest possible time when at its maximum voltage. The advantage of being able to do this is that under the above condition, the X-ray has its greatest penetration and what is equally important, there is no current going through the X-ray tube except when the voltage is at its maximum. The disadvantage of having the current passed through the tube when it is rising to maximum and descending to zero is that it unnecessarily heats up the target of the X-ray tube and at the same time while heating the target it does not have the power to make the tube develop an X-ray of sufficient penetration for the work desired. On the other hand, in X-ray treatment it is desirable to collect the high tension current when the primary voltage is only one half of the maximum, owing to the fact that the penetration of the ray varies according to the voltage supplied to the X-ray tube. Therefore, if we are able to supply a lower voltage to the X-ray tube, it means that the ray from the tube has less penetration and this is particularly desirable for treatment purposes. When the entire wave is used, or most of it, then the rays from the tubes are too intense for treatment purposes. By a proper adjustment of the new device, the current can be selected from any part of the rise and fall in the primary circuit. This is something that has not been possible heretofore and it results in a great

saving in the wear and tear of the X-ray tube itself which is very important to the operator, as these tubes are very expensive and with this new device, there is no current sent through the tube except, at the time that it is in a position to develop the desired ray in the tube.

In the accompanying drawings, forming a part of this application, and in which similar reference symbols indicate corresponding parts in the several views:—Figure 1 is a diagrammatic view, illustrating one embodiment of my invention; Fig. 2 is a side elevation, with the high potential pole-changing or rectifying switch illustrated diagrammatically, showing means for driving the selecting device and rectifying switch in synchronism and definite phase relation with the alternating-current supply; Fig. 3 is an enlarged detail section, illustrating means for locking the selecting device in its adjusted positions; and Fig. 4 is a diagrammatic view, illustrating a modification in which the ring of the selecting device and the cross connectors of the rectifying switch are carried by a common adjustable shaft.

Referring to the drawings, 1 indicates the primary of a high-tension, step-up transformer connected in parallel with a synchronous motor 2 in the leads 3 from any suitable source of alternating-current supply, such as an alternating current generator, or an inverted rotary 4; a rheostat 1<sup>a</sup> being shown in series with said transformer primary.

A selecting device is shown comprising a ring 5 of insulating material secured on a metal sleeve 6, which latter is carried by a bushing 7 of insulating material on the shaft 8 of said motor 2, or on a shaft driven by said motor in synchronism and definite phase relation with the alternating-current supply through the mains 3.

A ring 9 of insulating material is adjustably supported concentrically about the ring 5; said ring being shown provided with a hub 10 angularly adjustable on a stationary casing 11 and provided with a set screw 12 for locking it in its several adjusted positions. The rotary ring 5 carries a spring-pressed contact 13 in electrical circuit with the metal sleeve 6, and adapted to contact successively with a series of metal sectors 14, 15, 16 and 17 equally spaced in the insulating ring 9.

The selecting device is adapted to be connected in series in the circuit of the transformer primary by a brush 18 engaging the rotating metal sleeve 6, and a series of switches 14<sup>a</sup>, 15<sup>a</sup>, 16<sup>a</sup>, and 17<sup>a</sup> connected to the metal sectors 14, 15, 16 and 17; a shunt circuit 19 being provided with a switch 19<sup>a</sup> for cutting out said selecting device when desired.

10 An X-ray tube 20, is connected to the transformer secondary 21 in series with a suitable high-tension, pole-changing or rectifying switch having conducting arcs 22 and cross connectors 23, similar to those  
15 described in U. S. Patent #954,056. In Fig. 2, I have shown the ring 5 and cross connectors 23 connected directly to the shaft of the motor 2, but obviously any other means could be employed for synchronously  
20 rotating said parts.

With a four-pole motor, there will be two, complete positive and negative potential waves for each revolution of the motor shaft and the ring 5 carried thereby, and the ring  
25 9 can be so adjusted that the disk contact 13 will be rotated into closed circuit with the metal sectors 14 and 16 when a positive electromotive-force wave is at or near its maximum, and in closed circuit with the  
30 metal sectors 15 and 17 when a negative electromotive-force wave is at or near its maximum. Under such conditions, if the switch 14<sup>a</sup> be closed the sector 14 will select out and transmit through the transformer primary  
35 a fraction from the crest of one positive potential wave during each rotation of the ring 5; and if the switches 14<sup>a</sup> and 16<sup>a</sup> be closed the sectors 14 and 16 will send two similar impulses through the transformer primary  
40 during each rotation of said ring 5. Similarly, by closing the switches 15<sup>a</sup> and 17<sup>a</sup>, impulses would be sent through the transformer primary from the crests of negative potential waves. Thus, with all four  
45 switches 14<sup>a</sup>, 15<sup>a</sup>, 16<sup>a</sup> and 17<sup>a</sup> closed, there would be four impulses of maximum potential sent through the transformer primary during each rotation of the motor shaft; said impulses being rectified by the pole-changing switch to supply a uni-directional  
50 current to the X-ray tube. The above described adjustment of the ring 9, thus causes the selecting out of fractions from the points of maximum potential of the electro-

motive-force waves, which are especially suitable for fluoroscopic work.

For X-ray treatment, the ring 9 can be readily adjusted to select out portions of less potential from the electromotive-force waves, and it will be clear that said ring 9  
60 can be suitably adjusted to select out the portions of the electromotive-force waves especially suitable for all different uses.

The conducting arcs 22 of the pole-changing switch are of sufficient angular dimension to collect current fractions transmitted through the sectors 14, 15, 16 and 17 in all  
65 of the shifted positions of the ring 9, but not to transmit from the rotating cross connectors 23 the low voltage portions of the electromotive-force waves.

Fig. 4 illustrates a modification in which the cross connectors 23 and the contact-carrying ring 5 are rotated by a common shaft which is adjustably secured to the shaft of  
75 the motor 2.

I have illustrated preferred and satisfactory constructions, but changes could be made within the spirit and scope of my invention.

I claim:—

1. In an X-ray apparatus, the combination of a step-up transformer, an alternating current source and a selecting device connected in series with the primary of said  
80 transformer, means for adjusting said selecting device to permit predetermined portions only of each alternating current wave length to pass through said transformer primary, and an X-ray tube in the secondary  
90 of said transformer.

2. In an X-ray apparatus, the combination of a step-up transformer, an alternating current source and a selecting device connected in series with the primary of  
95 said transformer, means for adjusting said selecting device to permit predetermined portions only of each alternating current wave length to pass through said transformer primary, and an X-ray tube and a  
100 rectifier connected in series with the secondary of said transformer.

In testimony whereof, I affix my signature, in presence of two witnesses.

HARRY F. WAITE.

Witnesses:

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