(No Model.) 2 Sheets—Sheet 1.

A. O. BENECKE.

RESISTANCE BOX.

No. 511,286. Patented Dec. 19, 1893.

Fig. 1.

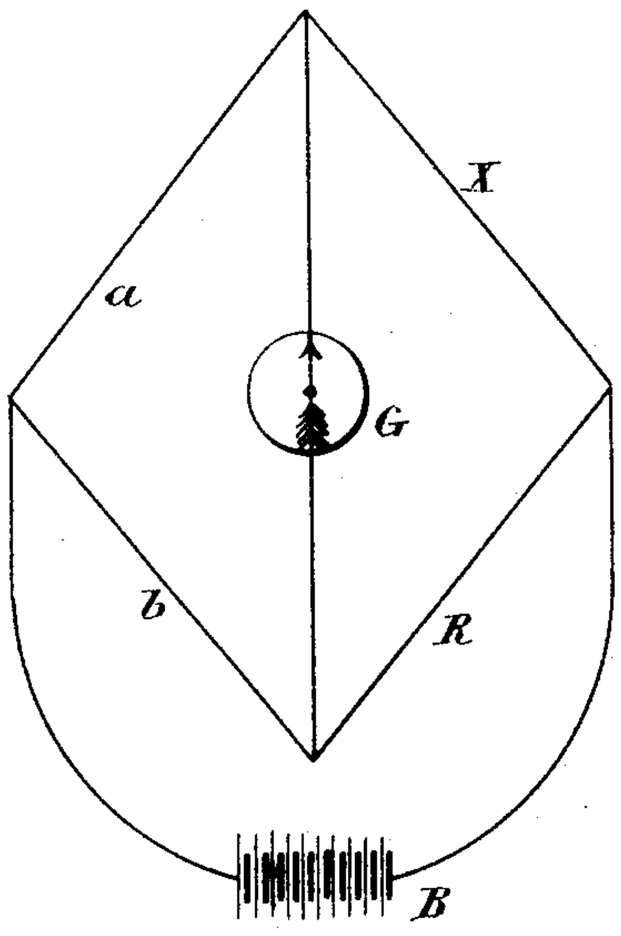
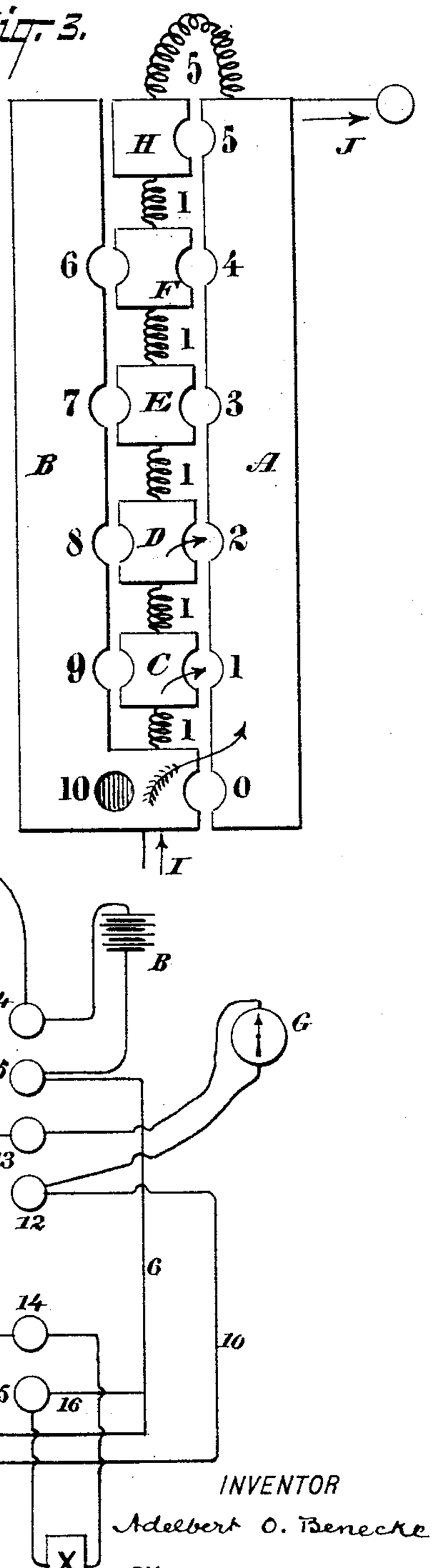
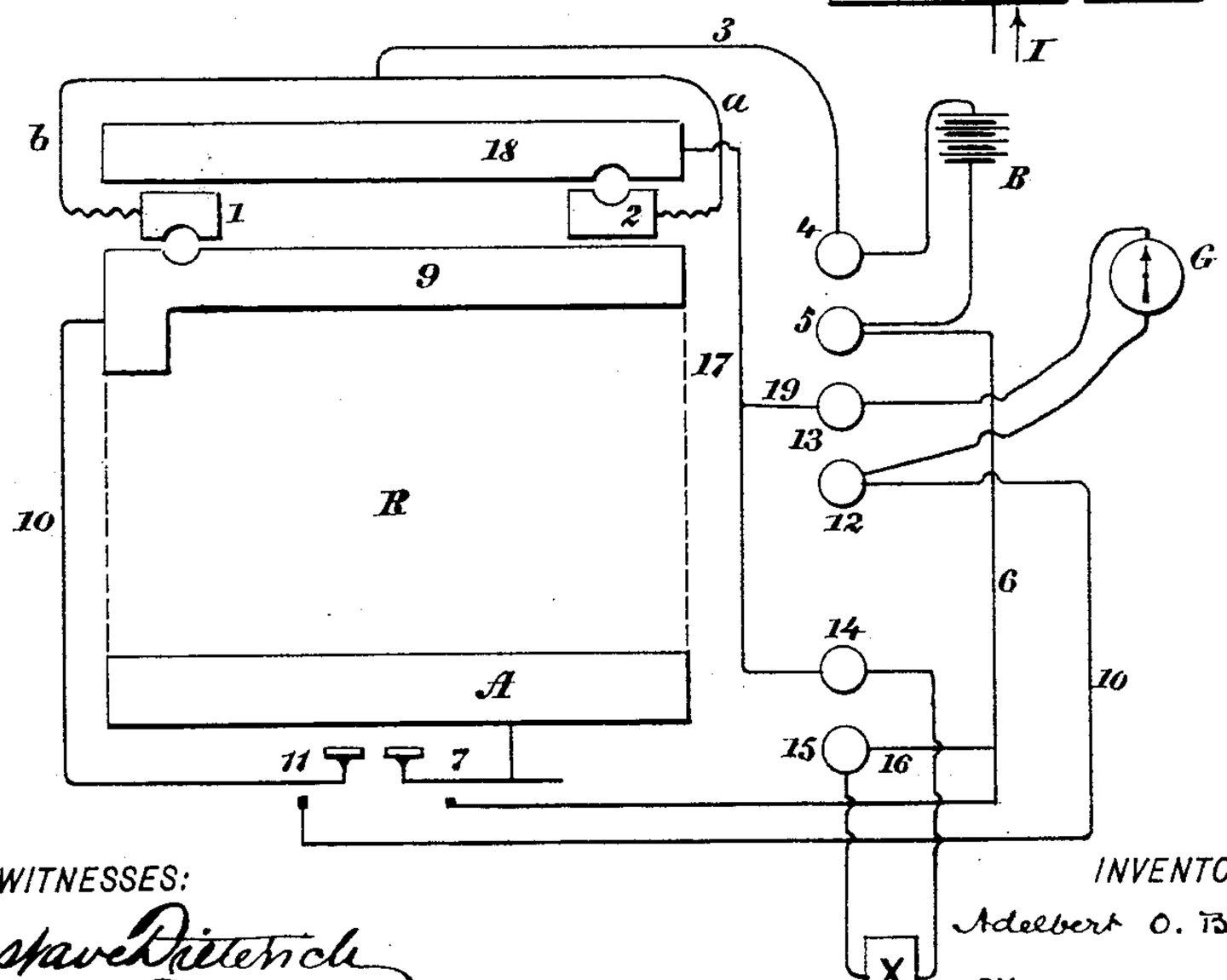


Fig. 2.

Fig. 3.





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WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

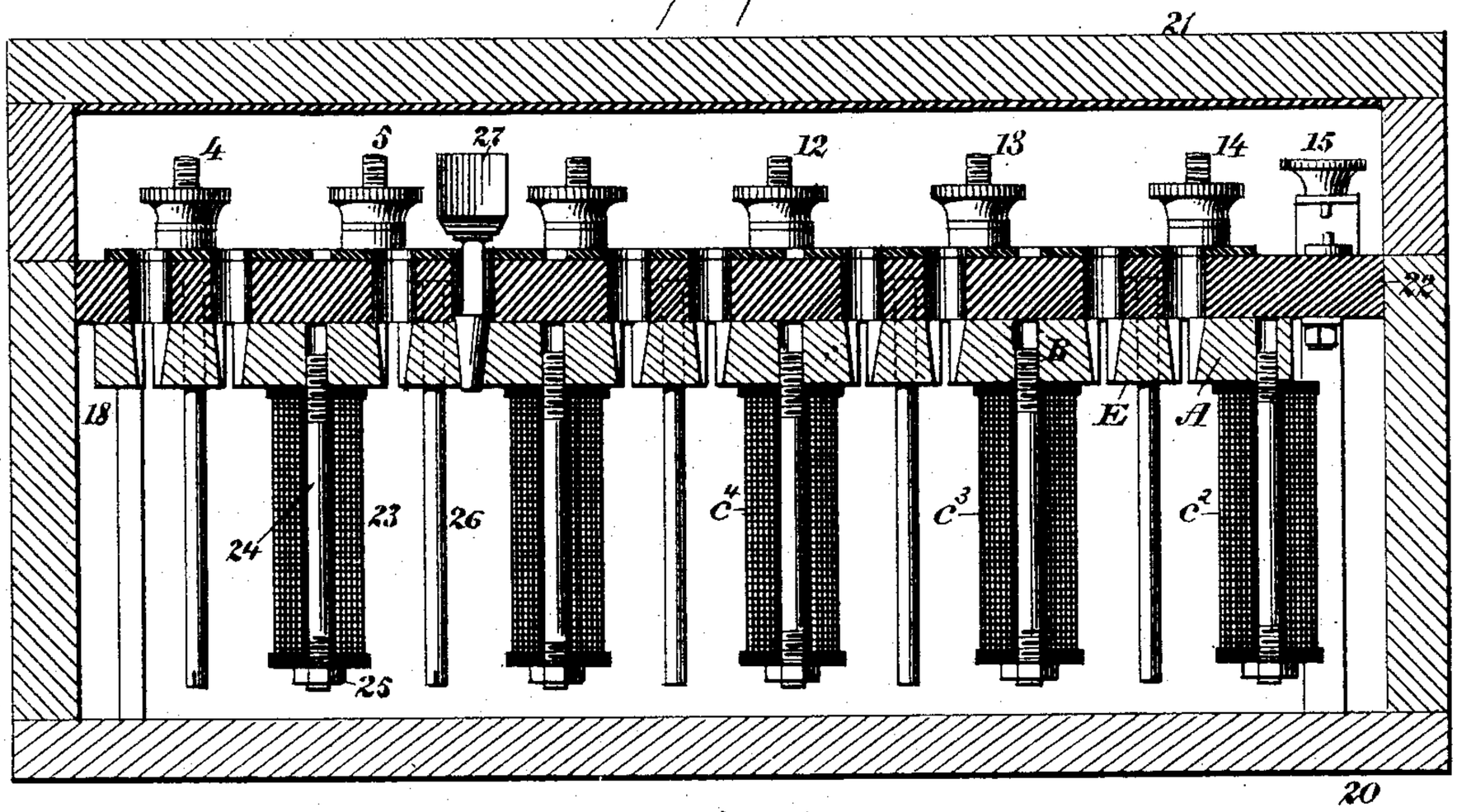
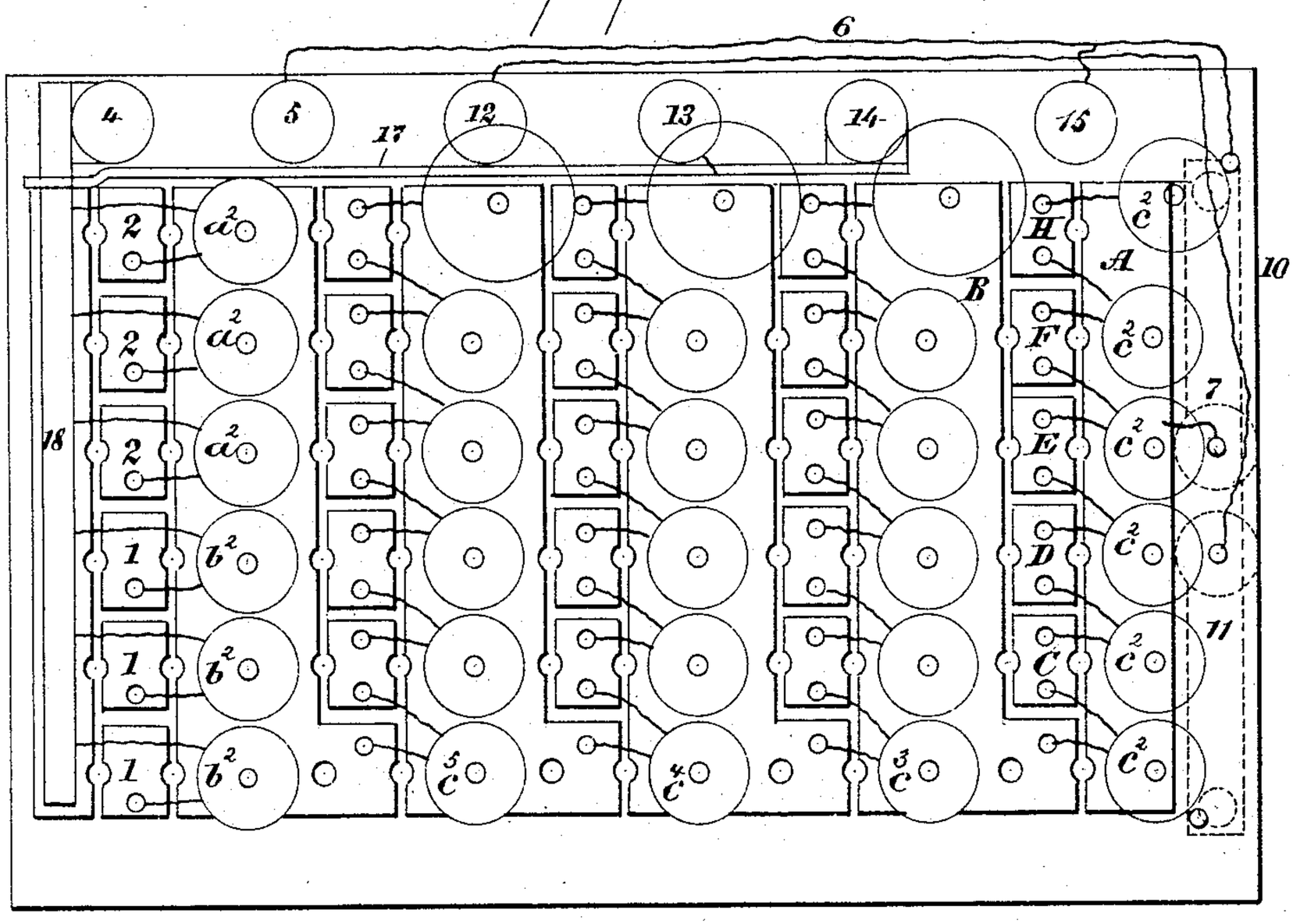


Fig. 5.



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UNITED STATES PATENT OFFICE.

ADELBERT O. BENECKE, OF NEWARK, NEW JERSEY.

RESISTANCE-BOX.

SPECIFICATION forming part of Letters Patent No. 511,286, dated December 19, 1893.

Application filed September 10, 1892. Serial No. 445,491. (No model.)

To all whom it may concern:

Be it known that I, ADELBERT O. BENECKE, of Newark, Essex county, New Jersey, have invented a new and useful Improvement in Bridges or Resistance-Coils, of which the following is a specification.

The object of my invention is to provide an improved form of bridge or resistance coil for making electrical measurements, in which equal variations in resistance can be obtained by the use of fewer coils than is commonly employed in instruments of this class, and whereby the coils are arranged in more compact form and smaller compass.

In the accompanying drawings, Figure 1 is a well-known electrical diagram representing the Wheatstone bridge. Fig. 2 is an electrical diagram showing the arrangement of connections of my improved bridge or resistance coil. Fig. 3 is a plan view of one set or series of coils together with their respective contact plates. Fig. 4 is a vertical longitudinal section through the apparatus, and Fig. 5 is a plan view showing the various contact plates and also the coil spools in place.

Similar letters and figures of reference indicate like parts.

In the diagram Fig. 1, *a* and *b* represent the arms of the bridge in which are placed the fixed resistances. R is the arm in which is placed the variable resistance and X the arm which includes the unknown quantity to be measured. G is the galvanometer and B the battery indicated by the usual symbols and connected in circuit with the bridge in the ordinary way.

In Fig. 2, similar parts being correspondingly lettered and figured, the connections for purposes of a bridge will be readily understood. Beginning at the contact plate 1, the arm *b* meets the arm *a*, which extends from the contact plate 2. From the point of junction of the arms *a* and *b* of the bridge, the wire 3 proceeds to the binding post 4. The binding post 4 connects with one pole of the battery B, the other pole of this battery connecting with the binding post 5. From the binding post 5 proceeds a wire, 6, in which is placed the contact key 7. This wire connects with a plate A which connects with the series of resistance coils R. Not shown in Fig. 2. The other end of this series of resistance coils communicates with a plate, 9, which plate, by means of a wire, 10, communicates with the binding post 12. In the wire 10 is a contact key, 11. The galvanometer G is connected between the binding post 12 and the binding post 13. 14 and 15 are two binding posts to which is connected the unknown resistance, X. The binding post 15 is connected by a wire 16 with the wire 6. The binding post 14 is connected by a wire, 17, with the plate 18, and by wire 19 with the post 13.

Referring now to Figs. 4 and 5, 20 is the containing box or case provided with a cover, 21. 22 is a platform of ebonite on the under side of which are fastened the contact plates, as A, B, C, &c. The resistance coils shown at 23 are made in the usual way, and are supported upon metal shafts or rods, 24, which are tapped into the under sides of the metal plates or blocks. Each coil is supported upon a nut, 25, upon the threaded end of the shaft 24. The vertical pins or shafts 26 are fair leaders for the wires passing from one coil to another. Connection between the metal plates to cut out the resistance coils as hereinafter will be explained, is effected in the usual way by plugs, one of which is shown at 27. This plug passes down through an opening in the ebonite platform and enters a wedge-shaped aperture between the metal contact plates.

I desire it to be understood that I do not claim herein the construction of a resistance coil or bridge in which the contact plates are arranged on the lower side of the supporting platform. Neither do I claim such an apparatus in which the metal contact plates are wholly inclosed in the box or case so that the parts of the ebonite or rubber platform which supports them are thus protected from the combined influence of the atmosphere and of light.

Referring now to Fig. 5, the series of coils marked a^2 b^2 are the ratio coils, and are connected all at one end to the bar 18, and each, at its opposite end to that which is fastened to the bar 18, to the small contact plates 1, 1, 1, 2, 2, 2. The coils a^2, b^2, may be made of any desired proportions and are used in the ordinary way in which such coils are employed in the commonly known bridge instrument. The first series of resistance coils in the variable resistance is represented at c^2, the sec-

ond series at c^3, the third series at c^4, and the fourth series at c^5. These series may represent units, tens, hundreds and thousands of ohms respectively. It will be observed that the series c^2 is supported on the bar A, that the second series c^3 is supported on the bar B, and that between the bar A and the bar B there are five smaller contact plates, C, D, E, F, H. Beginning at that end of the series of coils c^2 which is at the bottom of the drawings, it will be observed that the first coil has its terminals connected to the plate B and the plate C; the second coil has its terminals connected to the plate C and the plate D; the third coil has its terminals connected to the plate D and the plate E; and so on to the sixth coil, which has its terminals connected to the plate H and the plate A. This arrangement will be better understood by reference to Fig. 3, where the coils are represented symbolically by spirals, marked one ohm and five ohms.

Suppose that each coil except the last of the series which connects plate A and plate H to be of one ohm resistance, as marked in Fig. 3, and that the coil thus excepted be of five ohm resistance, then with the arrangement shown for plugging in Fig. 3, it will be plain that by the use of six coils I can get all the variations in resistance which ordinarily require ten coils in the resistance box as it is generally made. To illustrate, supposing the current to come in at the arrow I of Fig. 3 and to go out at the arrow J, if I should put a plug in the hole marked zero and thereby connect plate B and plate A, it is plain that the current will pass through none of the coils. If I place the plug in the hole marked 1, then the current will go through the coil between the plates B and C, which is one ohm; and similarly, if I successively place the plug in the holes 2, 3, 4, 5, the current will in each case pass through one more coil, and thus the resistance may be gradually increased from one to five ohms. Now to go to six ohms, I place simply a plug in the hole 6. Then the current will pass through the plate B to the plate F, and thence through one ohm resistance to the plate H, and thence through five ohm resistance to the plate A. To obtain seven ohm resistance I place the plug in a hole, 7; and finally to make ten ohm resistance, all of the holes are left unplugged, and the plug is simply put in a blind hole, which is here marked 10, and which establishes no connections, being merely an aperture in the bar B. Of course it is to be understood that this arrangement of contact plates in connection with the series c^2 of coils is repeated with all the other series of coils; and it is in this more especially that the distinctive feature of my invention resides. As I have before stated, it allows of the saving of forty per cent. of coils as now commonly used, with the consequent economy in expense and the insurance of greater accuracy in manufacture.

I claim—

1. The combination in a set of resistance coils or bridge of a series of fixed contact plates, a series of resistances respectively interposed between successive contact plates, and circuit connections and means whereby one or more of the intermediate contact plates may be electrically connected with either of the end plates of said series.

2. The combination in a set of resistance coils or bridge of a series of three fixed contact plates, as A, B, C, two resistances respectively interposed between plates B and C and C and A, and circuit connections and means whereby plate C may be electrically connected with either of said plates A or B.

3. The combination in a set of resistance coils or bridge of a series of three fixed contact plates, as A, B, C, two resistances respectively interposed between plates B and C and C and A, and circuit connections and means whereby plate C may be electrically connected with either of said plates A or B, and whereby said plate A and plate B may be electrically connected to cut out the said resistances.

4. The combination in a set of resistance coils or bridge of a series of three fixed contact plates, as A, B, C, two resistances respectively interposed between plates B and C and C and A, the resistance between plates C and A being greater than the resistance between plates B and C, and circuit connections and means whereby plate C may be electrically connected with either of said plates A or B.

5. The combination in a set of resistance coils or bridge of a series of fixed contact plates, as B, C, D, E, F, H, A, a series of equal resistances interposed respectively between the plates B, C, D, E, F, H, a greater resistance interposed between the plates H A, and circuit connections and means whereby said plates H and A may be electrically connected to cut out said greater resistance, and whereby said plates C, D, E, F, may be connected with either of said plates B or A.

6. The combination in a set of resistance coils or bridge of a series of fixed contact plates, as B, C, D, E, F, H, A, a series of equal resistances interposed respectively between the plates B, C, D, E, F, H, a resistance equal to the sum of the aforesaid equal resistances interposed between the plates H and A, and circuit connections and means whereby said plates H and A may be electrically connected to cut out said greater resistance, and whereby said plates C, D, E, F, may be connected with either of said plates B or A.

ADELBERT O. BENECKE.

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