

E. N. LIGHTFOOT.  
RESISTANCE UNIT.  
APPLICATION FILED MAY 4, 1908.

947,247.

Patented Jan. 25, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

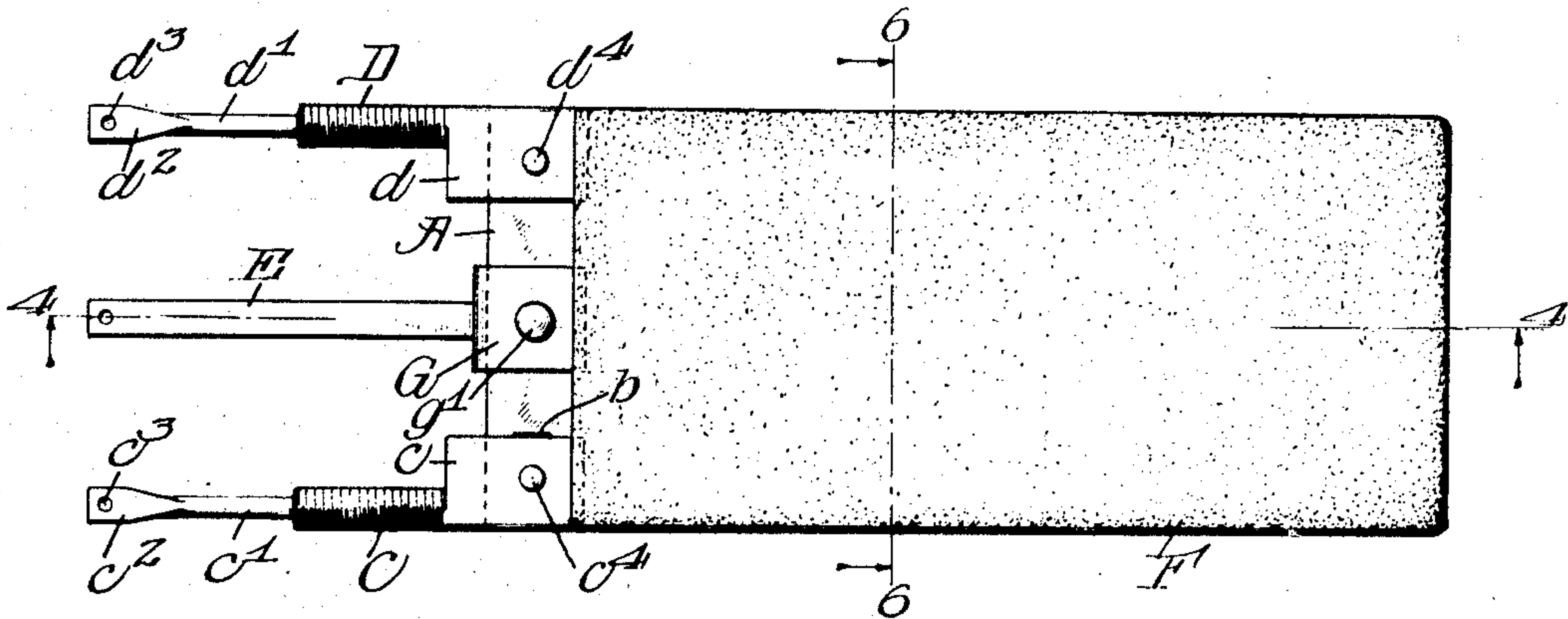


Fig. 2.

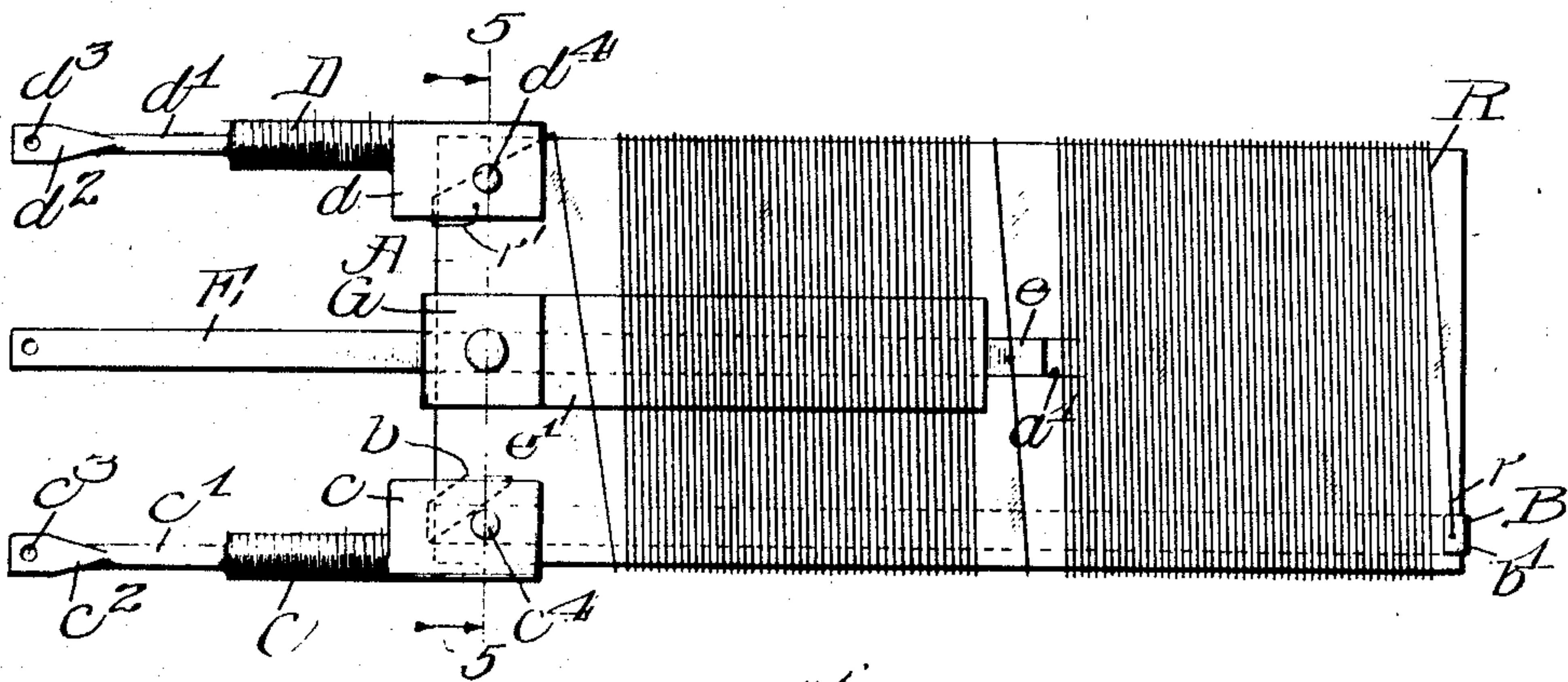
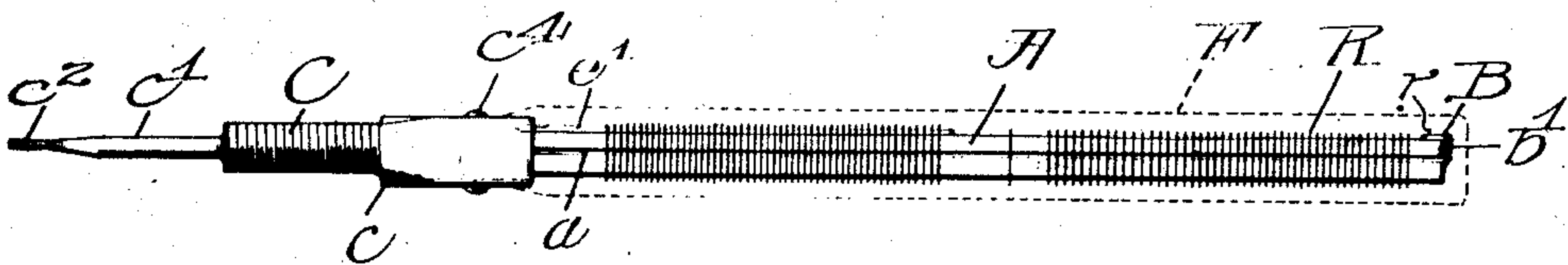


Fig. 3.



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2 SHEETS—SHEET 2.

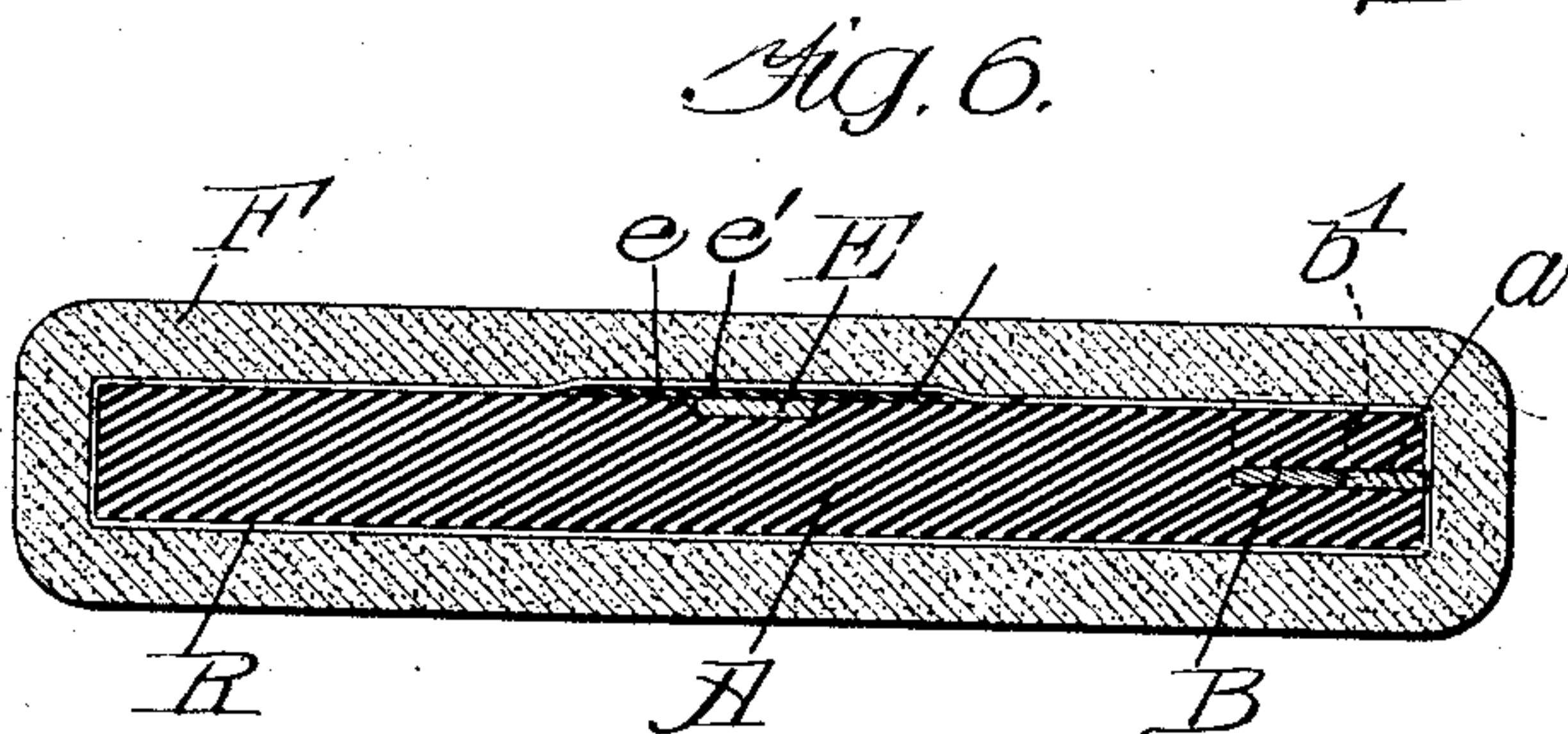
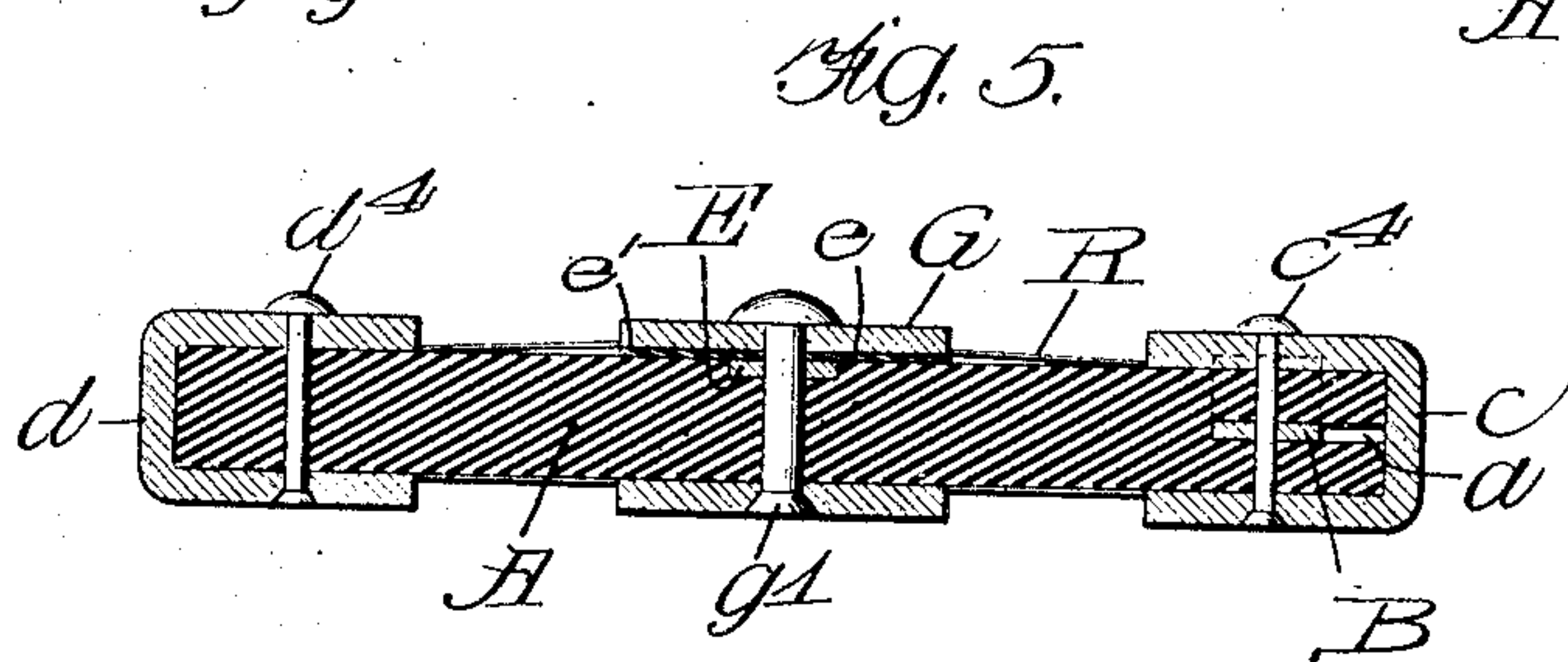
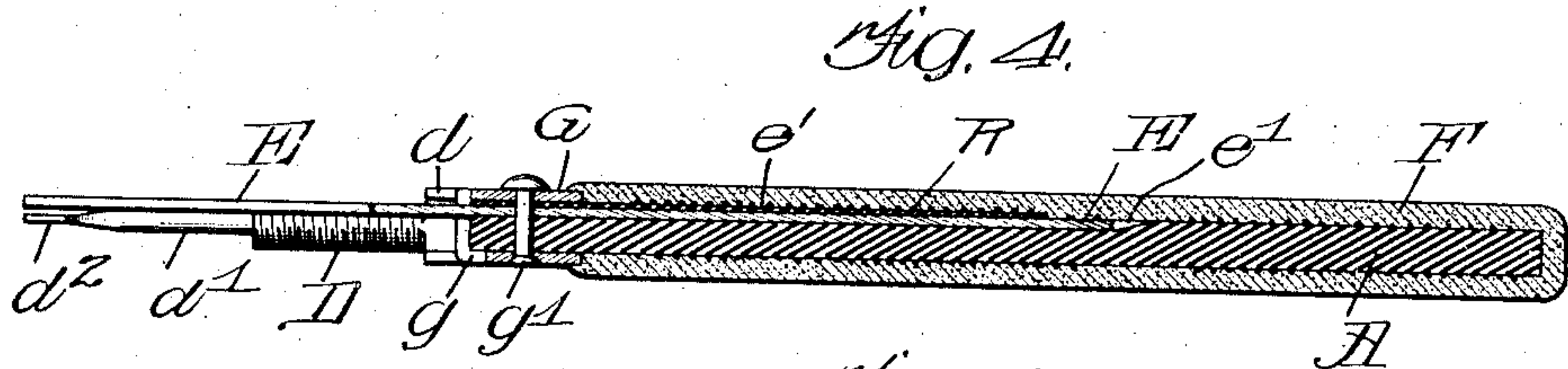


Fig. 7.

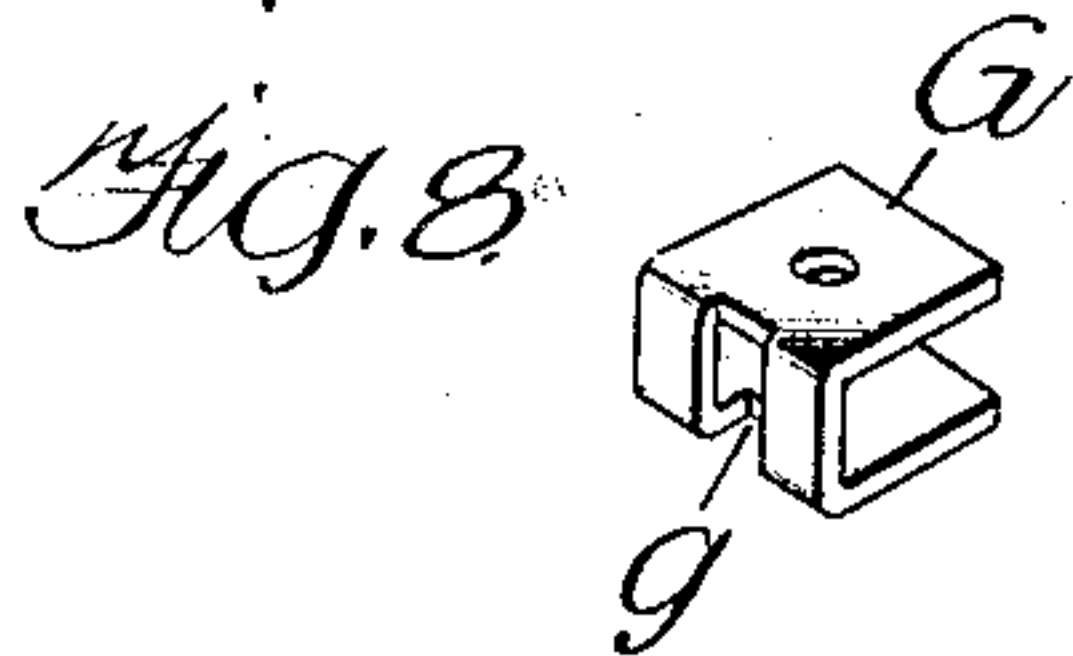
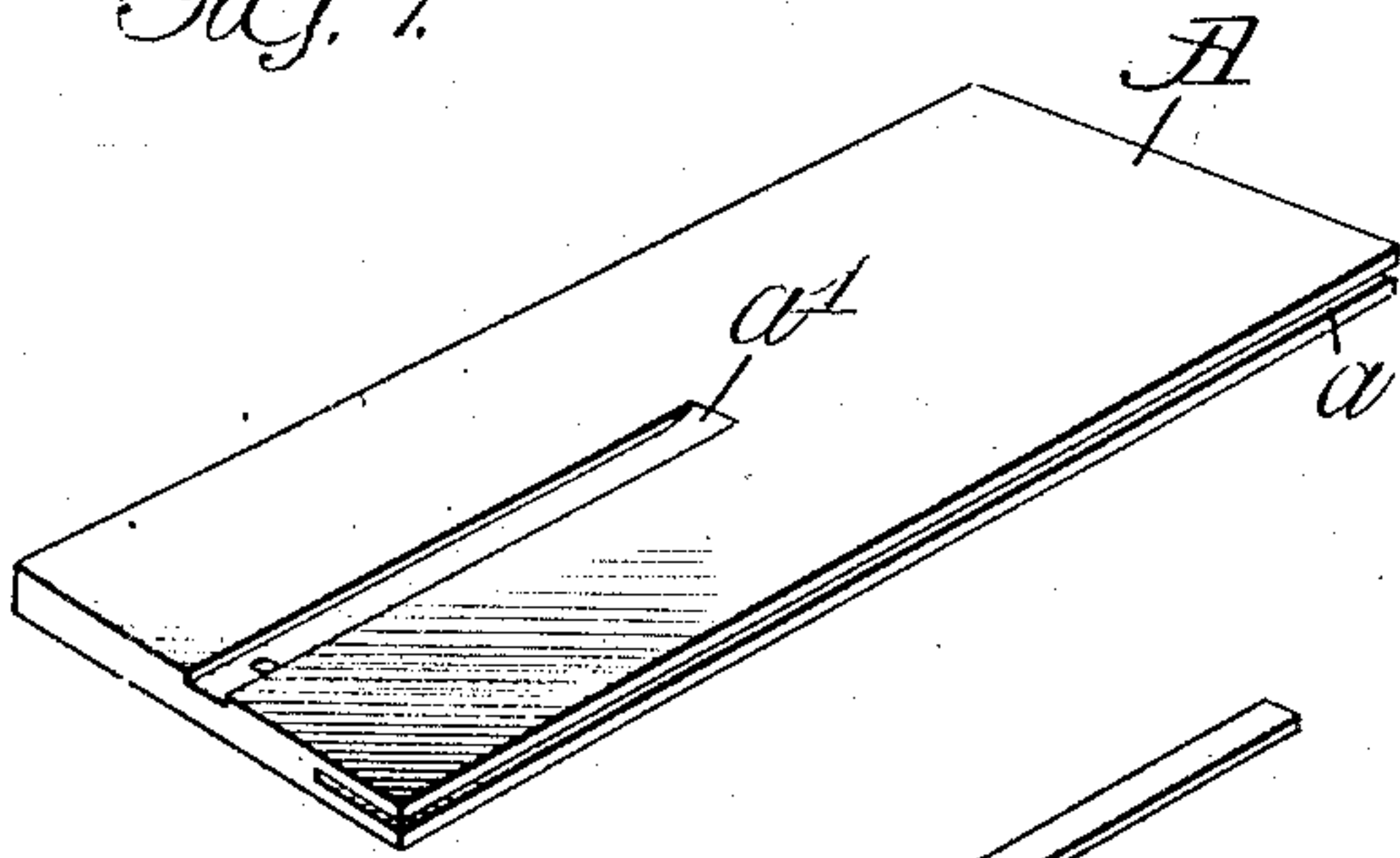


Fig. 10.

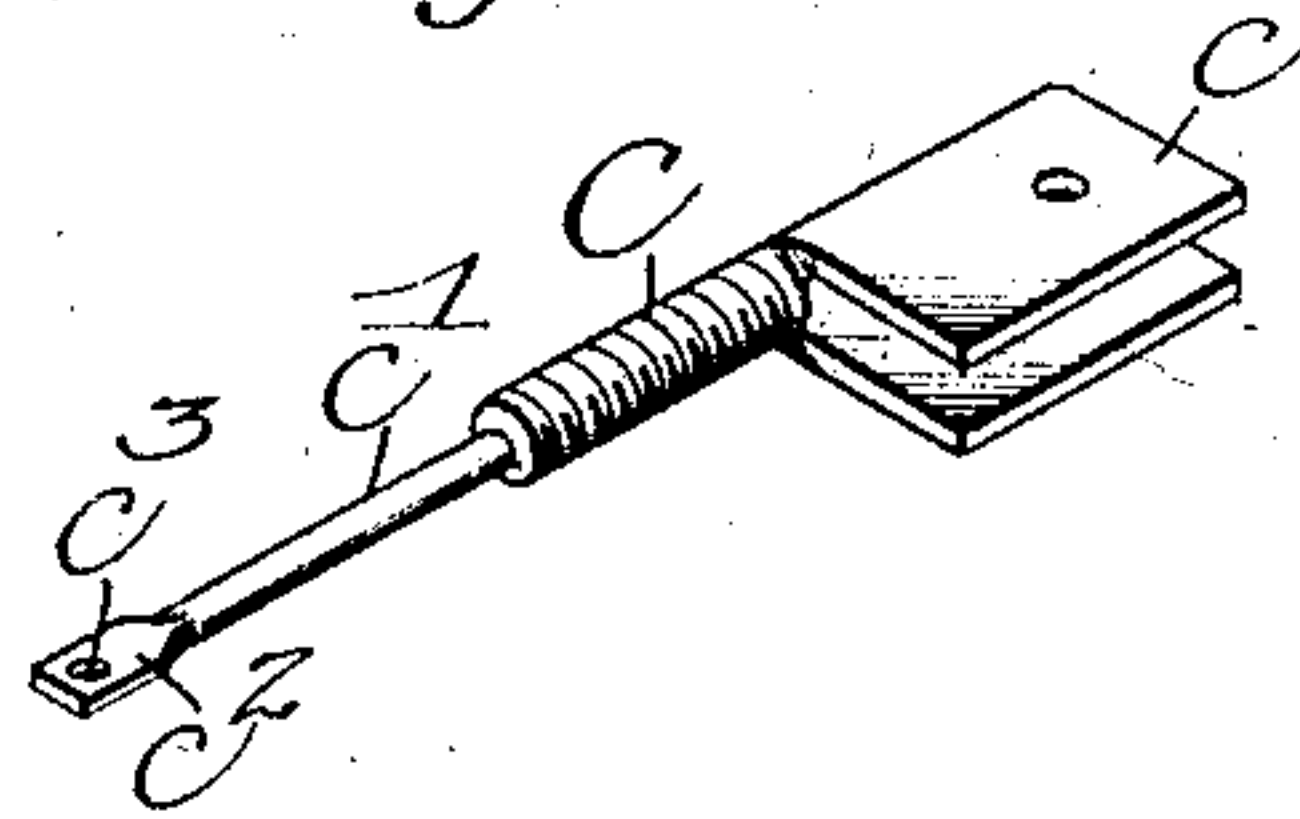


Fig. 9.

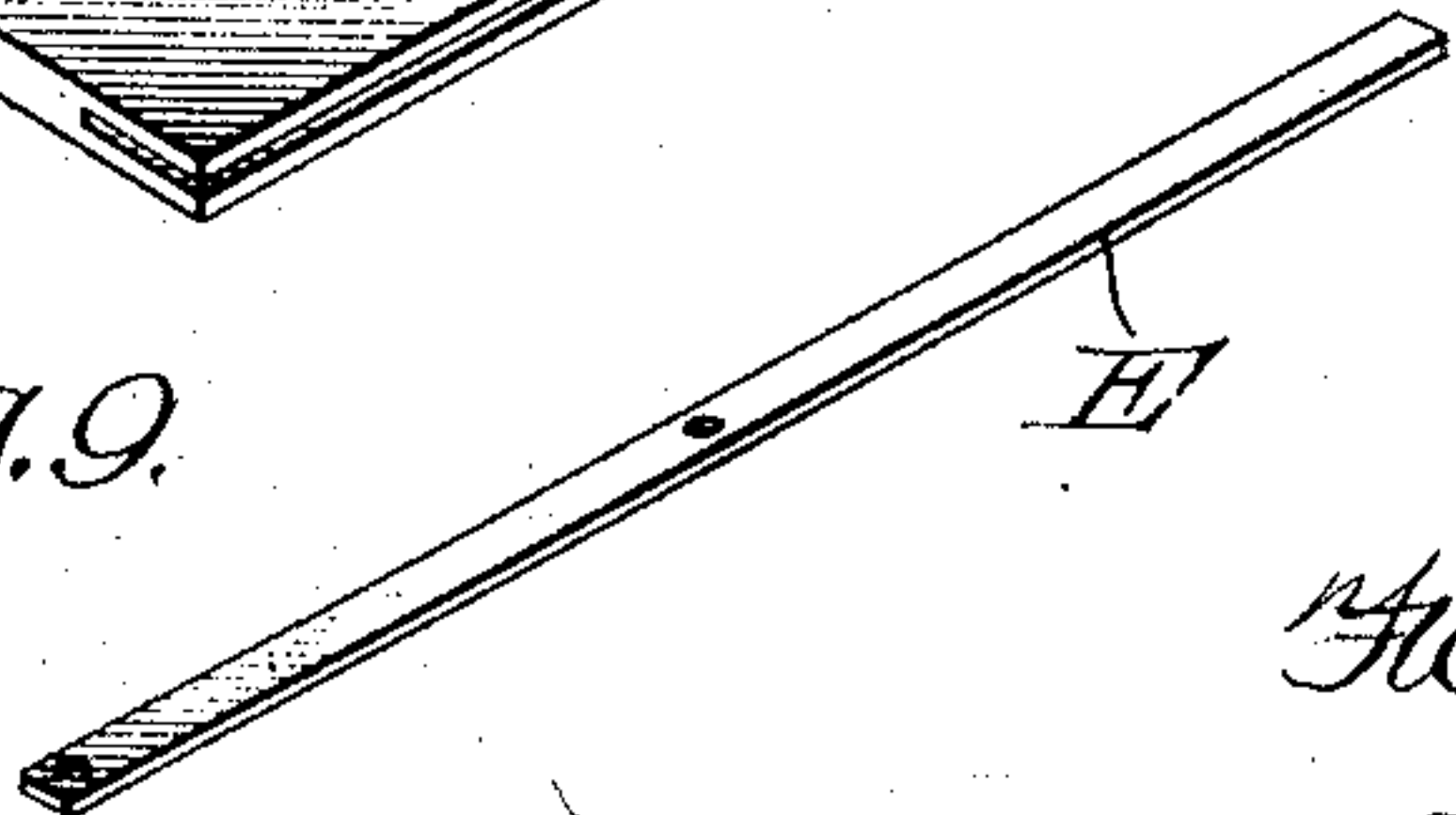
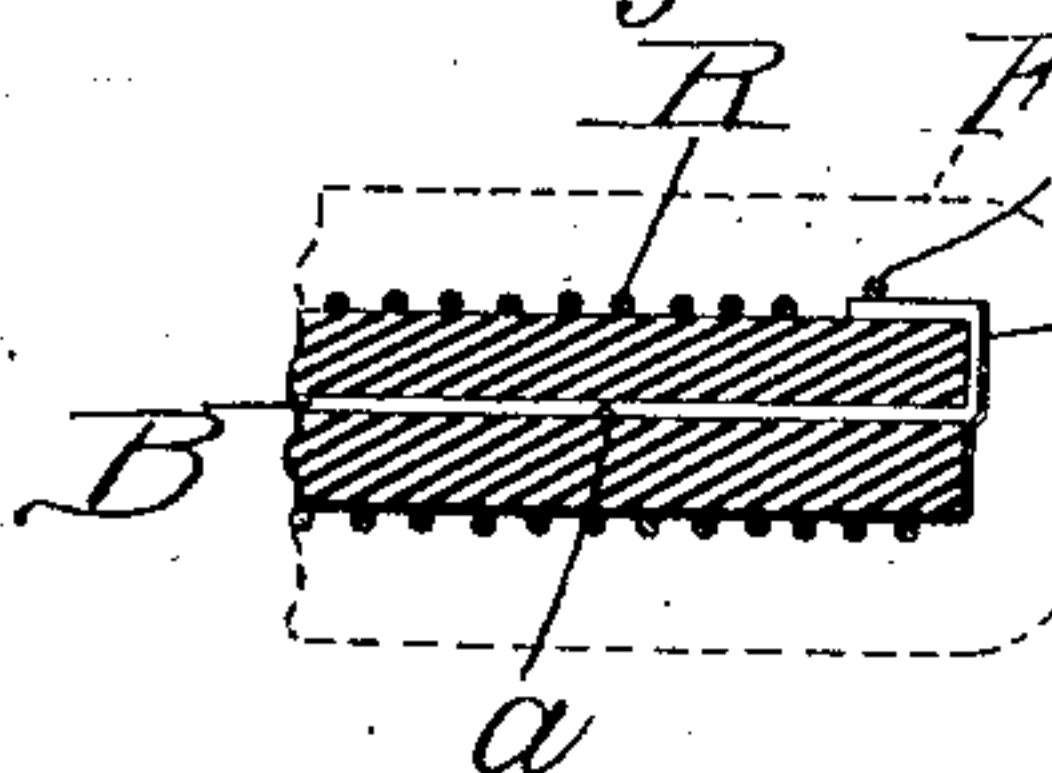


Fig. 11.



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# UNITED STATES PATENT OFFICE.

EDWIN N. LIGHTFOOT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

## RESISTANCE UNIT.

947,247.

Specification of Letters Patent.

Patented Jan. 25, 1910.

Application filed May 4, 1908. Serial No. 430,841.

*To all whom it may concern:*

Be it known that I, EDWIN N. LIGHTFOOT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Resistance Units, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to electrical resistances.

More particularly it relates to resistance units of the type used in telephone systems, but it should be understood that my invention is not limited to resistances used in such service.

One object of my invention is to provide a resistance unit constructed entirely of non-combustible material.

A further object is to provide a unit of such construction that a maximum number of the same may be mounted in a given space.

A further object is to provide a unit of a given size with the largest possible winding space to secure the maximum amount of resistance.

A further object is to provide means for dividing the resistance of each unit into steps.

According to the preferred form of my invention the resistance comprises a wire wound on a base of non-combustible insulating material carrying suitable terminals to which the resistance is electrically connected, the entire unit with the exception of the terminals being inclosed in a non-conducting fire-proof casing.

In order that my invention may be more clearly understood, I have illustrated, in the accompanying drawings, one embodiment thereof.

In the accompanying drawings—Figure 1 is a plan view of a resistance unit constructed in accordance with my invention. Fig. 2 is a view similar to Fig. 1, but showing the resistance unit with the casing removed. Fig. 3 is a side elevation of Fig. 2. Fig. 4 is a section taken on line 4—4 Fig. 1. Fig. 5 is a section taken on line 5—5 Fig. 2. Fig. 6 is a sectional view taken on line 6—6 Fig. 1. Figs. 7, 8, 9 and 10 are detailed views of parts of the unit. Fig. 11 is an enlarged de-

tailed view of a portion of Fig. 3 showing the resistance coil in sections.

Referring to the construction illustrated in the drawing, the several parts thereof are mounted upon a base A, best illustrated in Fig. 7. The base comprises a thin rectangular strip of non-combustible and non-conducting material such as asbestos board, porcelain or soapstone, but in practice I prefer to use the former. It should be understood that the size and shape of the base may be varied as desired and that any suitable material may be employed therefor. Two recesses *a* and *a'* are formed in the base, the former extending the entire length thereof, and the latter about half the length thereof. These recesses are preferably located as illustrated in the drawing, but the location thereof may be changed as desired. The recess *a* is provided to receive a conducting strip B and is of greater depth than the width of the strip for the purpose hereinafter set forth. The strip B has its ends turned back onto the outside of the base.

Secured to one end of the base, at opposite sides thereof, are terminals C and D. The terminal C comprises a bifurcated portion *c*, and an elongated portion *c'*, partially screw-threaded, and provided at its extremity with a flattened portion *c''*, through which extends an orifice *c'''*. The terminal D is similar in construction and comprises a bifurcated portion *d* and an elongated portion *d'*, partially screw-threaded and provided at its extremity with a flattened portion *d''*, through which extends an orifice *d'''*. The bifurcated portions of these terminals are adapted to clamp onto the base and are secured thereto by pins or rivets *c''''* and *d''''*. As will be hereinafter explained, the screw-threaded portions of the terminals C and D provide means by which the units are secured to a supporting panel. The bifurcated portion *c* of the terminal C is electrically connected to the end *b* of the strip B, the connection being made in any suitable manner, as by soldering the same together. The pin or rivet *c''''* also passes through the strip B and serves to retain the same against the rear wall of the recess *a* and out of contact with turns of the resistance. The slot *a'* is provided to receive one end of a terminal or conducting strip E, while the other end of said strip projects beyond the base to a point even with the ends of the terminals C and D. The



strip E is preferably of the same thickness as the depth of the slot  $a'$ , so that its upper face will lie flush with the surface of the base. A thin sheet of insulating material  $e'$ , such as mica, is placed over the recess  $a'$ , but is arranged to leave the extremity  $e$  of the strip E exposed. A bifurcated clip G having an opening  $g$  therein, through which the strip E projects is clamped onto the base over said strip. A pin or rivet  $g'$  serves to secure said clip, and the strip E to the base.

The resistance R preferably comprises a fine wire wound around the base A transversely thereof, and in such a manner that only one turn of wire passes over the exposed end  $e$  of the strip E, and this turn is soldered or otherwise electrically connected thereto. The terminal  $r$  of the resistance is soldered or otherwise electrically connected to the end  $b'$  of the conducting strip B, while the terminal  $r'$  of the resistance is soldered or otherwise electrically connected to the terminal D. It will thus be seen that the terminals C and D are connected to opposite ends of the resistance coil R, the terminal C being connected thereto through the strip B, while the terminal E affords means for dividing the resistance into two steps. While I have shown the resistance divided into two steps it should be understood that the terminal E may be dispensed with if desired, or the resistance may be divided into a greater number of steps by merely providing additional terminals similar to the terminal E and connecting the same to the resistance at different points. Resistances of this type are frequently mounted side by side in rows on the rear side of a supporting panel with their terminals extending through apertures formed in the supporting panel and projecting beyond the front face thereof. The units are secured to the supporting panel by nuts which are screwed onto the threaded portions of their terminals and bear against the face of the panel. This manner of mounting the units is well known and is, therefore, not illustrated. When the units are mounted as above described, it is desirable to place the same as close together as possible in order to reduce the side of the supporting panel. In order that the units may be placed in close proximity it is essential that some means be provided for insulating the same from one another and for preventing the jumping of an arc from one to another, in the event one of the units burns out, as otherwise an entire row of units might be destroyed upon the burning out of one of the same. To obviate this danger, and to insulate the units from one another I provide each unit with a fireproof insulating casing F which incloses all of the conducting parts thereof, with the exception of its terminals. This casing may assume any desirable form, but preferably comprises

a fireproof cement which will firmly adhere to the base and fill the spaces between the turns of the resistance, thus insulating the same from one another. The cement is preferably so applied as to fill up the recess  $a$ , as shown in Fig. 6, thus insulating the strip B from the turns of the resistance, but it should be understood that this is not essential, as the strip B is maintained at the rear of the recess out of contact with the resistance by the rivet  $c'$ . The cement may be applied in any practical manner, and may comprise any suitable ingredients. While I prefer to use cement for the casing, it should be understood that the casing may comprise any suitable material, and may be made detachable if desired. The casing may also be made waterproof if desired.

It will thus be seen that resistance units constructed in accordance with my invention occupy a very small space and that the same may be placed in very close proximity without danger, as they are well insulated and any arc caused by the burning out of one of the units would be quickly smothered within its casing and rendered harmless.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a resistance unit, the combination with a fireproof insulating base, of a resistance carried thereby, a pair of terminals mounted on one end of said base, one of said terminals being electrically connected to one end of said resistance and an insulated conducting strip interposed between said base and said resistance for connecting the other of said terminals to the opposite end of said resistance.
2. In a resistance unit, the combination with a fireproof insulating base, of a resistance wound thereon, a pair of terminals mounted on one end of said base, one of said terminals being electrically connected to one end of said resistance and a conducting strip connecting the other of said terminals with the opposite end of said resistance, said conducting strip being embedded in said base and maintained out of contact with the turns of said resistance.
3. In a resistance unit, the combination with a fireproof insulating base, of a resistance carried thereby, a pair of terminals mounted on said base and electrically connected to opposite ends of said resistance and another terminal carried by said base and connected to said resistance intermediate of its ends, said last mentioned terminal having an insulated portion interposed between said base and said resistance.
4. In a resistance unit, the combination with a fireproof insulating base, of a resistance wound thereon, of a plurality of terminals mounted on one end of said base, one of said terminals being electrically connect-



ed to one end of said resistance, another of said terminals being connected to said resistance intermediate of its ends and having a portion thereof embedded in said base and insulated from said resistance, and a conducting strip connecting another of said terminals to the opposite end of said resistance, said conducting strip being embedded in said base and maintained out of contact with the turns of said resistance.

5. In a resistance unit, the combination with a fireproof insulating base having longitudinally extending recesses formed therein, of a resistance wound on said base transversely thereof, a pair of terminals carried at one end of said base, one of said terminals being electrically connected to one end of said resistance, a conducting strip fitting in one of said recesses in said base for connecting the opposite end of said resistance to the other of said terminals, a third terminal having a portion thereof fitting in another of the said recesses in said base and electrically connected to said resistance intermediate of its ends, and means for maintaining said last mentioned terminal and said conducting strip out of contact with the turns of said resistance.

6. In a resistance unit, the combination with a fireproof insulating base, of a resistance carried thereby, terminals carried by said base and electrically connected to said resistance at different points, said terminals being adapted to support said base and a fireproof insulating casing inclosing the resistance bearing portion of said base.

7. In a resistance unit, the combination with a fireproof insulating base, of a resistance carried thereby, terminals mounted on one end of said base, one of said terminals being electrically connected to one end of said resistance, an insulated conducting strip connecting the opposite end of said resistance with the other of said terminals, and a fireproof insulating casing substantially inclosing said base, said resistance and said conducting strip.

8. In a resistance unit, the combination with a fireproof insulating base, of a resistance carried thereby, a plurality of terminals mounted on one end of said base, one of said terminals being electrically connected to one end of said resistance, another of said terminals being connected by an insulated portion to said resistance intermediate of its ends, an insulated conducting strip connecting another of said terminals to the opposite end of said resistance, and a fireproof insulating casing inclosing said base and all of the conducting parts except said terminals.

9. In a resistance unit, the combination with a fireproof insulating base, of a resistance wound transversely thereon, terminals mounted on one end of said base, one

of said terminals being electrically connected to one end of said resistance, a conducting strip embedded in said base out of contact with the turns of said resistance for connecting the opposite end of said resistance with the other of said terminals and a fireproof insulating casing inclosing said base and all of the conducting parts except said terminals.

10. In a resistance unit, the combination with a fireproof insulating base, of a resistance wound transversely thereon, terminals mounted on one end of said base, one of said terminals being electrically connected to one end of said resistance, a conducting strip embedded in said base out of contact with the turns of said resistance for connecting the opposite end of said resistance with the other of said terminals, another terminal connected to said resistance intermediate of the ends and having a portion embedded in said base and insulated from the turns of said resistance, and a fireproof insulating casing inclosing said base and all of the conducting parts except said terminals.

11. In a resistance unit, in combination, a non-combustible insulating base, a resistance mounted thereon, and terminals secured to said base and connected to said resistance at different points, said terminals being adapted to support said base.

12. In a resistance unit, in combination, a non-combustible insulating base, a resistance mounted thereon, terminals secured to said base and connected to said resistance at different points, and a cement covering substantially inclosing said base and said resistance and adhering to said base.

13. In a resistance unit, in combination, a flat elongated base formed of non-combustible insulating material, a resistance mounted thereon, terminals secured to one end of said base and connected to said resistance at different points, said terminals being adapted to support said base, and a cement covering substantially inclosing said base and said resistance, said cement covering being adapted to adhere to said base.

14. In a resistance unit, in combination, a non-combustible insulating base, a resistance wound thereon and elongated terminals, each having a bifurcated portion adapted to fit over an edge of said base, and to be rigidly secured thereto, said terminals being connected to said resistance at different points.

15. In a resistance unit, in combination, a non-combustible insulating base, a resistance wound thereon, terminals secured to said base at one end thereof, and electrically connected to said resistance at different points, certain of said terminals having extensions disposed between said base and said resistance, and means for maintaining said



extensions out of contact with said resistance, except at the points of connection therewith.

16. In a resistance unit, in combination,  
5 a non-combustible insulating base, a resistance wound thereon, terminals secured to said base at one end thereof and electrically connected to said resistance at different points, certain of said terminals having portions  
10 interposed between said base and said resistance, means for maintaining said portions of said terminals out of contact with said resistance, except at the points of connection therewith and a cement covering adhering  
15 to said base and substantially inclosing said base and said resistance.

17. In a resistance unit, in combination,  
a flat elongated base formed of non-combustible insulating material, a resistance wound  
20 thereon, terminals secured to one end of said base and connected to said resistance at different points, certain of said terminals hav-

ing portions disposed in recesses in said base, means for maintaining said portions of said terminals out of contact with said resistance, 25 except at the points of connection therewith and a cement covering adhering to said base and substantially inclosing said base and said resistance.

18. In a resistance unit, in combination, 30 a flat elongated base formed of non-combustible insulating material, a resistance wound thereon, terminals for said resistance, and a cement covering adhering to said base and substantially inclosing said base and said 35 resistance.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

EDWIN N. LIGHTFOOT.

Witnesses:

FRANK H. HUBBARD,  
S. W. FITZ GERALD.