No. 797,628.

PATENTED AUG. 22, 1905

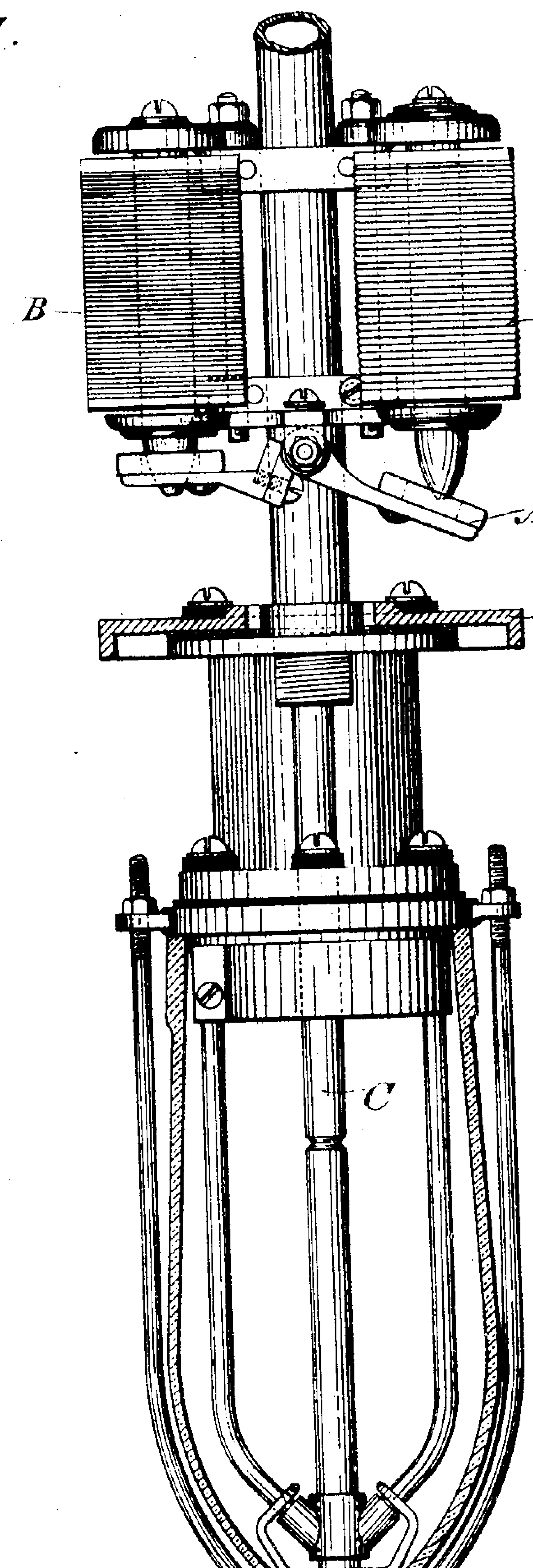
B. A. STOWE.

ELECTROMAGNETIC COMPENSATING DEVICE.

APPLICATION FILED MAY 24, 1904.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:
D. G. Davies
G. W. Saywell

INVENTOR:
Bernard A. Stowe
by his attorney
J. B. Fay

No. 797,628. PATENTED AUG. 22, 1905.

B. A. STOWE.

ELECTROMAGNETIC COMPENSATING DEVICE.

APPLICATION FILED MAY 24, 1904.

3 SHEETS—SHEET 2.

Fig. 4.

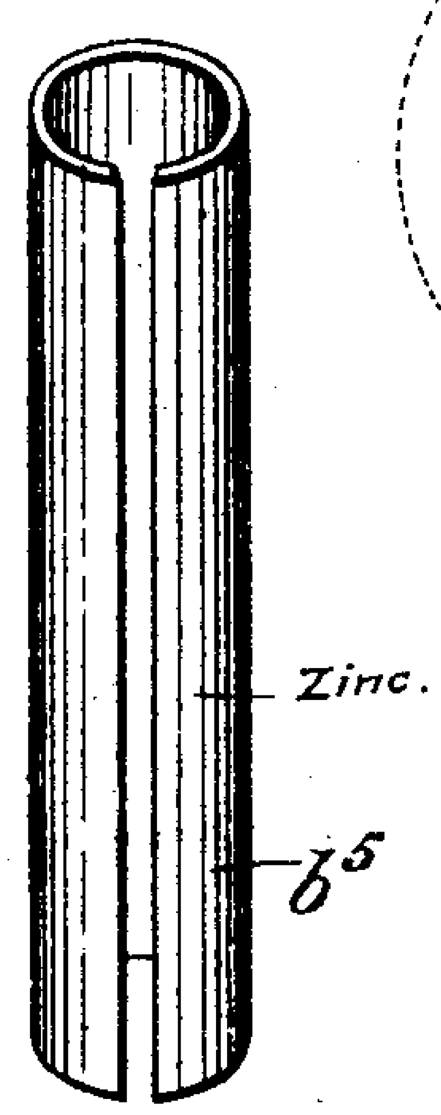


Fig. 2.

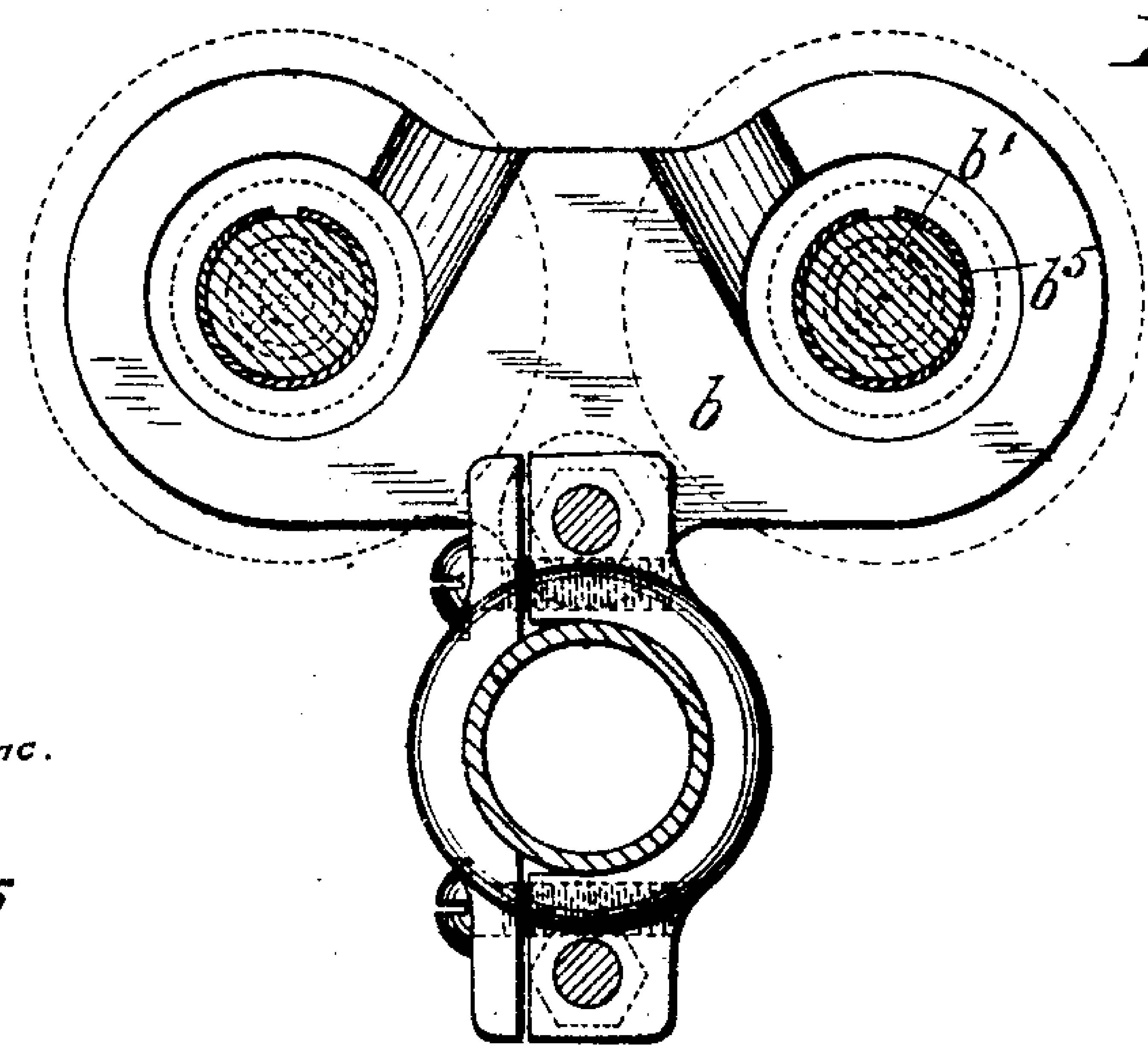
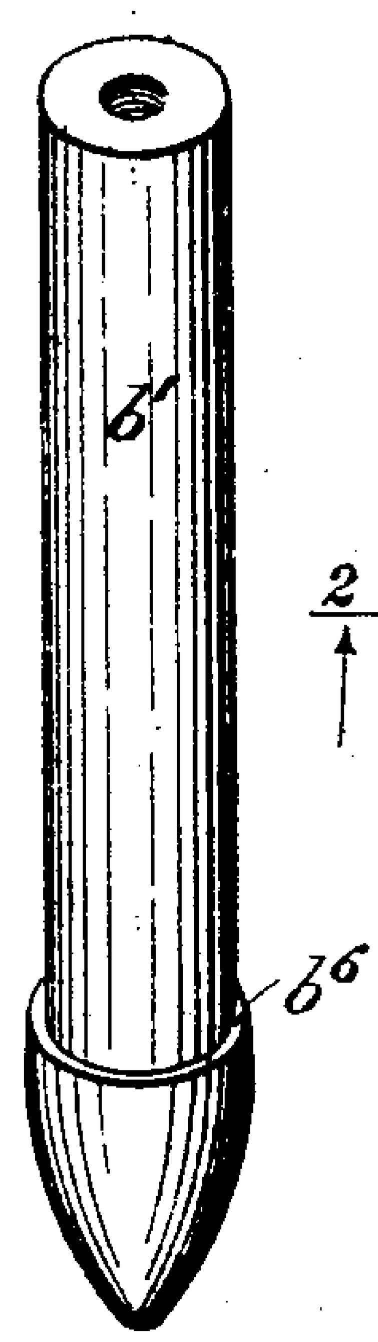


Fig. 3.

Fig. 5.



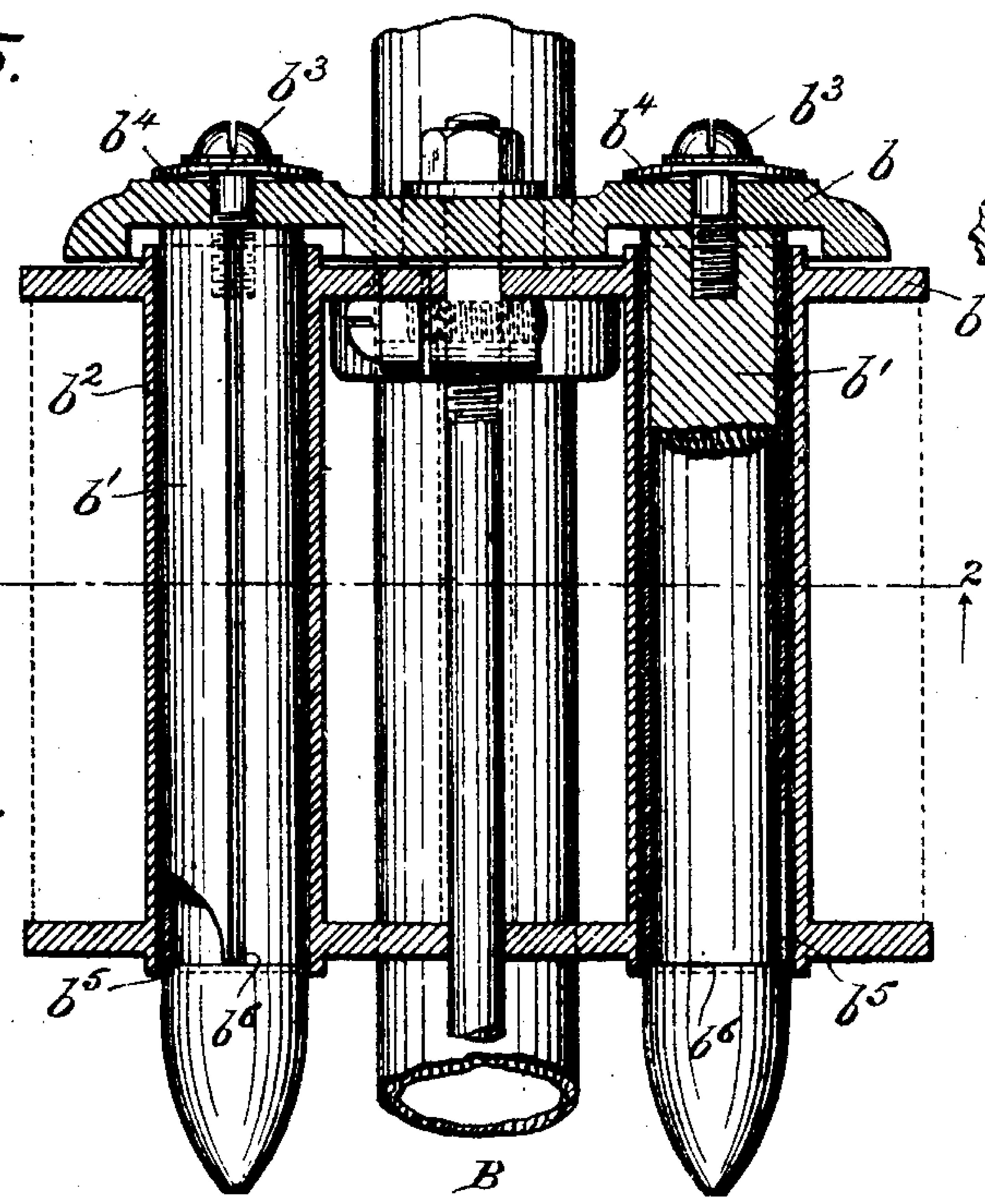
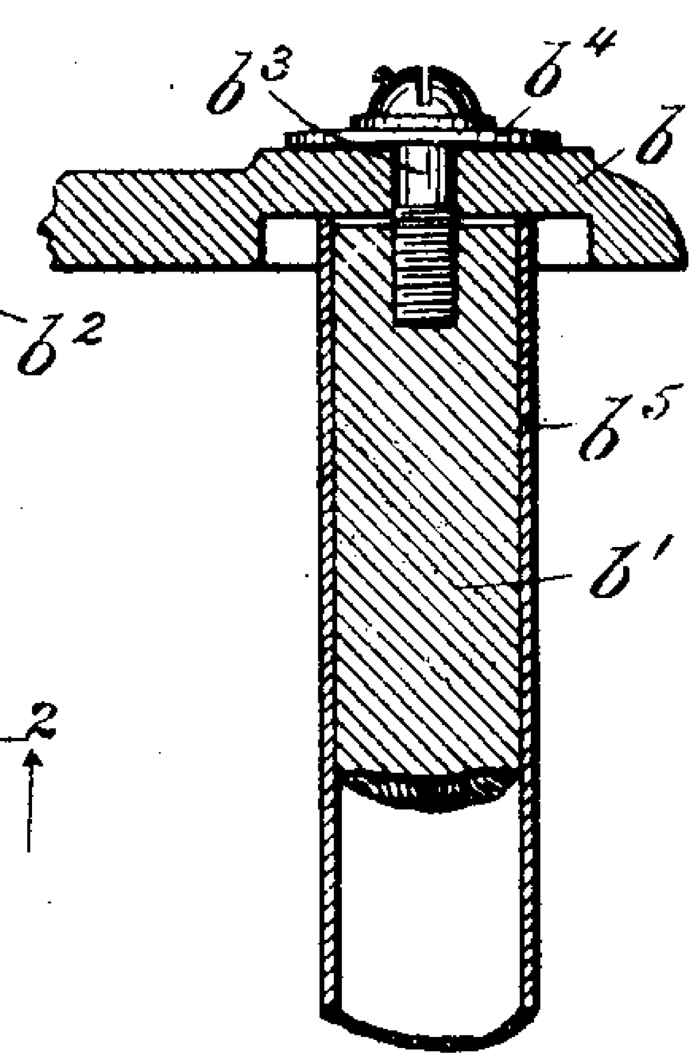


Fig. 6.



WITNESSES:

S. G. Davies

G. W. Saywell

INVENTOR:

Bernard A. Stowe

by his attorney J. B. Fay.

No. 797,628.

PATENTED AUG. 22, 1905.

B. A. STOWE.

ELECTROMAGNETIC COMPENSATING DEVICE.

APPLICATION FILED MAY 24, 1904.

3 SHEETS—SHEET 3.

Fig. 7.

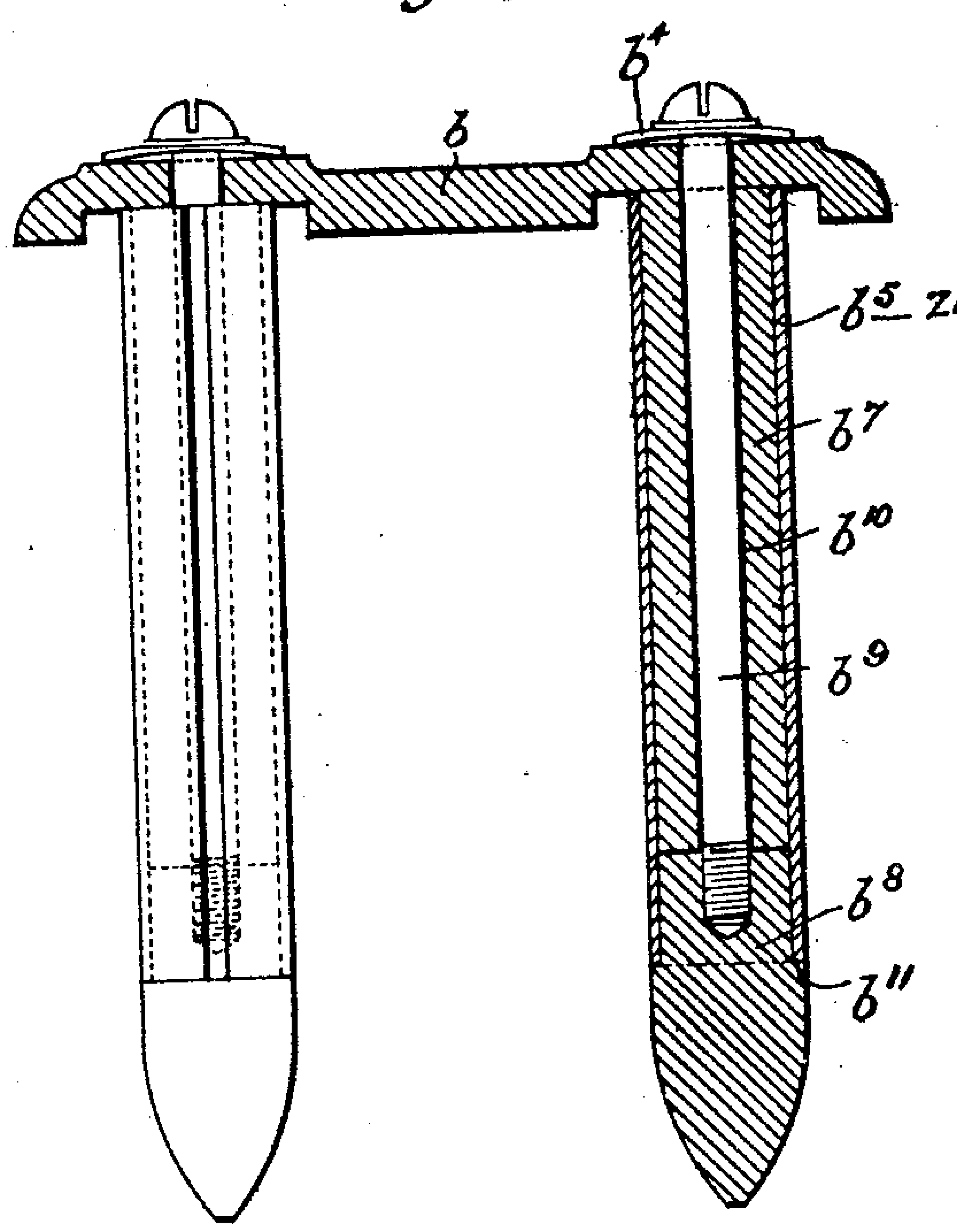
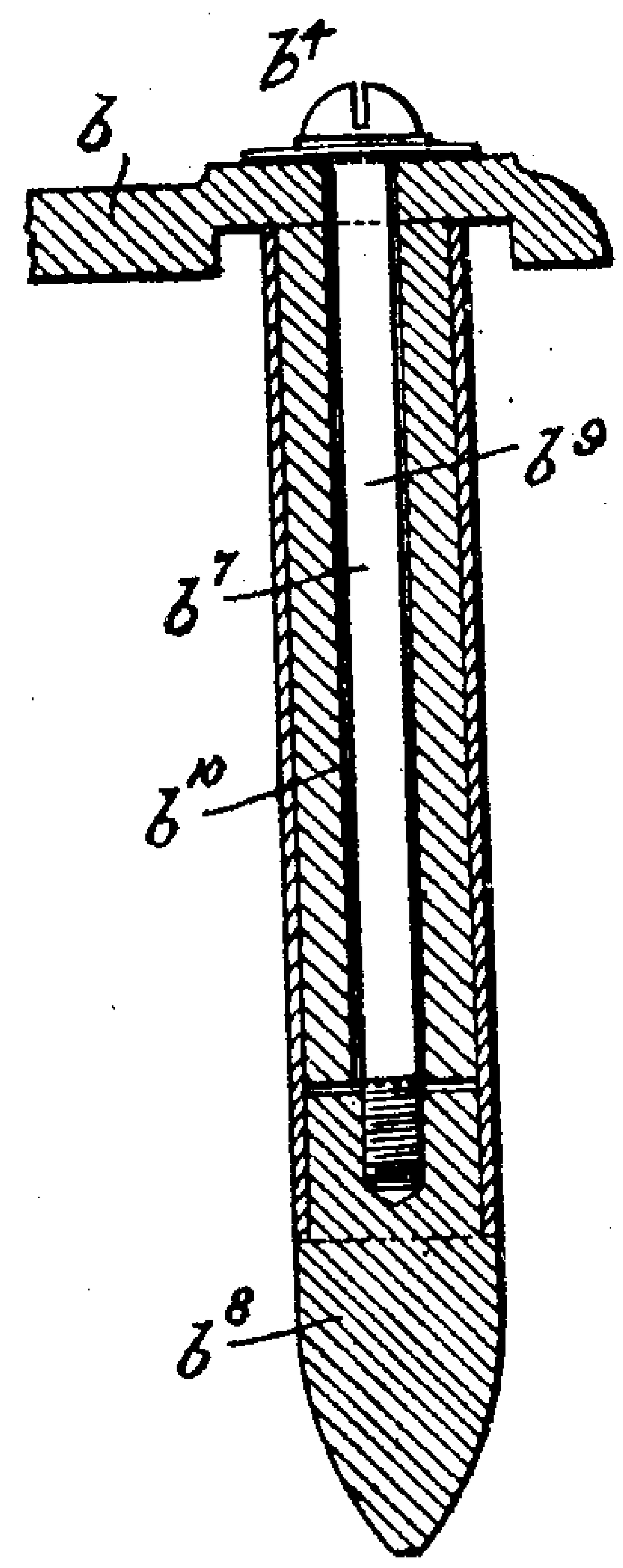


Fig. 8.



WITNESSES:
D. G. Davies
G. W. Saywell

INVENTOR:
Bernard A. Stowe
by his attorney
J. B. Fay.

ANDREW B. GRAHAM CO. PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

BERNARD A. STOWE, OF CLEVELAND, OHIO, ASSIGNOR TO THE JANDUS ELECTRIC COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

ELECTROMAGNETIC COMPENSATING DEVICE.

No. 797,628. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed May 24, 1904. Serial No. 209,459.

To all whom it may concern:

Be it known that I, BERNARD A. STOWE, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Electromagnetic Compensating Devices, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to electromagnetic compensating devices as applied to the compensation for variations of conditions, and particularly to the compensation for the variations of electrical conditions in arc-lamps due to the variation of temperature resulting from the heat generated by the resistance of the electrical circuit in such lamps.

Said invention consists of means hereinafter fully described, and particularly set forth in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings, Figure 1 represents the main portion of an inclosed arc constant-current lamp embodying my invention. Fig. 2 represents a section of the operating magnet-coil of the lamp, taken upon a horizontal plane and looking upward, the winding of such magnet being indicated in dotted lines. Fig. 3 represents a vertical axial section of said magnet, showing part of the magnet-cores in elevation. Figs. 4 and 5 represent perspective views of details of said magnet. Fig. 6 represents an axial section of a portion of said magnet, illustrating a change of relative position of parts thereof. Figs. 7 and 8 represent detail views of a modified form of device embodying my invention.

The general construction of the lamp, the main portion of which is illustrated, is that of constant-current lamps now in general use, in which a main electromagnet A, whose armature A′ is actuated by the lamp-current to establish the arc by moving the upper carbon C, and a shunt electromagnet B, whose action is opposed to that of magnet A and is provided for regulating and modifying such actuation. This mechanism is mounted upon a suitable frame. It has been found that the character of the movement of the armature is influenced by the temperature of the magnets—that is, when the latter are heated a more marked action is obtained than when the magnets are cold. Unless, therefore, means for compensating for the action of the heat acquired by the operation of the lamp be provided a constancy of action of the magnet, and hence a constancy of conditions at the arc, is not obtained under the same conditions in the circuit. Let it be assumed that the lamp is of the usual construction, is cold, and that the mechanism is set so that a given current will effect an actuation of the armature so as to produce a required voltage at the arc. The current now being turned on a given arc will be obtained. As the lamp continues to operate the mechanism, including the magnets A and B, becomes heated. Such heating decreases the electrical conductivity of the thin copper wire of the shunt-coil B by reason of its temperature coefficient of resistance, but does not materially affect the conductivity of the wire of coil A as a result of its larger cross-sectional area and fewer turns. The magnetic conductivity of the two magnets is, on the other hand, increased; but since the action of the two magnets is opposed in this form of lamp any variation in the action of one magnet by reason of temperature variation is compensated for by a substantially similar variation in the other magnet. In following the effect of changes in temperature in the structure illustrated the normal changes in magnetic conductivity may hence be disregarded. The electrical conductivity of the wire of the shunt-magnet B being decreased and its resistance correspondingly increased, a lesser part of the current flows through coil B than before and a greater quantity through coil of magnet A, thus increasing the actuating effect of the armature actuated by said magnet A, drawing the carbons farther apart and increasing the voltage at the arc. The character of the arc changes correspondingly, so that it will be seen that an arc of one character is produced at the beginning of the lamp's operation and an arc of a different character is produced after the mechanism becomes heated. In order to correct this deficiency, I provide a structure in which such changes are compensated for and an arc produced which will have substantially the same illuminating qualities at substantially all periods of its operation and throughout all of the changes of temperature to which the lamp mechanism is subjected. Such structure is embodied in the operating-magnet A and is illustrated in Figs. 2, 3, 4, 5, and 6. Said magnet consists of a yoke b, two cores b' b', the usual spools b^2 b^2 and their windings, together with other parts which will be described. Each core b' is connected with the yoke b by means of a screw b^3 passing therethrough, an elastic washer b^4 being interposed between said yoke and the screw's head, so that it will be seen such core is yieldingly secured to the yoke and may be caused to recede slightly therefrom. Enveloping each such core is a metallic shell b^5, which under normal conditions—that is, when the parts are of normal or atmospheric temperature—is of a length such that one end of the shell abuts the inside surface of the yoke and the opposite end abuts a shoulder b^6 on the core. Said shell is constructed of a metal, such as zinc, which has a coefficient of expansion greater than that of the iron core b', so that an increase in temperature will cause it to expand in the direction of the core's axis, and so cause the core to recede from the yoke, as shown in exaggerated form in Fig. 6. It will therefore be seen that the conductor of magnetic lines of force, consisting of the yoke and core, has its magnetic conductivity affected by such breaking of the normal connection established between the several parts of said conductor. An increase in temperature of magnet A due to the heat generated during its operation and the consequent concomitant increase in the degree of action of the said magnet A, previously described, is therefore compensated for by a decrease in the conductivity at the joint between the core and yoke of the magnet A. The latter's parts are so arranged that such increase of conductivity is caused to be substantially directly proportionate to the increase of magnetic action upon the armature of magnet A, which would be normally affected by the increased flow of current through the coil thereof resulting from the decreased electrical conductivity of magnet B, so that the character of the modified action of the magnet effected by the compensating means, and hence the conditions at the arc, remains substantially constant throughout such variations of temperature as are experienced by the lamp mechanism during the period included between the beginning of the lamp's operation, when the temperature of its mechanism is normal, and such time as such mechanism attains its maximum temperature.

In Figs. 7 and 8 I have illustrated a second form of core construction which embodies the principles of the above-described invention and which I have found embodies advantages not present in the first-described structure. In this structure the yoke b is of the previously-described construction; but the core is divided into two unequal parts b^7 and b^8. The lower or short part b^8 is secured to the yoke and caused to normally abut the lower end of part b^7 by means of a long screw b^9, passing through a bore b^{10}, as shown. The shell b^5 as before abuts the under surface of the yoke and a shoulder b^{11}, formed upon the part b^8 intermediate of its extremities. The diameter of part b^7 is such that it will fit tightly in shell b^5. The expansion of shell b^5 hence causes the two parts of the core to separate, as shown in Fig. 8, part b^7 remaining fixed relatively to yoke b, the elastic washer b^4 being provided, as before. The magnetic leakage will hence take place at the plane of separation of the two parts b^7 and b^8, as will be readily understood. The location of this plane of leakage at the lower portion of the magnetic circuit instead of at the top, as in the first-described structure, I have found renders the operation of the device more delicate and reliable. In this modified form the part b^7 may be considered part of the yoke in so far as relates to the similarity of construction and operation of the two forms of the above-described invention. The lower part b^8 of the core would in such event correspond with the core b' of the first-described device. The said modified form, then, may be structurally considered as merely embodying the shortening up of core b' and the extensions of the yoke into the coil to complete the magnetic circuit and form part of the core.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention—

1. In an electromagnetic compensating device, the combination with a magnetic conductor, of means for positively varying the magnetic conductivity thereof concomitantly with a change in temperature of the magnet-coil and inversely relatively to such temperature.

2. The combination with actuating means including an electromagnet and normally affected by temperature variations, the action of such means being positively affected by an increase in temperature of parts thereof, of means for controlling the magnetic conductivity of said electromagnet to compensate for such positive increment so as to substantially maintain a constancy of action of said actuating means.

3. In an electromagnetic compensating device, the combination with a magnetic conductor comprising two elements yieldingly held in contact with one another, of a member operatively connected with said two elements and having a coefficient of expansion greater than that of one of said elements, whereby temperature variations will effect the degree of contact of said elements.

4. In an electromagnetic compensating device, the combination with a magnetic conductor including two elements yieldingly held in juxtaposition, of a member operatively connected with said two elements and having a coefficient of expansion greater than that of said conductor.

5. In an electromagnetic compensating device, the combination with a magnetic conductor including two elements yieldingly held in juxtaposition, of a member mounted upon and operatively engaging one of said elements, engaging the other of said elements, and having a coefficient of expansion greater than that of said conductor.

6. In an electromagnetic compensating device, the combination with a magnetic conductor including two elements yieldingly held in juxtaposition, of an expansible member mounted between said two elements and having a coefficient of expansion greater than that of said conductor.

7. In an electromagnetic compensating device, the combination with a magnetic conductor comprising a yoke and a core yieldingly connected therewith, of an expansible member mounted between said yoke and core, and having a coefficient of expansion greater than that of the conductor parts adjacent to it.

8. In an electromagnetic compensating device, the combination with a magnetic conductor comprising two separable parts normally held in contact, of means controlled by temperature for determining the position of said parts relatively to each other.

9. In an electromagnetic compensating device, the combination with a magnetic conductor, of means controlled by temperature for effecting magnetic leakage in said conductor.

10. In an electromagnetic compensating device, the combination of a magnetic conductor comprising two separable parts, yielding means connecting said two parts, and a metallic member rigidly mounted relatively to the one part engaging the other part, and having a coefficient of expansion greater than that of said conductor.

11. In an electromagnetic compensating device, the combination of a magnetic conductor comprising two juxtapositioned separable parts; yielding means connecting said two parts, and a hollow cylinder of zinc or similar material having a coefficient of expansion greater than iron surrounding said conductor engaging the one conductor part and rigidly mounted relatively to the other part.

12. In an electromagnetic compensating device, the combination of a main electromagnet, a second electromagnet having its coil connected in shunt with the main-magnet coil, and means for varying the magnetic conductivity of the main magnet concomitantly with a change in temperature of the coil of the shunt-magnet.

13. In an electromagnetic compensating device, the combination of a main-magnet coil, a shunt-magnet coil, a separable magnetic conductor in the field of said main coil, and automatically-operating means for effecting the separation of said conductor concomitantly with an increase in temperature of the shunt-magnet coil.

14. In an electromagnetic compensating device, the combination of a magnet-coil, a separable core in the field of said coil, and automatically-operating means for effecting the separation of said core concomitantly with an increase in the flow of current through said coil.

Signed by me this 12th day of May, 1904.

BERNARD A. STOWE.

Attest:

A. E. MERKEL,

HENRY J. VOGT.