

E. GATES.

APPARATUS FOR MAKING RADIOGRAPHS.

(Application filed Sept. 26, 1898.)

(No Model.)

Fig. 1.

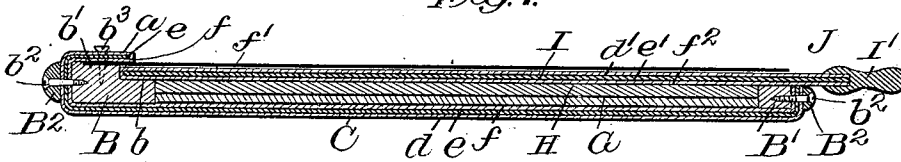


Fig. 2.

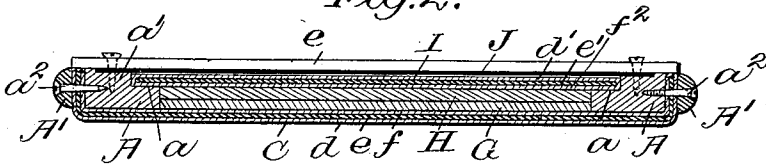


Fig. 3.

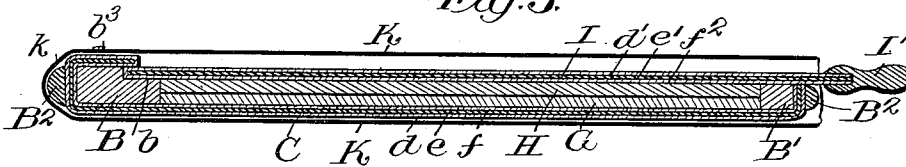


Fig. 4.

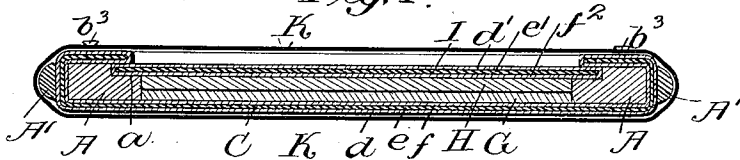


Fig. 5.

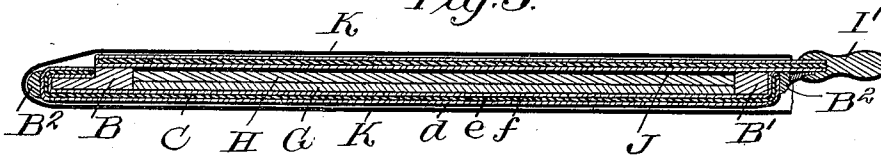


Fig. 6.

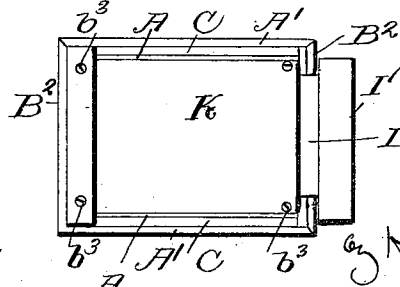
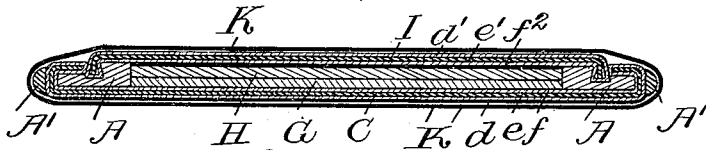


Fig. 7.

Witnesses  
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Inventor

Elmer Gates,  
by N. H. S. Mendenhall, atty.

# UNITED STATES PATENT OFFICE.

ELMER GATES, OF CHEVY CHASE, MARYLAND, ASSIGNOR TO THEODORE J. MAYER, OF WASHINGTON, DISTRICT OF COLUMBIA.

## APPARATUS FOR MAKING RADIOGRAPHS.

SPECIFICATION forming part of Letters Patent No. 653,383, dated July 10, 1900.

Application filed September 26, 1898. Serial No. 691,909. (No model.)

*To all whom it may concern:*

Be it known that I, ELMER GATES, a citizen of the United States, residing at Chevy Chase, in the county of Montgomery and State of Maryland, have invented certain new and useful Improvements in Apparatus for Making Radiographs, of which the following is a specification, reference being had therein to the accompanying drawings.

10 It is generally accepted as a fact that in taking skiagraphs or radiographs there are conditions as to the penetrative power or the maximum efficiency of X-rays which can only be attained by a careful manipulation of the apparatus, varying its handling somewhat in each case of use according to the exhaustion of the tube, the potential difference between cathode and anode portions of the tube, whether the spark be produced by a static machine or by an induction-coil, atmospheric and other conditions, which necessitate the use of considerable time in making the adjustments and in bringing the apparatus from a state of rest into a condition of highest usefulness for the particular work in hand at that particular time, and when this result has been accomplished there should be no change or interruption of the operation until the sensitive plate has been exposed to the action of the X-rays at their maximum of efficiency as thus produced for the requisite period of time; but with the appliances heretofore employed such preferable mode of procedure is impossible, it being the practice to stop the machine just as the said maximum of efficiency has been attained to permit the plate in its holder or carrier to be brought into the room, placed in the apparatus, and adjusted, after which the apparatus is started and again brought up to its maximum of efficiency, where it is maintained for such space of time as will suffice to produce the best result which is possible under the interruption which has occurred. While it is generally believed that better skiagraphs or radiographs could be made in case the machine were not stopped to permit the plate in its holder to be brought into the room, placed in the apparatus, and adjusted, yet with plate-holders as heretofore constructed it has been found advisable to

thus stop the machine in order to avoid "fogging" the plate while it is thus being handled in the open air of the room while the X-rays are being given off by the tube.

The object of my invention is to produce a skiagraph or radiograph by exposing the plate or other sensitive surface to the action of X-rays of the desired maximum intensity maintained by a continuous operation of the machine unbroken by a stoppage, as above explained, and also without the plate being present in the apparatus during the time when the above-indicated production of X-rays of the desired effective intensity are being generated or produced as contradistinguished from the ordinary method or process of subjecting said plate or sensitive surface to the action of X-rays which are of less than the desired effective intensity, are gradually brought up to such effectiveness, and are then maintained at such maximum for a period of time.

In carrying out my invention I propose to protect the sensitive surface from the action of the X-rays until the latter have been developed up to the desired effective intensity, and then expose said sensitive surface to the action of such effective X-rays. In carrying out my invention I propose to keep the plate at such a distance from the apparatus and under the proper conditions as will practically insure that it shall not be affected by the rays while they are being developed, and then, without stopping the machine, bring in the plate in a holder which is impervious, or at least practically impervious, to such rays, place the plate in proper position to receive the X-rays and remove therefrom a portion of the impervious holder, and subject said sensitive surface to the action of X-rays of the maximum or desired intensity of effectiveness for the requisite period of time. In carrying out this part of my invention I prefer to employ a holder made of some material which is impervious to X-rays—such as, for instance, lead prepared in thin sheets, with upon one side or upon both sides thin sheet-iron to support the lead and protect it against accidental injury or displacement—but good results may be attained by the use of fluores-

cent or tungsten screen, upon which said rays impinge with an inner composite sheet of material, part of which is impervious to energy-waves of such length as will traverse such screen, so that by the conjoint operation of the fluorescent screen and the inner opaque sheet the sensitive surface is protected from the action of the X-rays for the required period of time; but after the plate-holder has been placed in the apparatus and adjusted the opaque surface can be withdrawn and the sensitive surface exposed to the action of the X-rays of the desired maximum intensity and the skiagraph taken.

Having thus set forth in general terms the character of my invention, I will explain one mode which I have adopted for carrying it into effect.

Figure 1 is a central longitudinal section of a plate-holder made in accordance with my invention. Fig. 2 is a central transverse section of the same plate. Fig. 3 is a central longitudinal section of a modification. Fig. 4 is a transverse section of Fig. 3. Fig. 5 is a central longitudinal section of another modification. Fig. 6 is a transverse section of Fig. 5. Fig. 7 is a top plan view, on a reduced scale, of Fig. 1.

Like references indicate similar parts in all the figures.

Referring particularly to Figs. 1, 2, and 7, A A B' represent, respectively, the side bars and the end bars of a rectangular frame, made preferably of wood, as is customary in plate-holders. As shown in the cross-sections, the bars A A have upon their upper faces ledges or shoulders *a a a' a'*, and the end bar B has similar ones *b b'*, while the opposite end bar B' is thinner than B, being practically of the thickness of B at its inner edge, so that the upper faces of bar B' and the ledges or shoulders *a a b* are in plane.

The back of the holder is indicated generally by C, and it is composed of a series of layers or thin films alternately disposed of some of the substances which are most nearly impervious to the X-rays, among which materials I recommend lead and iron as being very useful, and I prefer to make the outer and inner sheets of iron, because of its being so much harder and stiffer than lead, and therefore better adapted for the surfaces which will be exposed to the wear and tear incident to handling. For convenience in illustration I have shown the back as composed of only three layers, an inner one *d* of iron, a middle one *e* of lead, and an outer one *f* of iron; but I wish it understood that in practice I prefer to use a larger number of alternately-disposed sheets, making them, particularly the inner ones, very thin, thus avoiding undue weight of the holder, and making the outer and inner layers in one continuous sheet doubled back upon itself will facilitate confining the intermediate sheets in proper place and also the making of smooth edges to the finished article. As indicated

at the other edges, the outer layer may be turned inward over the intermediate ones and soldered to the inner one, thereby avoiding rough edges. Upon three sides of the frame this composite sheet is continued around over the outer edge surface and inward upon the front surface and preferably a short distance beyond the shoulders or ledges *a' a' b'*, thus forming narrow recesses or grooves between the composite sheet and the end and side bar surfaces *a a b* to receive the edges of the slide to be described.

A' A' B<sup>2</sup> are ribs of either metal or wood, with screws *a<sup>2</sup> a<sup>2</sup> b<sup>2</sup>* passing through the ribs and the composite sheet into the frame-bars to confine the parts in place, the corners of the frame proper being held by glue and pins or screws, as is customary.

G represents the sensitive plate or surface, which may be of any usual or approved sort, and need not therefore be described in detail. In front of the sensitive surface there is or may be a tungsten screen H or its equivalent.

The slide I consists of a composite sheet similar to that of which the back is made, as is indicated by the same letters *d e f*, with an expanded end or bar I' to handle it by, and its width and thickness are such as to facilitate its being inserted if the grooves formed for its reception between the ledges or shoulders *a a b* and the projecting edges of the composite sheet, as has been explained.

J is a sheet or plate of material which is pervious or transparent to the X-rays, but is impervious, or nearly so, to the ordinary light-rays and is disposed upon the surfaces *a' a' b'* just in front of the slide, so that the object of which the skiagraph is to be made may be placed in proper position against this sheet J without interfering with the withdrawal of the slide after the X-rays have been brought up to the required efficiency, and I prefer that the flexibility of J be such that when the slide has been withdrawn the said object can be pressed toward the sensitive surface, so that there shall be only the thickness of the flexible sheet between the object and said surface, or the tungsten screen, when the latter is used. Thus this sheet J serves as a slide guard or protector, insuring absolute non-contact of the slide with the object placed in front of it.

I recommend a thin sheet of manila paper of proper size to fit closely within the walls of the recess when frictional contact will ordinarily hold J in place; but as means for further securing it in position screws *b<sup>3</sup>* may be inserted through the composite sheet and J or suitable points.

In the construction shown in Figs. 3 and 4 the parts are the same as I have described above, except that in place of a guard or protector secured between the ledges or shoulders *a' a' b'* I propose to employ one in the shape of an envelop or bag-like jacket *k*, which surrounds the entire holder frame and

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back, except that it is open at one side to receive the slide and is preferably held in place by means of the ribs A' A' B<sup>2</sup>.

As it is sometimes desirable to take a skia-  
 5 graph of an object of much greater size in one or both directions than the sensitive plate and of such character that it is desirable to omit from the holder the parts which project beyond or in front of said sensitive surface,  
 10 I have devised the modification shown in Figs. 5 and 6, where the grooves for the reception of the edges of the slide are formed in the side bars A A of the frame and are dove-tailed in cross-section to fit the correspond-  
 15 ingly-shaped edges of the slide, which are turned inward at practically right angles to the body of the slide, as at *i i*, (see Fig. 7,) and the bent-over edges of the composite sheet are secured in recesses  $a^x b^x$ , so that after  
 20 the slide has been withdrawn the bag-like envelop or guard K can lie in a plane across the sensitive surface, or the tungsten screen, when the latter is used, and also upon the adjacent parts of the holder, as will be readily under-  
 25 stood without further explanation.

Instead of using a series of plates or even a single plate of material which is impervious or nearly impervious to the X-rays, I may employ a slide made of some material which  
 30 will convert the X-rays into waves of a materially-different length and place behind that a sheet of material which will intercept such

longer waves, and thereby accomplish substantially the same result.

What I claim is—

1. A plate-holder for a sensitive surface comprising a removable slide made wholly or in part of a material that is impervious or nearly so to X-rays. 35

2. A plate-holder for a sensitive surface, comprising a slide made in whole or in part of material which is impervious, or nearly impervious, to X-rays, and a guard or protector in front of the slide adapted to prevent contact of the slide with the object to be represented on the sensitive surface, substantially as set forth. 40 45

3. A plate-holder for a sensitive surface comprising, in combination, a guard that is pervious to X-rays but impervious to light-rays, and a slide which is impervious to X-rays. 50

4. A plate-holder for use with an X-ray apparatus comprising, in combination, a plate sensitive to such rays, a slide impervious thereto, and a guard that is impervious to light-rays but pervious to X-rays. 55

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

ELMER GATES.

Witnesses:

H. H. DOUBLEDAY,  
 WM. H. DE LACY.