905,136.

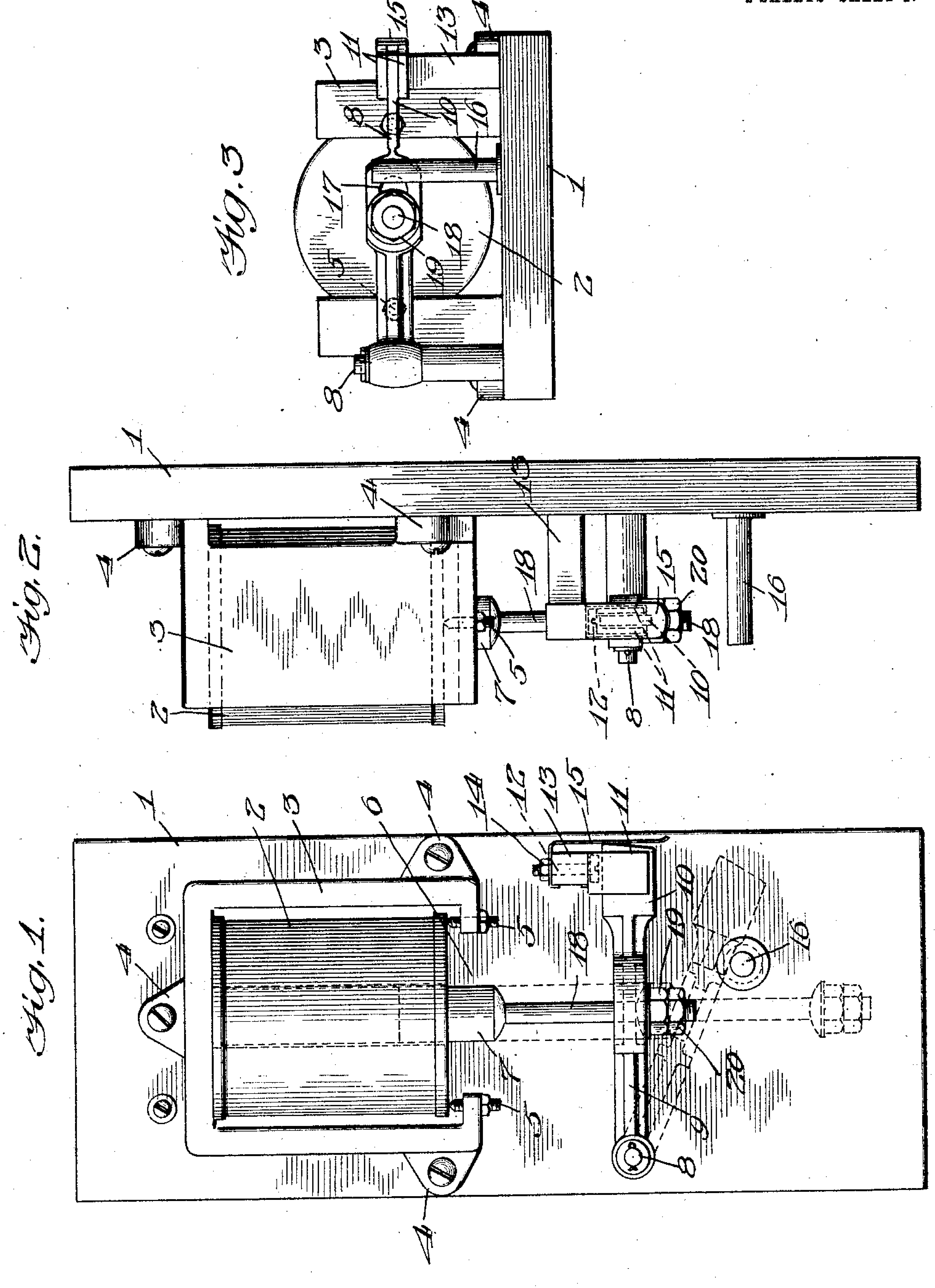
T. E. BARNUM.

ALTERNATING CURRENT MAGNET.

APPLICATION FILED APR. 15, 1905.

Patented Dec. 1, 1908.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 4.

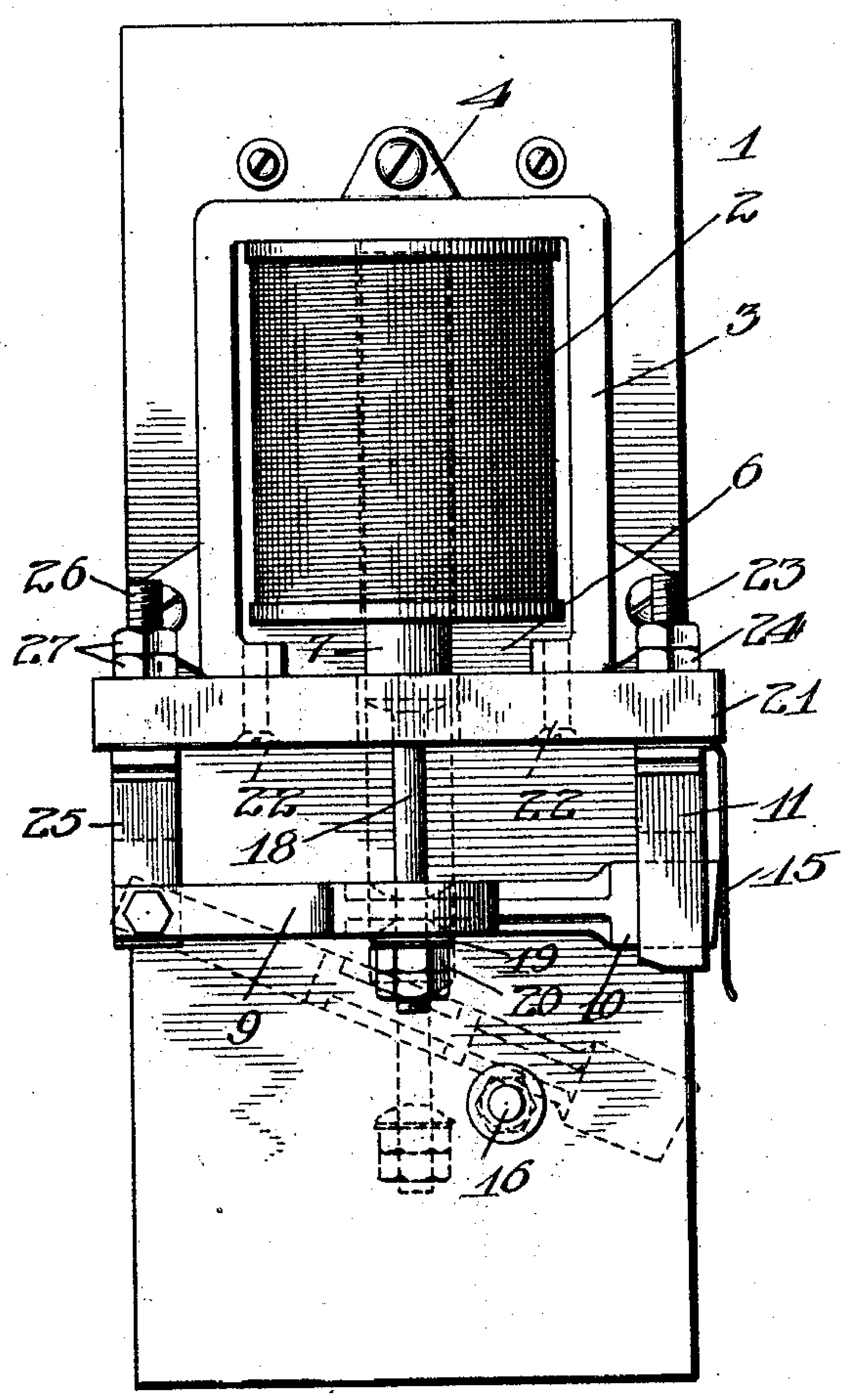


Fig. 5.

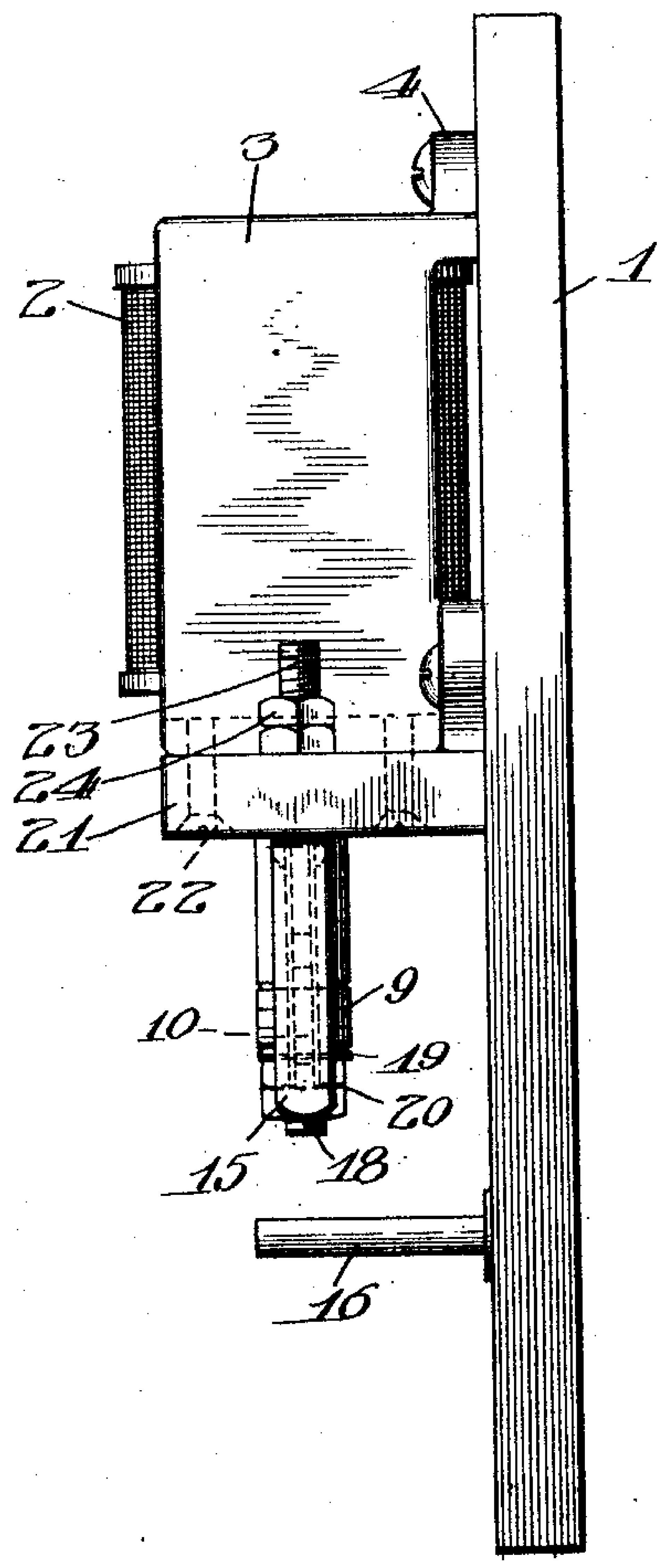
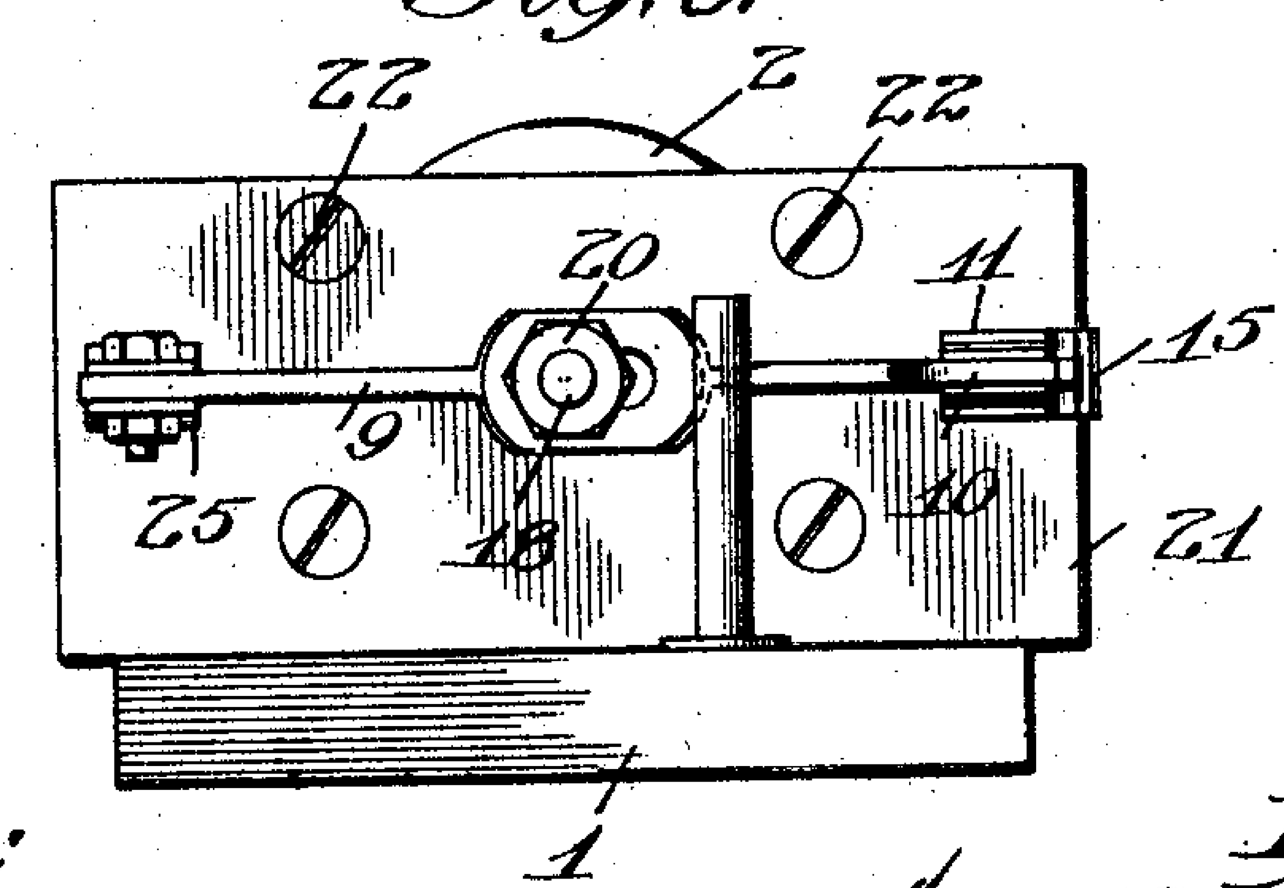


Fig. 6.



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UNITED STATES PATENT OFFICE.

THOMAS E. BARNUM, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO CUTLER-HAMMER MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

ALTERNATING-CURRENT MAGNET.

No. 905,136. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed April 15, 1905. Serial No. 255,713.

To all whom it may concern:

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Alternating-Current Magnets, 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 improvements in magnets, for use on alternating current circuits, my object being to provide a magnet which will be simple in construction, and at the same time self-protecting from overheating after the magnet has attracted its armature.

A further object of my invention is to provide a pulling magnet in which when the current is first admitted to the windings thereof, a large amount of current will flow and consequently exert a strong pull on the armature but after the armature has been attracted to the coil, the amount of current flowing through the coil is greatly reduced.

A still further object of my invention is to provide means for connecting the armature of the magnet to a switch whereby a "hammer" blow will be given in opening and closing the switch to more readily operate the same.

I have illustrated the preferred embodiment of my invention in the accompanying drawings, in which:

Figure 1 is a front elevation of my device showing the same operating a switch; Fig. 2, is a side elevation of the same; Fig. 3 is a bottom plan view of my device; Fig. 4 is a front elevation of a modification of my device; Fig. 5 is a side elevation thereof, and Fig. 6 is a bottom view.

In one form of the practical embodiment of my invention, upon a suitable base 1, made of insulating material, usually in the form of a marble slab is mounted a solenoid winding 2 of the usual type which is surrounded by and supported within an iron shroud 3 having projecting lugs 4, through which screws are passed to secure the same to the base 1. Suitable screws 5 pass through the lower side of the shroud to adjustably support the coil upon the same. The shroud 3, it will be noted, is not continuous and on its underside is cut away to form the air space 6. A core or plunger 7 is adapted to operate in the coil and be raised thereby when the current is admitted to the windings of the coil.

The air gap 6 is so proportioned that when the plunger or core is in its lowermost position the passage of current through the coil will not be substantially affected—that is, the variable air gap in the magnetic circuit is comparatively large, and the fixed air gap is of such proportion that when the plunger or core is down the self-induction of the magnet will not be affected and the current will pass. As the variable air gap, however, decreases, the fixed air gap 6 becomes relatively more important, and when the plunger is in its raised position the fixed air gap is practically the only air gap in the magnetic circuit and prevents the self-induction of the coil from becoming so high as to prevent the passage of sufficient current to maintain the core in its raised position. By thus so proportioning the fixed air gap 6 with respect to the variable air gap formed by the plunger or core, when the plunger or core is at its lowest position the self-induction of the coil will be only sufficient to prevent current to pass through the coil which will be so great as to heat the same but will not prevent the passage of sufficient current to raise the core; but when the plunger is at its uppermost position, only a sufficient amount of current will be permitted to pass through the coil to energize the magnet sufficiently to maintain the plunger firmly in its raised position; and it is thus by so proportioning the fixed air gap with respect to the variable air gap that I am enabled to accomplish the object of my invention and prevent the self-induction of the magnet from being too high when the plunger is in its uppermost position and prevent the fixed air gap when the plunger is in its lowermost position from substantially affecting the magnetic circuit.

Projecting from the base 1 below the solenoid is a pin 8 upon which is suitably pivoted a switch arm 9 having its opposite end flattened as at 10 and adapted, when in a closed position to engage between the bifurcations 11 of a contact plate and be held in a closed position thereby. In order that this plate may be mounted in line with the outer end of the switch arm, it is preferably secured by means of a screw 12 upon the outer end of a pin 13 projecting from the base. The screw 12 passes through the pin and a nut 14 upon the upper end thereof holds in position a spring 15 which extends below the lower ends of contact clips 11 so that the circuit is broken at this point last and the spring takes the arc resulting from opening the switch with the current passing. The downward movement of the switch arm is limited by a stop 16 secured upon the base 1.

The central portion of the switch arm is enlarged and has formed therein a slot 17 through which is adapted to pass a rod 18 secured at its upper end to the core or plunger 7. A nut 19 is screwed upon the lower end of the rod and is adapted when the rod is raised by the core or plunger 7 to engage the switch arm and move the same. A set nut 20 is also provided upon the lower end of the rod to prevent the nut 19 from being displaced after it has once been adjusted.

In operation, assuming the switch to be open when the current has been admitted to the windings of the coil 2, the self-induction set up by the wires of the magnetized coil is so small, due to the gap in the magnetic circuit and to the external air gaps 6, that a large amount of current will flow through the coil and exert a strong pull upon the core to raise the same. As the nut 19 will not engage the switch arm until after the core has been started in its upward movement, a "hammer" blow will be delivered to the switch arm and the same will be readily raised by the core or plunger until the arm makes contact with the contact plate 11 and is engaged by the spring 15. As the core is sucked up into the coil, the air gap in the magnetic circuit will be decreased and the self induction set up by the coils accordingly increased. When the core has reached its uppermost position, the magnet circuit is so nearly closed that the self induction is so great that the amount of current flowing through the coil is reduced to just enough to maintain the core in the raised position. In practice the current may be reduced to as low as one-tenth the amount which flowed when the plunger was in its lowermost position. It will be noted that due to the fact that the switch arm is supported in a closed position by the spring, very little current must pass through the winding of the coil as only sufficient force must be exerted by the coil after the switch arm is closed, to maintain its own core in a raised position. When the switch is to be opened by cutting off the current through the coil the plunger will be permitted to drop by its own weight and deliver a "hammer" blow upon the switch arm releasing the same from the retaining spring and permitting the arm to drop to its lowermost position.

In my Figs. 4 to 6, I have shown a slight modification of my device in which an insulating plate 21 is secured at right angles to the base and maintained in position by screws 22 passing through the plate and screwing into the iron shroud 3 of the magnet. This plate forms a support for the contact 11, a bolt 23 passing through said contact and plate and held in position by nuts 24. The spring 15 is also supported and held in position by the bolt 23. A depending support 25 is also secured to said plate by a bolt 26 and nuts 27 and to the lower end of this support is pivoted the switch arm 9.

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

1. An alternating current magnet having an air gap in the magnetic circuit independent of that formed between the magnetic circuit and the movable armature, and so proportioned that when the armature is in one position, the self induction of the magnet will permit the passage of current therethrough to actuate the armature, but when the armature is in another position, the self-induction of the magnet will increase to permit only sufficient current to pass through the magnet to maintain the armature in its second position.

2. In an alternating current magnet the combination with the magnetic coil of an iron shroud surrounding said coil having an air gap formed therein so proportioned that when the armature of the magnet is in one position, the self induction of the magnetic coil will permit the passage of current therethrough to attract the armature, but when the armature is attracted, only sufficient current is permitted to pass through the magnet to maintain the armature in its second position.

3. An alternating current magnet having a variable air gap and a non-variable air gap of the magnetic circuit, said air gaps being so proportioned that when the armature is in one position, the effect of the variable air gap upon the magnet is modified to a minimum extent by the non-variable air gap, but when the variable air gap is the smallest, the non-variable air gap will permit only sufficient current to pass through the magnet to maintain the armature in its final position.

4. In an alternating current magnet the combination of the solenoid winding, of a core or plunger operated thereby, an external magnetic circuit associated with said winding and provided with a fixed air gap; said air gap being so proportioned that when the core or plunger is in one position the air gap in the magnetic circuit formed by said plunger reduces the self-induction of the coil to a minimum, but when the core or plunger is in a second position the self induction of the coil is so affected that only sufficient current will be permitted to pass

therethrough to maintain the core in its final position.

5. In an alternating current magnet the combination with a solenoid winding, of a core or plunger operated thereby, and forming part of a magnetic circuit associated with the solenoid, said magnetic circuit being provided with a fixed and a variable air gap, the latter being so proportioned that when the variable air gap is greatest, the effect of the fixed air gap upon the self induction of the magnet is reduced to a minimum, but when the variable air gap is smallest, the fixed air gap will so affect the self-induction of the coil that only sufficient current may pass therethrough to maintain the core or plunger in its final position.

6. In an alternating current magnet the combination with a solenoid winding, of a core or plunger operated by said winding, and an iron shroud surrounding said winding having an air gap therein, said air gap being so proportioned that when the core or plunger is in one position, the effect of the air gap upon the self induction of the coil is reduced to a minimum, but when the core or plunger is in a second position, the self induction of the coil will be so affected that only sufficient current may pass through the coil to hold the core or plunger in its second position.

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

THOMAS E. BARNUM.

Witnesses:

F. S. WILLWIT,

L. P. COULTER.