

E. W. CALDWELL.  
X-RAY APPARATUS.  
APPLICATION FILED MAR. 5, 1906.

931,034.

Patented Aug. 17, 1909.

Fig. 2.

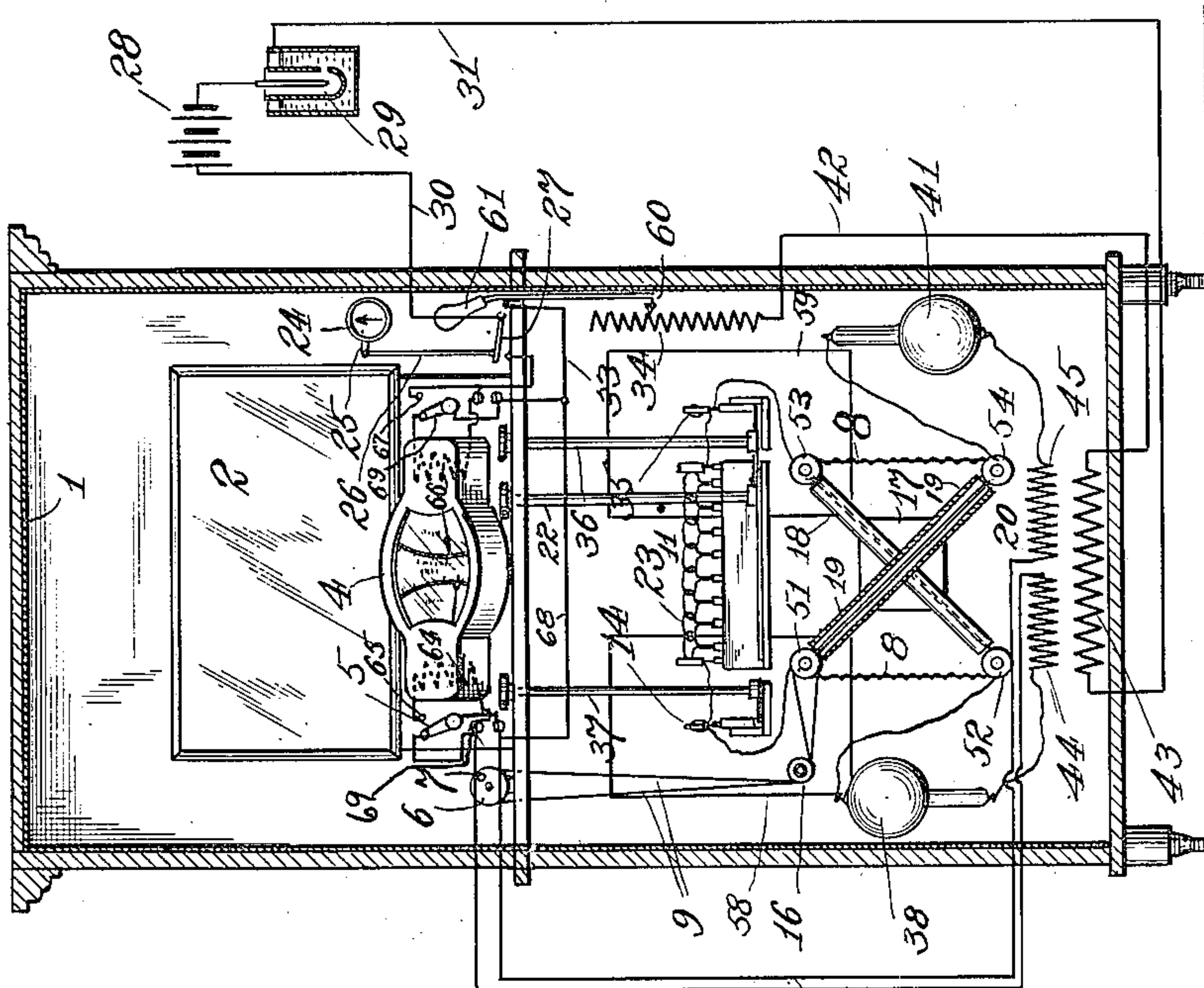
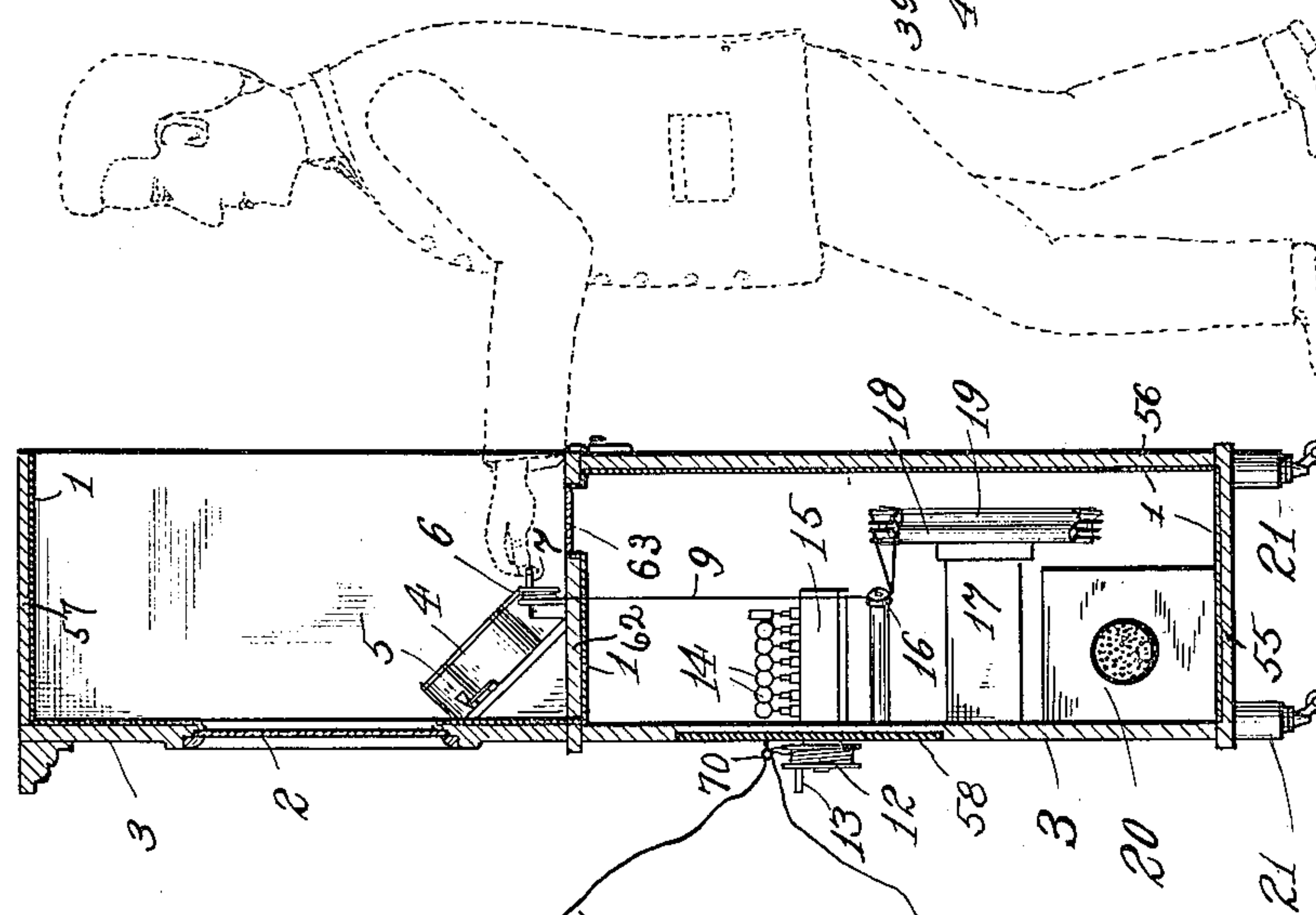
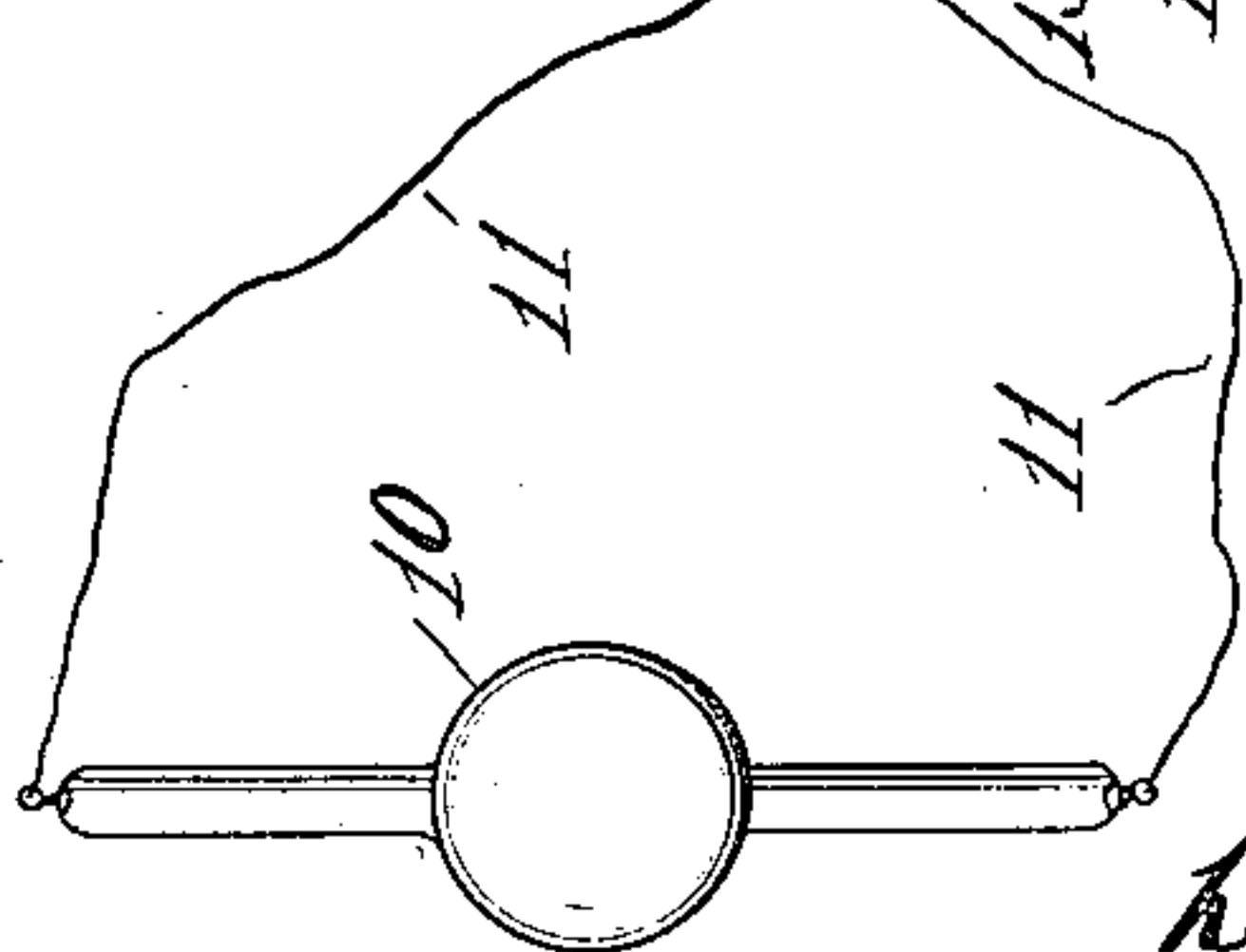


Fig. 1.



WITNESSES:  
*Josephine A. Greene.*  
*Joseph J. Collins*



INVENTOR  
*Eugene W. Caldwell*  
BY  
*Almon & Almon*  
ATTORNEYS



# UNITED STATES PATENT OFFICE.

EUGENE W. CALDWELL, OF NEW YORK, N. Y.

## X-RAY APPARATUS.

No. 931,034.

Specification of Letters Patent.

Patented Aug. 17, 1909.

Application filed March 5, 1906. Serial No. 304,163.

*To all whom it may concern:*

Be it known that I, EUGENE W. CALDWELL, a citizen of the United States, and resident of the city, county, and State of New York, have invented certain new and useful Improvements in X-Ray Apparatus, of which the following is a specification, taken in connection with the accompanying drawings, which form a part of the same.

This invention relates to X-ray apparatus and relates especially to a combined closed cabinet and impervious shield for the operator, the indicating and control devices being preferably arranged adjacent a window through which the operator can look while being protected from the X-rays.

In the accompanying drawings, showing an illustrative embodiment of this invention, Figure 1 is a side sectional view and Fig. 2 is a rear vertical sectional view, in which the electrical circuits are indicated diagrammatically.

In the illustrative embodiment of this invention shown in the drawings, the impervious shield for the operator comprises the front board 3 which also forms the front of the coil cabinet, this cabinet comprising the bottom 55, the top shelf 62 and the back 56 which is preferably removable to give access to the interior. A cover 57 may be employed and serve as a shelf and the device may be mounted on suitable casters 21 when desired so as to be readily moved. A number of suitable observation windows, such as 2, may be mounted in the shield so as to give the operator standing behind the cabinet and shield a view of the X-ray tube 10 and subject. These windows are preferably of special lead glass or similar transparent material which is impervious to the X-rays and similar windows, such as 63, may be provided in the shelf 62 so as to enable the operator to observe the apparatus within the cabinet. An impervious lining 1 of sheet lead or similar material which prevents the passage of the X-rays is provided, preferably extending around the cabinet in the manner indicated, so as to completely shield the operator behind it from the X-rays from the tube 10 or other apparatus used so that under no circumstances could a person in the position indicated experience any harmful effects from such rays.

Within the cabinet the coil 20 is shown as mounted on the bottom, this coil, as is dia-

grammatically indicated in Fig. 2 comprising the primary 43 which may be arranged in circuit with a liquid interrupter 29 of the character described in Caldwell patent, 677,498, of July 2, 1901. This interrupter operates when the circuit is closed through the battery or other source of electricity 28 to give an interrupted current to the primary.

As indicated, the primary winding comprises the wire 30 connected with the switch 27 which when pressed down into closed position allows the current to flow through the ammeter switch 69 and ammeter coil 66, and then passing through the connections 33 and rheostat contact 60 flows through as much of the rheostat winding 34 as is in circuit and then through the connection 42 to the other end of the primary winding.

As indicated, the rheostat contact is shown as attached to a suitable handle 61, passing up through the cabinet shelf so as to be conveniently adjusted by the operator, although this particular arrangement of circuits while convenient is not, of course, necessary. A timing device 24 is also preferably arranged adjacent the observation window 2 and this timing device, which may be in the form of a stop watch or other arrangement, is preferably connected with the primary switch so as to be simultaneously actuated and allow the timing device to operate just as long as the primary circuit is closed. This allows an X-ray exposure to be interrupted when desired and still gives a record of its total duration. As indicated, a suitable cord or connector 26 joins the lever or stopping element 25 of the timing device with the primary switch 27, so that the timing device is allowed to operate only so long as the primary switch is closed.

The secondary winding of this induction coil 20 is preferably made up of several sections and grounded neutral milli-ammeter connections lead out from the zero point of this central winding. As indicated, these connections 39 and 40 are taken out preferably from the neutral point of the two sections 44, 45 of the secondary winding and the connection 40 may be electrically connected through the grounding wire 68 with the low voltage primary circuit or other ground so as to avoid all undesirable static effects in the milli-ammeter and control devices in contact with the operator. As indi-



cated the connection 39 is shown as electrically connected through the milli-ammeter switch 5 with the other connector 40, but by throwing this switch over to engage the contact 65 the secondary current flows through the milli-ammeter coil 64 and gives a suitable indication of the strength of the secondary current which energizes the X-ray tube. It is desirable to have a comparative indication of the strength of the primary and secondary currents passing through the X-ray coil and this can be conveniently arranged by using the combined ammeter 4 having a compound or double scale as indicated, one scale and needle indicating the strength of the primary current which flows through the ammeter coil 66 and the other which may be arranged side by side for direct comparison indicates the secondary current flowing through the milli-ammeter coil 64 when the milli-ammeter switch 5 is in indicating position. Of course, by throwing the ammeter switch 69 over into engagement with the contact 67 the primary current is short-circuited around the ammeter coil 66 and can pass without energizing it.

The ends of the secondary windings 44 and 45 are preferably connected to the Villard bulbs 38 and 41 as indicated so as to promote the uni-directional character of the secondary currents entering the tube. If desired also a suitable reverser may be employed to change the polarity of the secondary terminals 70 without changing the direction of current through coil, meter or Villard tubes. As indicated this reverser is mounted on the insulating support 17 and comprises suitable insulators which may be in the form of tubes 19 of hard rubber or other suitable material. On the ends of these insulators are mounted the guides 51, 52 53 and 54 which may be in the form of small metal wheels or pulleys. As indicated the guide 52 may be connected with the Villard bulb 38 and the guide 54 with the bulb 41 so that these two guides are in permanent electrical connection through the Villard tubes with the ends of the secondary winding of the coil, while the other guides 51 and 53 are in electrical connection with the series spark gap and X-ray tube, as will be described. A flexible connector 9 in the form of a cord or the like, may be arranged over the operating pulley 6 provided with the handle 7 and after passing around the idle pulleys 16 passes over the guide 51. Then the conductor or portion 8 of this connector passes to the guide 52 from which the connector passes through the insulator tube 19 to the guide 53 from which the conductor portion 8 of the connector passes to the guide 54. Then the connector passes through the other insulator tube 19 over the guide 51 and to the idle pulley 16. It is apparent that in the position indicated the

conductors 8 which may be conveniently arranged by wrapping a light wire or the like around the desired portions of the connector which is otherwise non-conducting make electrical contact between the guides 51 and 52 and also between guides 53 and 54, the connector passing in hour-glass form between these guides. If, however, the reversing pulley 6 is operated the connector is moved from this position so as to bring the conductor portions into the position of diagonals between the quadrilaterally arranged guides, the diagonal portions of the connector being electrically separated by insulators between them, being located in this instance within the insulator tubes 19. Electrical contact is made under these conditions between the guides 51 and 54 and between the guides 52 and 53, thus giving a reversal of this high potential current through the tube and other devices beyond the guides 51, 53.

Suitable insulating plates 58 and 59 are preferably mounted in the front face of the cabinet, these plates being conveniently formed of hard rubber or other good insulating material. The brackets 15 are mounted on these plates as indicated in Fig. 1 and the series spark gaps in the form of oscillating buttons or members 14 may be employed and operated from the handle 37 projecting up through the control shelf 62, as is described in the Caldwell patent 797,718 of August 22, 1905. The members of this adjustable series spark gap 14 are as indicated in Fig. 2 electrically connected with the guide 51 and the similar members 35 mounted on the other insulating plate 59 and operated by the handle 36 are as indicated electrically connected with the other guide 53. If desired, a parallel spark gap may also be arranged by the use of similarly operating oscillating members 23 which may be in the form of wire loops as indicated and operated by the handle 22 in a similar manner. Upon the window 58 a spool 12 is arranged and provided with an operating handle 13 and upon which the wire 11, which, of course, may be a light flexible conductor cord of any form, is wound. This wire preferably passes through a conducting eye 70 which is in electrical contact with the outer member 14 of the series spark gap. This wire can, therefore, be readily extended to the extent desired and its outer end being connected with the X-ray tube 10 the tube is thus actuated by these two wires 11 in a well known manner.

As previously stated the coil and all the regulating devices charged with high potential electricity are located within the inclosed coil cabinet which minimizes the noise attendant on the sparking which occurs in the secondary regulating devices, while at the same time these devices can be



readily seen at any time by the operator looking through the inspection window 63. Furthermore, all these control devices in the secondary circuit of the coil in which the X-ray tube is located can be conveniently operated by the operator from above the control shelf without opening the cabinet. The other indicating and control devices, some of which as stated are in the primary circuit of the coil, are also convenient to the operator when standing in the position indicated behind the cabinet and protecting shield and any of these devices may be operated and inspected by the operator without turning or materially impairing his observation of the tube and subject through the observation window 2 to which all these devices are conveniently arranged.

Having thus described this invention in connection with an illustrative embodiment thereof, to the details of which I do not desire to be limited, what I claim as new and what I desire to secure by Letters Patent is set forth in the appended claims.

1. In X-ray apparatus, a combined coil cabinet and impervious shield for an operator, an X-ray tube mounted in front of said shield, observation means in said shield to allow an operator behind the same to observe the operation of said X-ray tube in front of said shield, control devices for said tube adjacent said observation means in such position that an operator actuating them must be behind said shield and substantially protected thereby, a coil and secondary control devices within said cabinet, and means to allow the operation of said secondary control devices within said cabi-

net to be observed by the operator in position behind said shield.

2. In X-ray apparatus, a combined impervious shield for an operator and inclosing cabinet for a high potential generating device, an X-ray tube mounted in front of said shield and control devices for said tube mounted on the rear of said shield in such position that an operator actuating them must be behind said shield and substantially protected thereby, the operation of said X-ray tube being observable from behind said shield.

3. In X-ray apparatus, an impervious shield for an operator, connections projecting from the front of said shield to operate an X-ray tube mounted in front of said shield, observation means substantially impervious to X-rays located in said shield in position to allow an operator behind said shield to observe the operation of said X-ray tube in front of said shield and control devices for said tube mounted on the rear of said shield in such position that an operator actuating them must be behind said shield and substantially protected thereby.

4. In X-ray apparatus, an impervious shield for an operator, an X-ray tube mounted in front of said shield, control devices for said tube mounted on the rear of said shield, said control devices being in such position that an operator actuating them must be behind said shield and substantially protected thereby.

EUGENE W. CALDWELL.

Witnesses:

HARRY L. DUNCAN,  
JESSIE B. KAY.