(No Model.) 2 Sheets—Sheet 1.

J. J. WOOD.

RESISTANCE COIL.

No. 507,345. Patented Oct. 24, 1893.

FIG. 1.

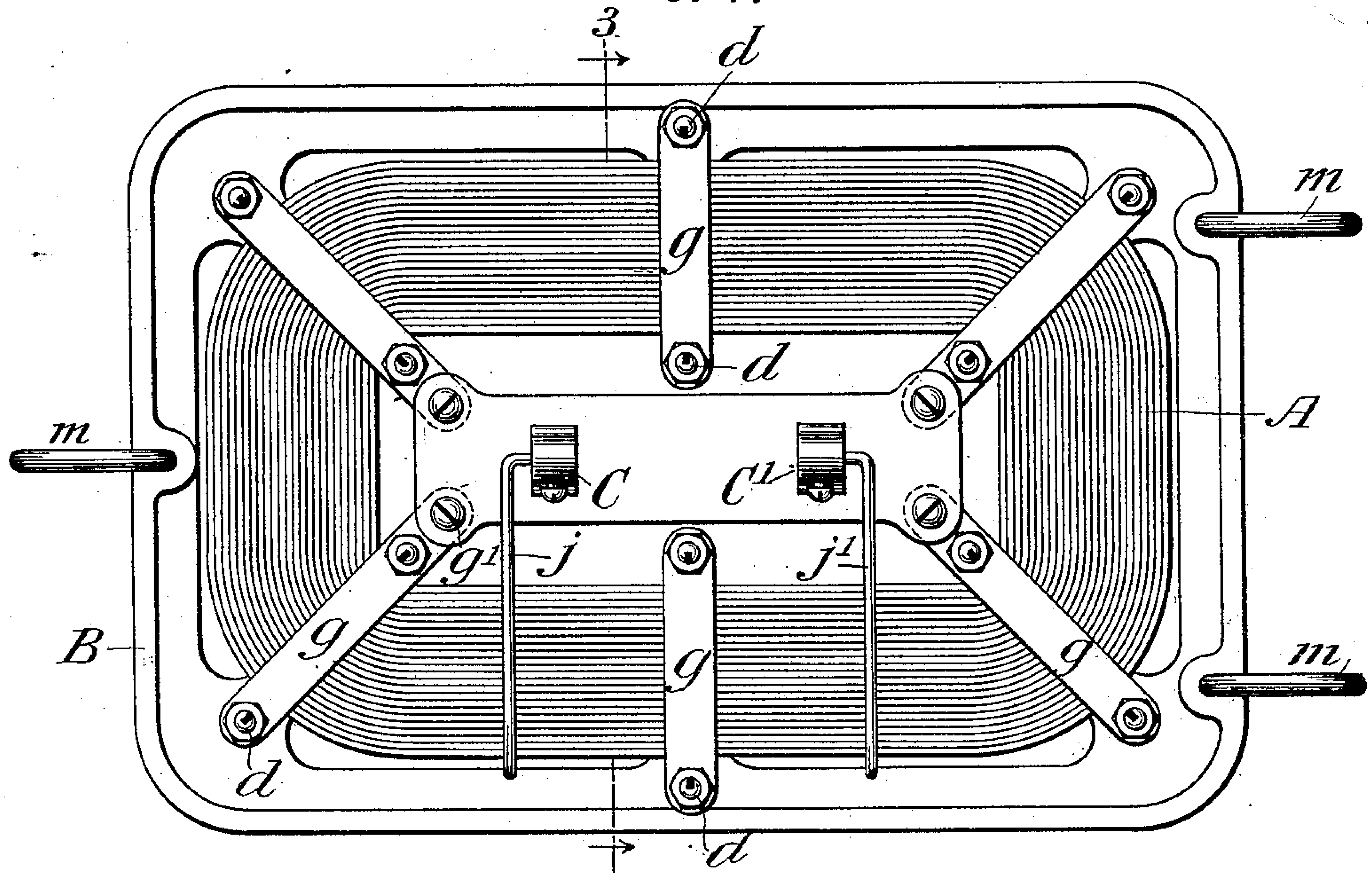


FIG. 2.

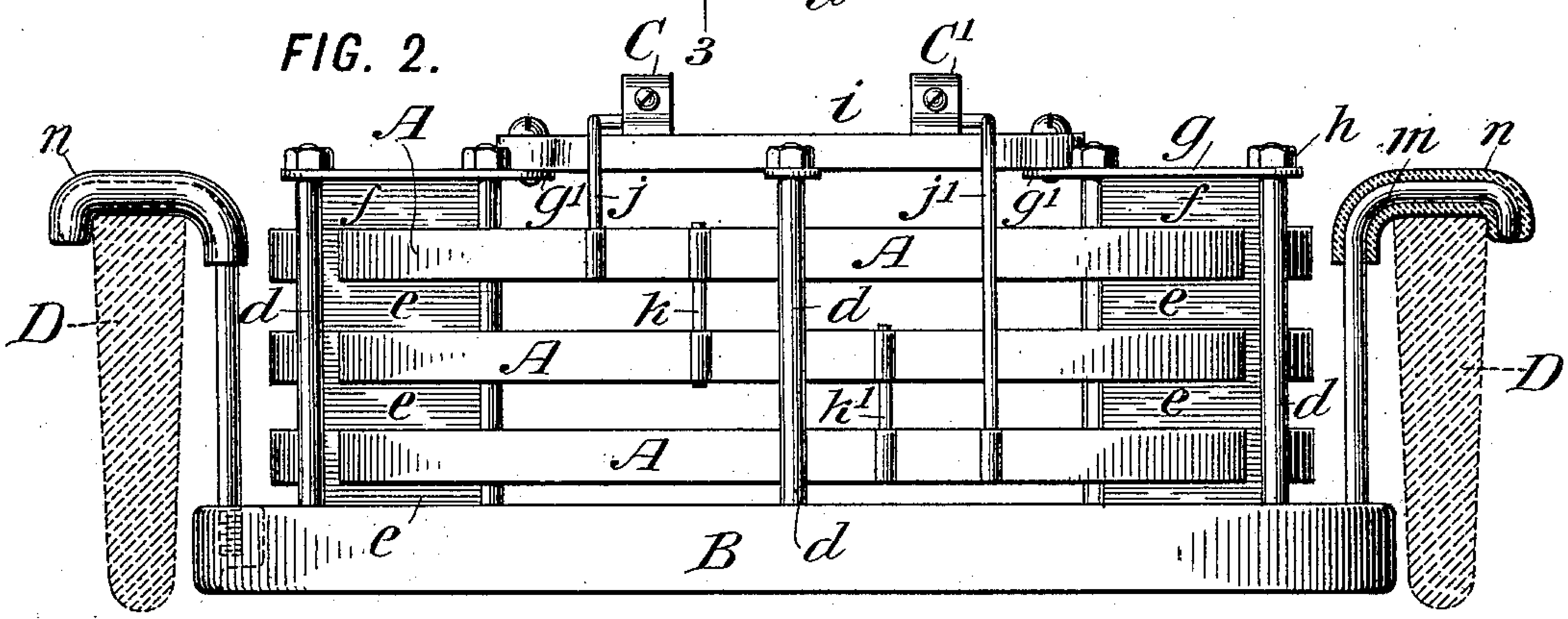


FIG. 10.

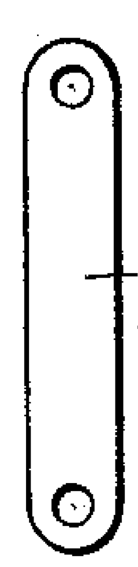


FIG. 3.

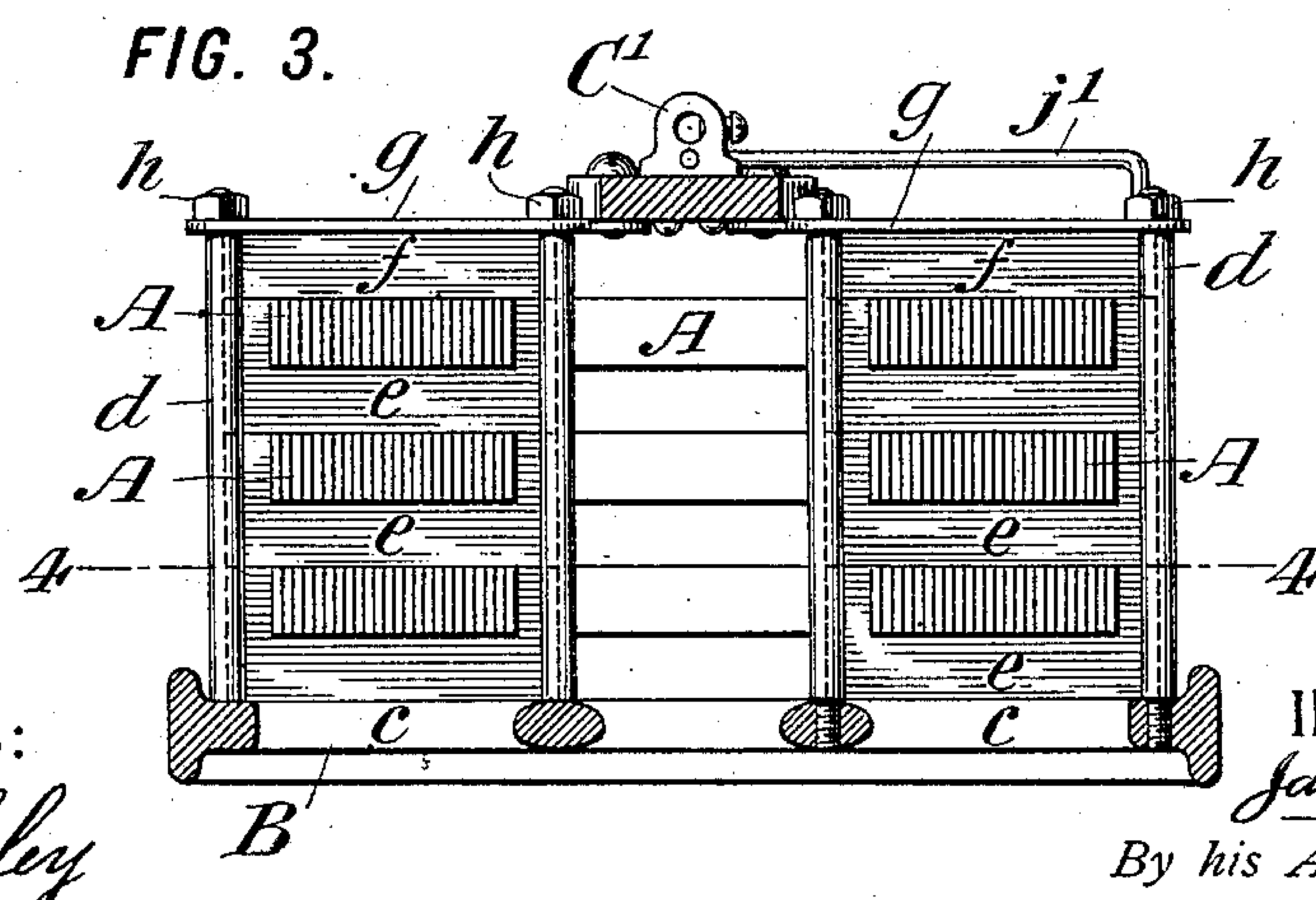
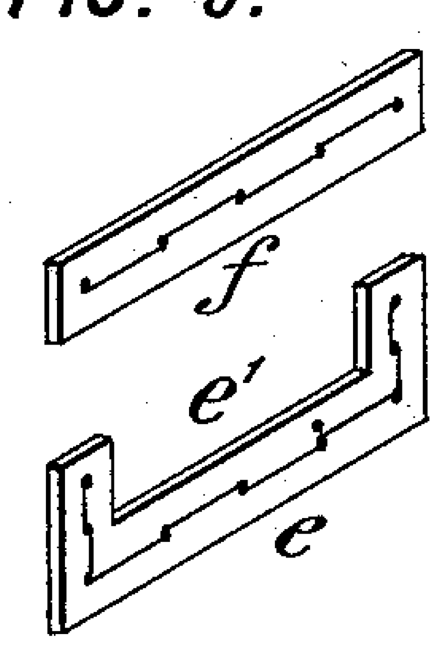


FIG. 9.



WITNESSES:

C. E. Ashley

H. W. Lloyd.

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co

(No Model.)

2 Sheets—Sheet 2.

J. J. WOOD.

RESISTANCE COIL.

No. 507,345.

Patented Oct. 24, 1893.

FIG. 4.

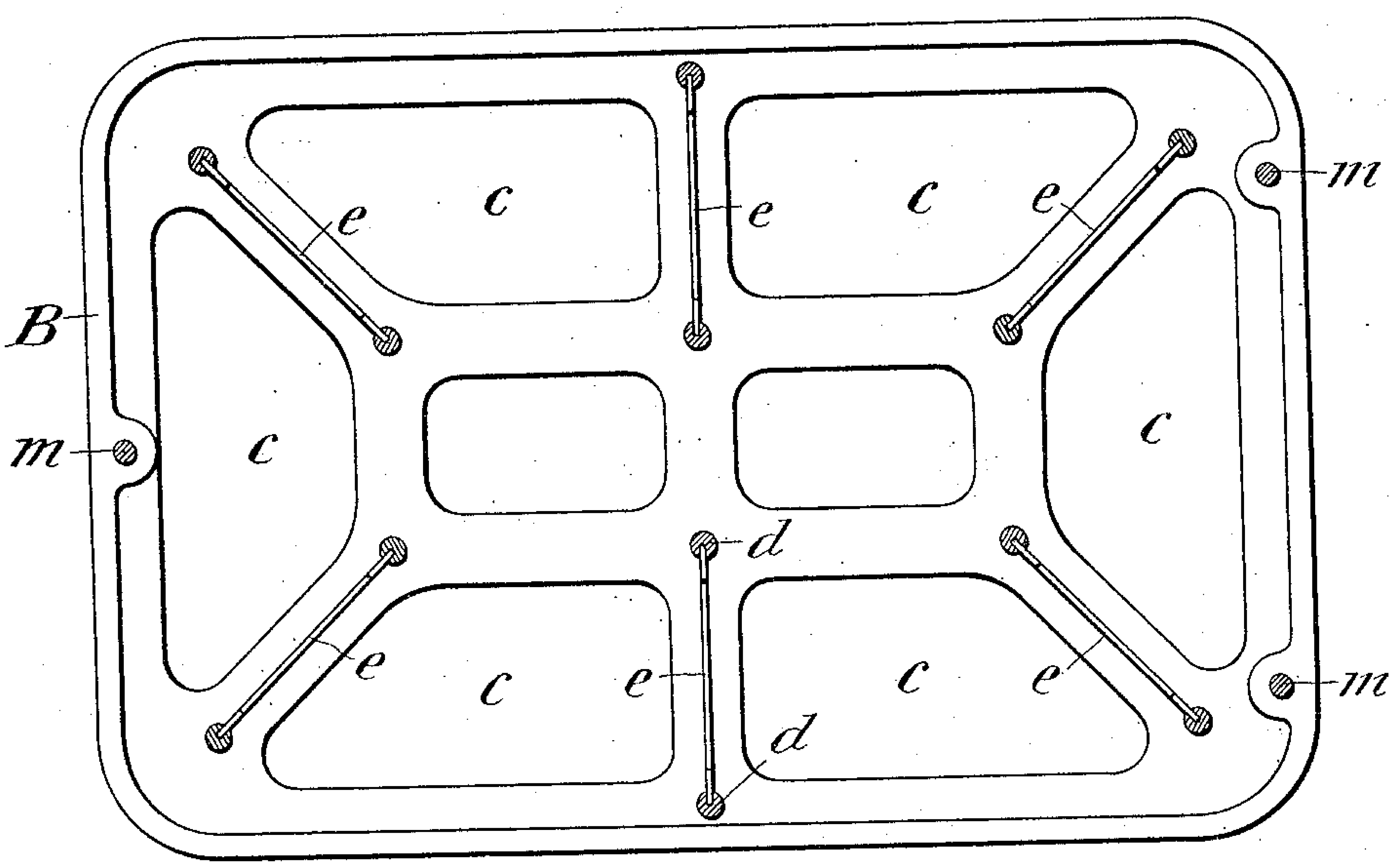


FIG. 5.

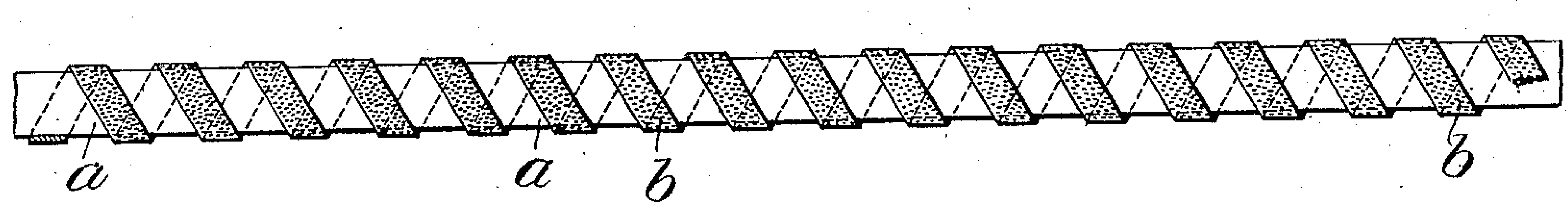


FIG. 6.

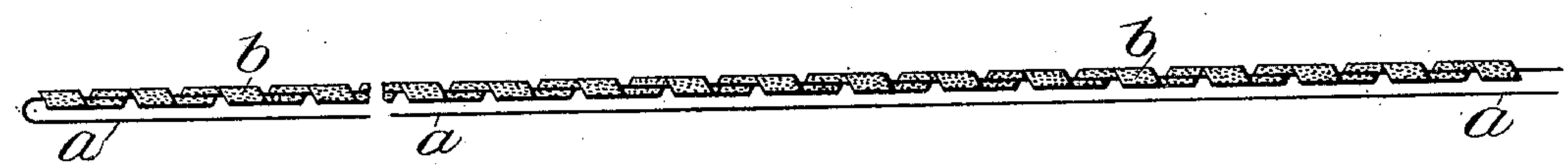


FIG. 11.

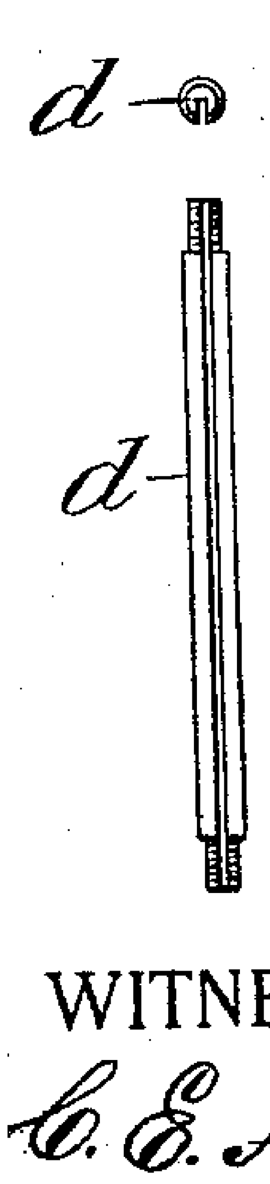


FIG. 7.

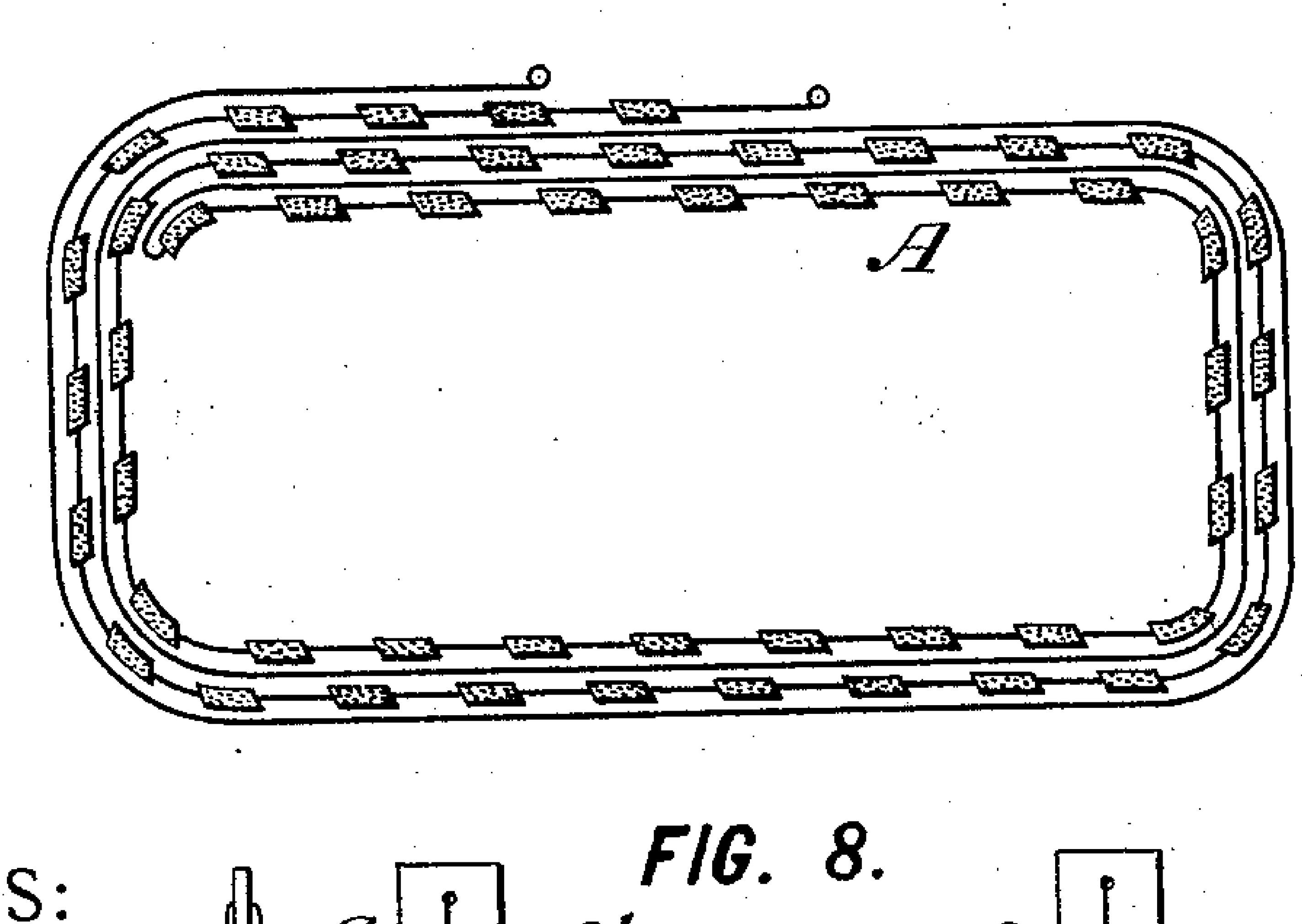


FIG. 12.

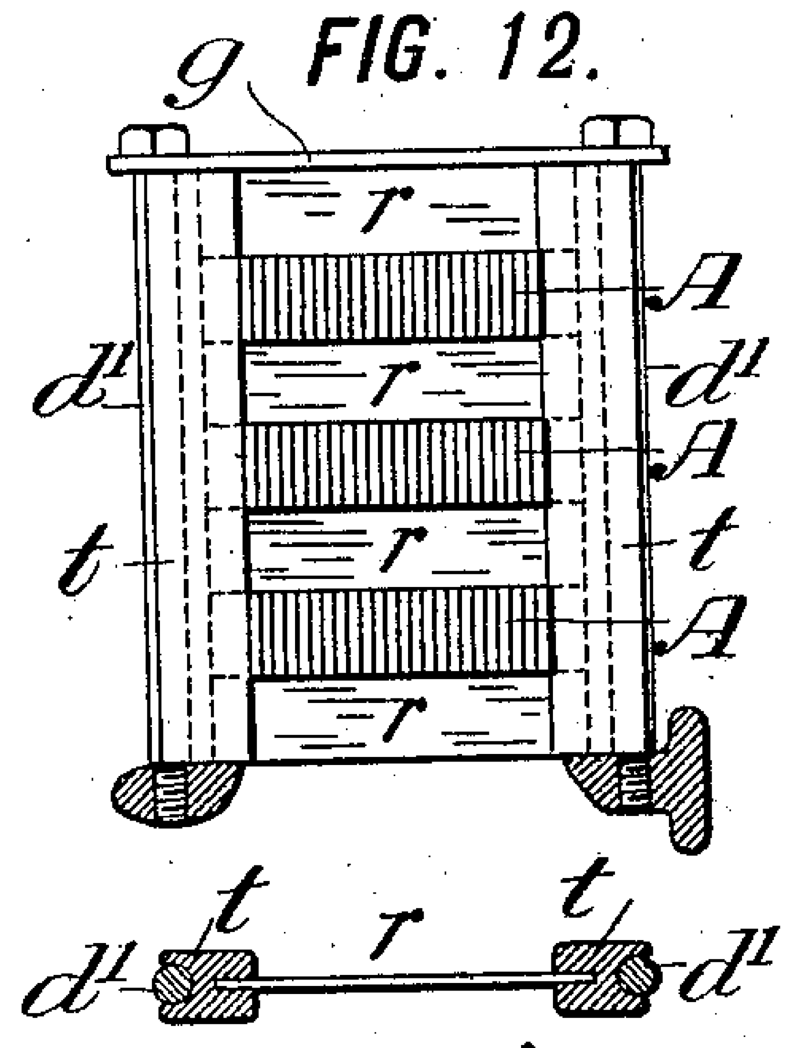
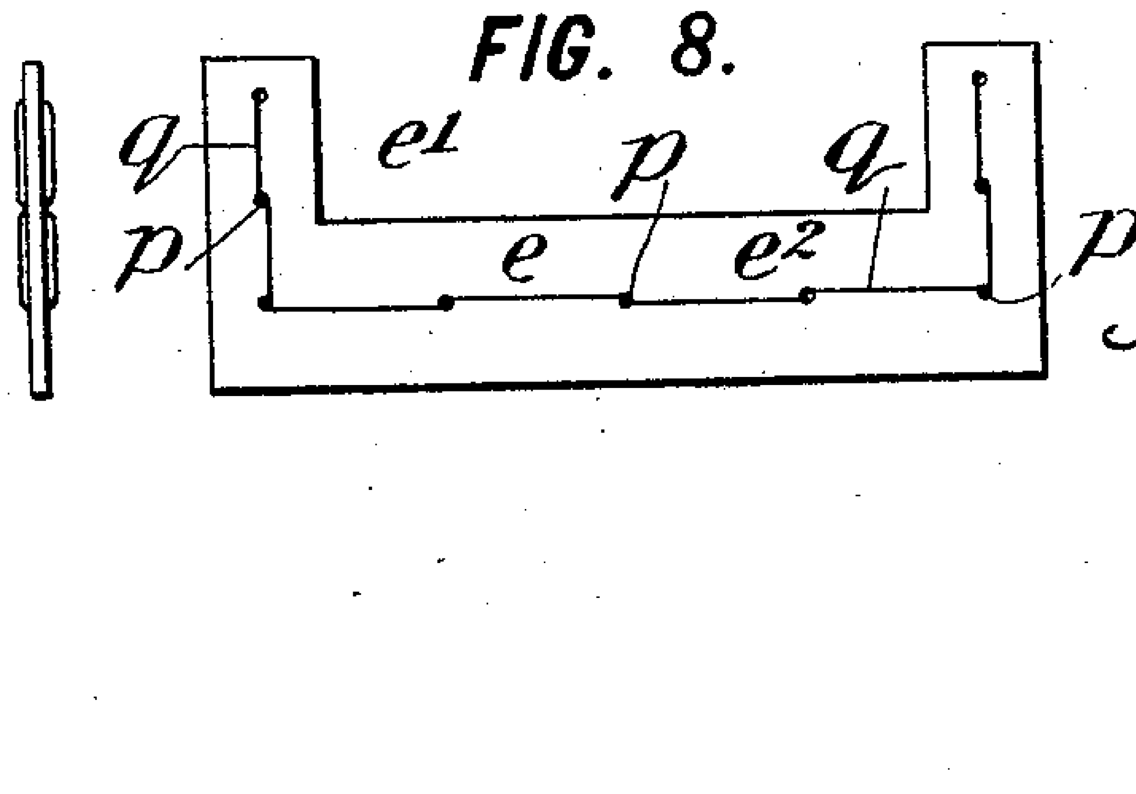


FIG. 8.



WITNESSES:

C. E. Ashley

H. W. Lloyd.

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co.

UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

RESISTANCE-COIL.

SPECIFICATION forming part of Letters Patent No. 507,345, dated October 24, 1893.

Application filed June 30, 1893. Serial No. 479,221. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Resistance-Coils, of which the following is a specification.

This invention provides an improved construction of resistance coils for carrying heavy currents, adapted especially to non-inductive resistances for alternating currents.

Although applicable to other uses, my improved coil has been designed particularly for the resistance shunt between the commutator brushes that is used with compound wound alternating dynamos.

My improved resistance consists in a general sense of one, two or more flat coils supported at intervals between recessed insulating plates which themselves are firmly mounted in sockets in a bearing frame. The flat coil is made by taking a tape or ribbon of suitable metal, preferably German silver, and winding one half its length with an open spiral of insulating material, preferably asbestus tape, then doubling the metal tape upon itself at the middle and coiling it into a flat coil, the insulating winding serving to keep the juxtaposed convolutions out of contact with one another.

The preferred construction of my new resistance is shown in the accompanying drawings, wherein—

Figure 1 is a plan. Fig. 2 is a side elevation. Fig. 3 is a transverse section on the line 3—3 in Fig. 1. Fig. 4 is a plan of the supporting frame with the coil removed, the uprights of the frame being in horizontal section on the line 4—4 in Fig. 3. Fig. 5 shows a fragment of the metal tape with its winding of insulating tape. Fig. 6 is an edge view of the metal tape doubled upon itself, showing its one half wound with insulating material and its other half naked. Fig. 7 is a plan of the same tape showing it wound into a flat coil, this view being somewhat diagrammatic since the coil is shown wound more openly and with fewer convolutions than the complete coil shown in Fig. 1. Fig. 8 includes a front and edge view of one of the recessed insulating plates of mica for supporting the flat coil. Fig. 9 shows the two mica plates *e f* in perspective. Fig. 10 is a plan of one of the top plates *g*. Fig. 11 shows one of the rods *d* removed. Fig. 12 shows a modification of the insulating plates.

To make a non-inductive resistance coil for alternating currents, I proceed according to my invention preferably as follows: I take a ribbon or tape of German silver of a width and thickness and length that are determined by calculation according to the current to be passed through the resistance, as determined by formula well known to electricians. As an example I will mention a tape sixty feet long, five-eighths inch wide, and .006 inch thick. I wind one-half the length of this tape or ribbon with an open spiral of insulating material, as for example with asbestus of suitable dimensions, naming for example a tape three-eighths inch wide by one-sixteenth inch thick. This is wound spirally in the manner shown in Fig. 5, where *a* is the metal tape or ribbon and *b* is the insulating winding. The spiral insulating winding is made very open in order to leave ample air spaces between the successive convolutions of the insulating spiral. After winding one-half of the metal tape in this manner, it is then doubled upon itself in the middle as shown in Fig. 6, so that it constitutes in effect two parallel metal tapes, one of which is wound with the insulating spiral, and both of which are electrically joined or connected at one end, that is to say, at the point where the tape is doubled upon itself. An obvious modification would consist in taking two wholly distinct tapes, winding one with an insulating winding, and soldering or otherwise joining the other one to it. The double metal tape is then coiled upon itself so as to form a flat coil, which is illustrated in a somewhat diagrammatic manner in Fig. 7, the coil usually containing many more convolutions than that shown, and the tapes being drawn more closely against each other. In so coiling the tapes, the naked tape is confined between two insulated tapes on opposite sides, so that it is protected from coming into contact with either of the adjoining tapes and thereby short-circuiting the coil. The spiral insulating winding by reason of its open nature provides open spaces for circulation of air at frequent intervals, in order that the heat which is disengaged in the coil may be readily conducted away by the air which will circulate upwardly through these spaces as it is heated from the coil. To make the circulation most effective, the coil is arranged horizontally flatwise with its component metal tape arranged edgewise or in vertical planes.

The flat coil constructed as already described is lettered A. Ordinarly a plurality of these coils are employed, and they are mounted one above another in the manner shown in Figs. 2 and 3. For the proper support of these coils at suitable distances apart, and so that they shall be thoroughly insulated by heat resisting insulation, I provide a supporting frame and recessed insulating plates of mica which I will now describe.

A metal base-plate B, preferably of the shape shown in Fig. 4, with ventilating openings *c c* through it, has screwed into it at proper intervals a series of pairs of upright pins or screw rods *d d*, which project up for a greater or less height depending upon the number of coils A A that are to be supported upon the frame. The pairs of rods *d* are arranged at suitable intervals, and the two rods of each pair are set somewhat wider apart than the width of the flat coil between its inner and outer convolutions. The several rods *d* are grooved from end to end, (see Fig. 11) and each rod is so turned that its groove shall be presented toward the other rod of the same pair. Preferably the two rods of each pair are set at equal distances from each other. A series of recessed insulating plates *e* of mica or other suitable insulating material are provided of the construction shown in Fig. 8. Each plate is of just sufficient length so that its opposite ends may fit into the grooves in the rods *d* of one pair, as shown in Fig. 4. Each plate is provided with a recess *e′* of just sufficient length and height to receive within it the corresponding portion of the coil A. Each plate *e* is made wide enough so that its portion e^2 below this recess equals in width the desired spacing between the coils A A. In the construction shown there are six pairs of rods *d*, and accordingly six insulating plates *e* are slid down with their ends inthe grooves of the rods until their bottomsrest upon the top surface of the base-plate B. The first or lowest coil A is then placed in position in the recesses *e′* of the several insulating plates, whereby the coil is properly confined in place and is properly supported at suitable intervals by proper insulations of fireproof material. Another set of insulating plates *e* is then slid into the grooves in the rods and pressed down close against the top of this lowest coil, so that the coil is confined in place between the insulating plates below it and those immediately above it, as shown in Fig. 3. A second coil A is then inserted in the recesses of this upper or second set of insulating plates. A third set of insulating plates *e* is then put in place on top of this second coil A (if a third coil A is to be applied), this operation being continued until all the coils A that are desired to be mounted have been thus put in place. On top of the upper coil A is placed a series of plates *f*, as shown in Fig. 3, these plates being of the same length as the plates *e*, but without any recess *e′* in the top thereof, being in fact mere plain rectangular plates of suitable length and width (see Fig. 9). Then to hold the several insulating plates carried between each pair of rods firmly in position, as well as to prevent any spreading of the rods, a metal plate *g* (Fig. 10) is applied to each pair of rods, these plates having holes in their opposite ends which slip over the upper ends of the rods, and on the protruding ends of the rods, which are screwthreaded, and screwed nuts *h* which clamp the plates *g* firmly down in place on top of the insulating plates *f*. By means of this construction any number of coils A can be mounted in the same frame, using the same base-plate B, and without alteration of the insulating plates *e f* or metal top plates *g* or nuts *h*, the only change required being that the screwthreaded rods *d* shall be made appropriate in length.

It remains now to describe the several electrical connections. The electric terminals of the entire resistance consist of binding posts C C′ which are mounted preferably above the coils. They are preferably mounted on a plate *i* of insulating material, such as marble or porcelain, which is supported by being fastened at its opposite ends to inward prolongations *g′* of the corner plates *g*, which to the extent of these prolongations are longer than the other plates. To the binding post C is soldered or otherwise secured a metal rod or wire *j* which extends to one side beyond the coils A A, as shown in Fig. 1, and thence extends downward as shown in Fig. 2, and terminates opposite the uppermost coil A, its end being soldered to one end of the German silver tape of this coil. The opposite end of the tape of this same coil is similarly united to another conducting wire or rod *k*, which extends thence downward and its opposite end is soldered to one of the ends of the German silver tape of the next coil A beneath, as shown in Fig. 2. The opposite end of this intermediate coil is similarly soldered to another wire or rod *k′*, which extends thence downward to the lowermost coil A, being soldered to one end of the tape thereof. The opposite end of the tape of this last coil is soldered to the end of a wire or rod *j′*, which is a counterpart of the wire *j* except that it extends farther down. The upper end of this wire *j′* is soldered or otherwise united to the binding post C′, whereby the circuit is completed between the two binding posts. All the connections with the wires *j k j′ k′* are preferably made by rolling the end of the metal tape into an eye or socket, into which the end of the rod is thrust and then soldered.

For conveniently and firmly supporting the entire resistance on the frame of a dynamo or in any other analogous location wherever opposite parallel bars or supporting ledges are formed between which the resistance can be placed, I provide the base-plate B with upwardly projecting hooks *m m*, the hooked ends of which are turned outwardly as shown best in Fig. 2, so as to engage and hook over the parallel bars shown in dotted lines at D D in this figure. The hooks *m* are made to screw into the base-plate B, or are otherwise swiveled thereto so that they can be turned, in order that when the resistance has to be passed up from beneath between the parallel bars D D the hooks *m* may first be turned inwardly or parallel with the ends of the base-plate until after the resistance has been brought up to a little above the required position, whereupon they are to be turned outwardly, as shown, and then by dropping the resistance down they will rest upon the bars. To make a firm seat I prefer to employ one hook *m* at one end and two hooks at the opposite end. To insulate the frame of the resistance coil from the frame of the dynamo, I prefer to form the hooks *m* with insulating coverings *n*, as shown in Fig. 2, at the points where they come in contact with or rest upon the bars or ledges of the frame. These insulating coverings may consist of a soft rubber tube drawn over the hooked end of the respective hooks.

In using mica for the plates *e f*, I have found that the thin leaves or laminæ of which it is composed are liable to be split apart in shaping or preparing it. To overcome this difficulty, I form the plates at short intervals with holes *p* through them, and through these holes I pass a fine wire *q*, preferably a soft copper wire, sewing or weaving it back and forth through the holes in such manner as to tie the several laminæ closely together and prevent the separation of the mica plate into its component leaves. This wire *q* does not affect the insulating properties of the supporting plates, and is not itself heated by induction, since it extends in such direction that it is not affected thereby.

My invention is susceptible of considerable modification without departing from its essential features. For example, the insulating plates *e f* may be made of other material than mica, as for example of molded porcelain or annealed glass, which for better ventilation should be brought to an edge where they touch against the resistance coils. Mica, however, is preferable because it is not affected by heat, and by being made in thin plates set vertically, it offers the least obstruction in the upward currents of air. Although it is preferable to employ plates of insulating material cut out on their upper sides to form recesses *e'* into which the resistance coils may be dropped, yet these recesses are not wholly essential, since the spaces for receiving the coils may be otherwise provided, as for example by the construction shown in Fig. 12, which corresponds to one side or half of Fig. 3, the sketch beneath it showing the construction in horizontal section. In this construction the vertical pins or rods, here lettered *d'*, are not grooved, and against them fit grooved uprights of insulating material, porcelain for example, lettered *t t*, which have grooves on one side engaging the upright pins, and on their opposite sides have deeper grooves in which are thrust the ends of mica or other insulating strips *r r*. The upright insulators *t* being first set in position, a strip *r* has its ends entered into their grooves and is pressed between them to the bottom; the first coil A is then dropped down into place on this strip. A second strip *r* is then applied (this being done of course at all the insulating supports), and a second coil A is then put in place; these operations being repeated until all the coils A that are desired have been put in place, whereupon a strip *r* is applied on top of the upper coil, and the plate *g* (Fig. 10) is applied on top of this to hold the strips down. In this way recesses are formed for inclosing the coils without the formation of any recesses in the individual insulating plates. But the construction first described is much to be preferred. The modification thus illustrated shows that the opposite grooves may be formed in the insulating plates instead of in the rods or pins *d* of the frame. Many other analogous changes of detail may be employed in place of the precise details shown.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. A resistance coil consisting of two parallel metal tapes, one of them wound with an open spiral of insulating material, and the two coiled together into a flat coil.

2. A non-inductive resistance coil consisting of two parallel metal tapes connected together at one end, and connected to the terminals at their other ends, one of them wound with a spiral of insulating material, and the two coiled together into a flat coil.

3. A resistance coil consisting of a metal tape wound for half its length with an insulating spiral, doubled upon itself at its middle, and then coiled into a flat coil.

4. A flat coil combined with insulating plates at intervals, set edgewise and holding the coil, and a frame for supporting said plates.

5. A flat coil combined with pairs of insulating plates at intervals, having recesses to receive the coil, and the plates of each pair inclosing the coil between them, and a frame for supporting said plates.

6. A flat coil combined with insulating plates at intervals, set edgewise and embracing the coil, and a frame constructed with opposite guides receiving the ends of said plates, whereby the plates are held in position.

7. A flat coil combined with insulating plates at intervals for supporting it, and a frame having pairs of grooved rods at inter-

vals with their grooves engaging the ends of the respective plates.

8. A plurality of flat coils arranged one above another, combined with superposed insulating plates arranged at intervals, having recesses to receive the coils, and a frame for supporting said plates formed with upright grooves receiving the ends of the respective superposed plates.

9. A plurality of flat coils arranged one above another, combined with superposed insulating plates arranged at intervals, said plates formed with recesses in their upper portions to receive the coils, with each recess closed on its upper side by the bottom of the plate above it, and a frame for supporting said plates.

10. The combination with coils A A of base-plate B, pairs of grooved rods *d d* projecting therefrom, insulating plates *e e* with their ends confined in the grooves in said rods and formed with recesses receiving said coils, insulating plates *f f* over the topmost coil, and plates *g g* applied over the upper insulating plates and having holes engaging the upper ends of the rods and fastened thereto, whereby the insulating plates are held in place.

11. The combination with coils A A, base-plate B, pairs of grooved rods *d d*, insulating plates *e e f* for supporting and confining the coils, top plates *g* fastened to the rods, insulating plate *i* mounted on said top plates, and binding posts C C′ supported on said plate *i*.

12. The combination with coils A A of binding posts C C′ and conducting rods *j j′* leading therefrom and terminating opposite the upper and lower coils and joined to one end of the respective coils, and the opposite ends of said coils connected together through intermediate electrical connectors extending from coil to coil.

13. A resistance coil having a supporting frame, and hooked rods having a rotative engagement with said frame, so that by turning them their hooks may be turned out to overhang beyond the frame or turned in within the frame, whereby the frame may be suspended between opposite parallel bars or ledges.

14. The combination with a flat coil, of mica insulating plates for supporting it, pierced with holes at intervals, and wired through these holes to prevent separation of the mica laminæ.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
ARTHUR C. FRASER,
GEORGE H. FRASER.