No. 791,591. PATENTED JUNE 6, 1905.

A. SUNDH & D. L. LINDQUIST.

ELECTROMAGNET.

APPLICATION FILED OCT. 27, 1904.

2 SHEETS—SHEET 1.

FIG. 1.

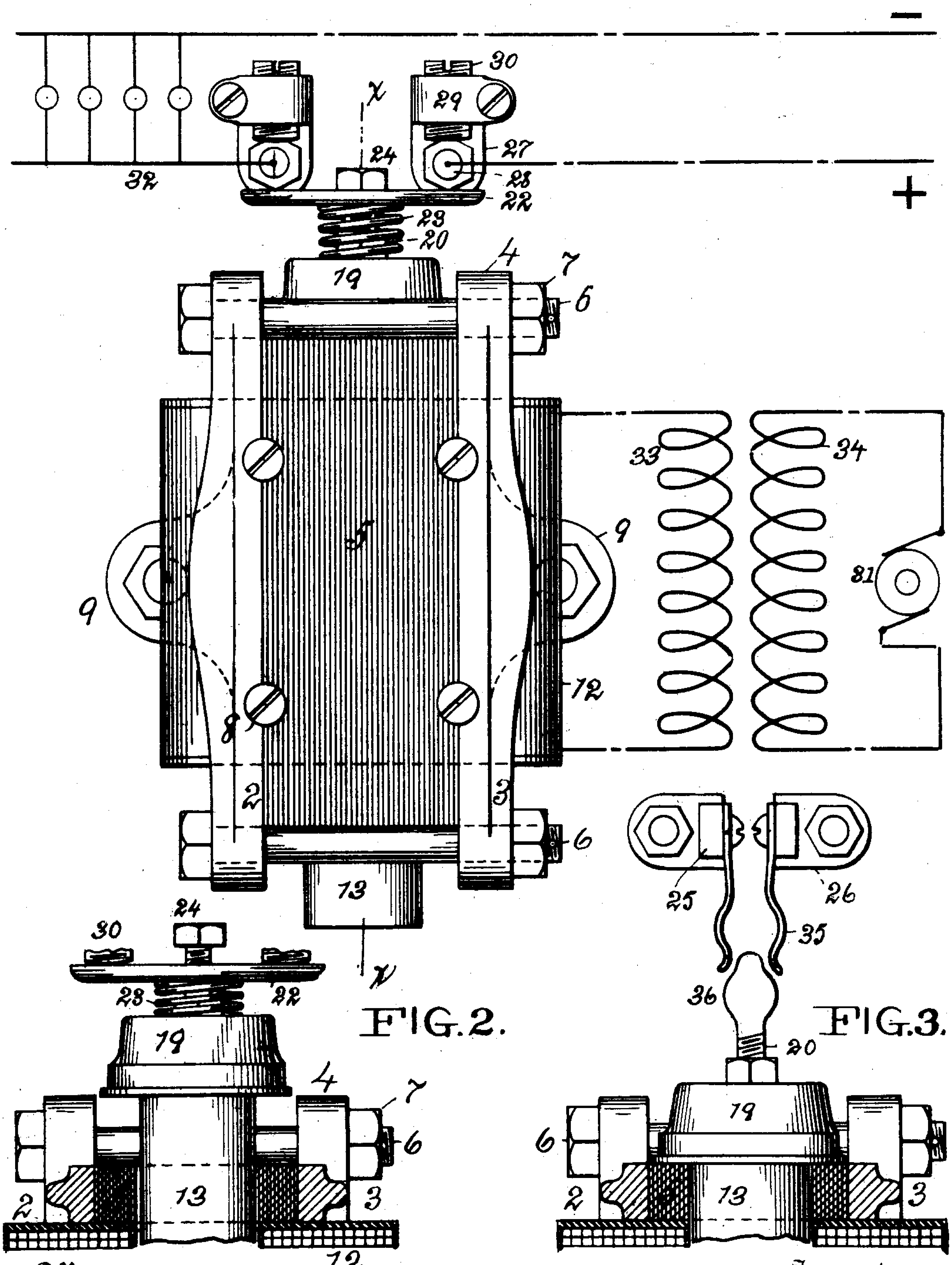

FIG. 2.

FIG. 3.

Witnesses
J. A. Van Wart
Wm. H. Siegman

Inventors
August Sundh
David L. Lindquist
By their Attorney
Park Benjamin

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2 SHEETS—SHEET 2.

FIG.4.

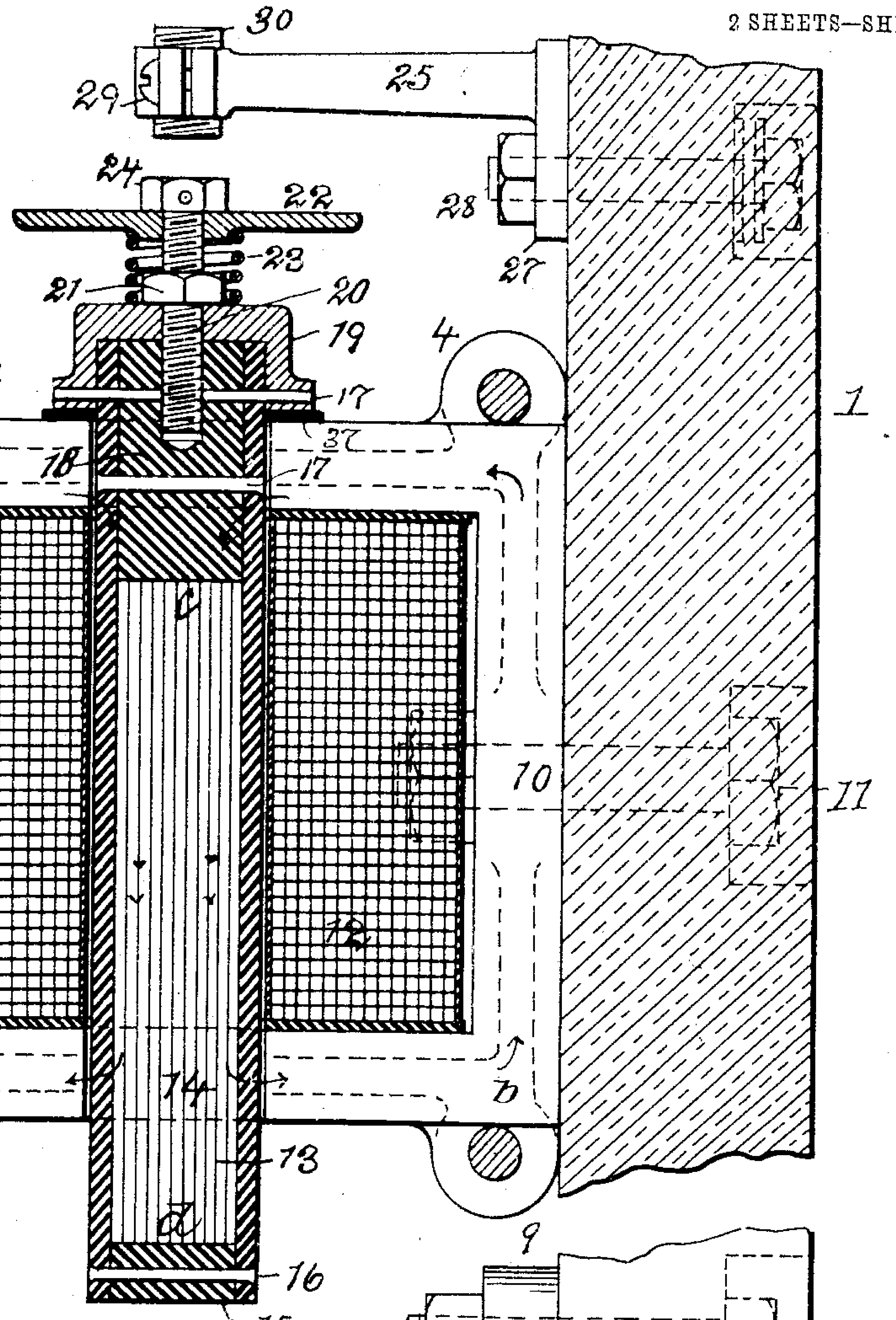
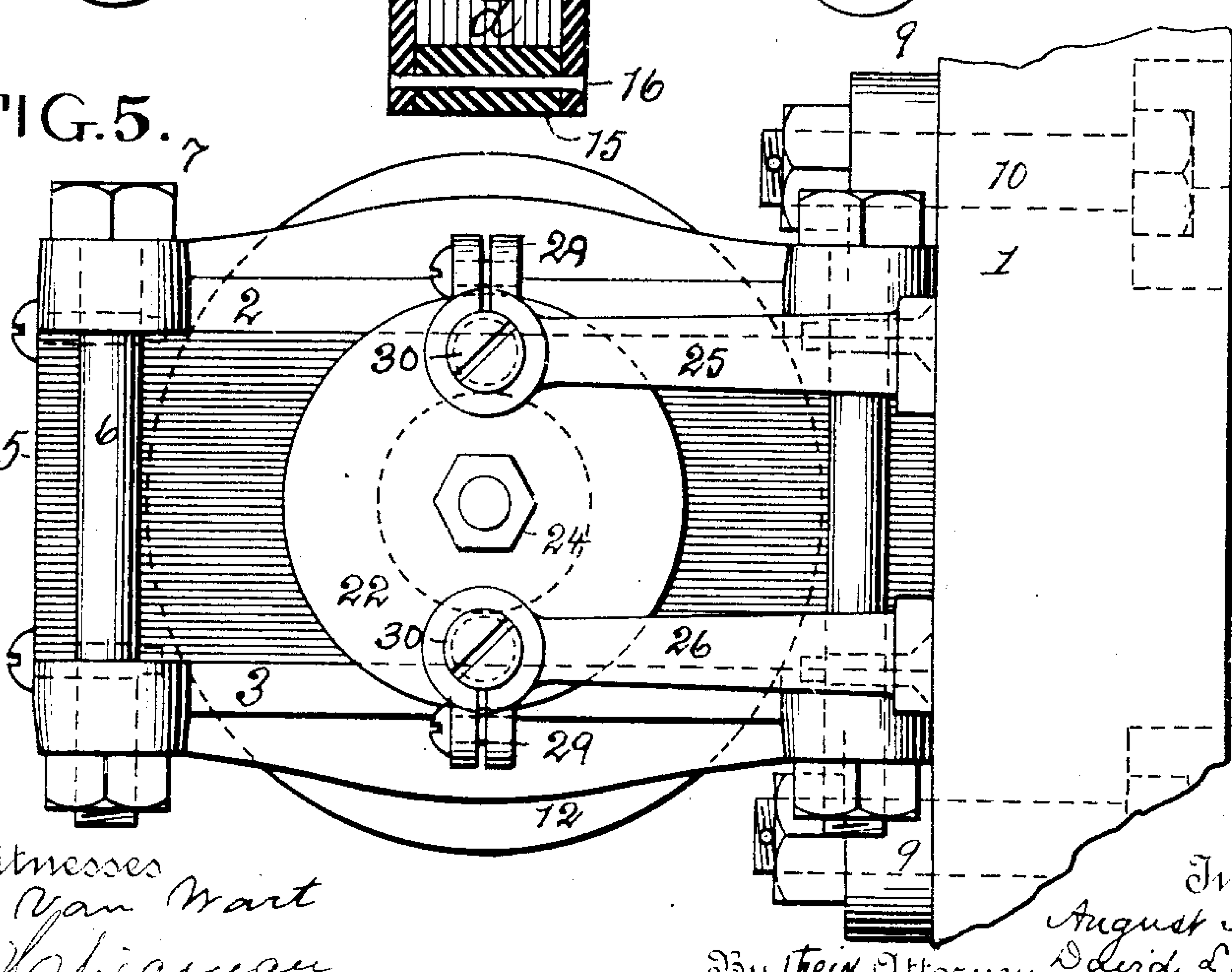


FIG.5.



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Parker Benjamin

UNITED STATES PATENT OFFICE.

AUGUST SUNDH AND DAVID LEONARD LINDQUIST, OF YONKERS, NEW YORK.

ELECTROMAGNET.

SPECIFICATION forming part of Letters Patent No. 791,591, dated June 6, 1905.

Application filed October 27, 1904. Serial No. 230,266.

To all whom it may concern:

Be it known that we, AUGUST SUNDH and DAVID LEONARD LINDQUIST, of Yonkers, Westchester county, New York, have invented a new and useful Improvement in Electromagnets, of which the following is a specification.

The invention relates to the prevention of chattering and other noises commonly made by armatures or other mechanism set in vibration by an alternating current.

The principle of the invention resides in causing the armature first to become magnetically equilibrated and then taking up by any suitable resilient means its vibrations due to current alternations in the magnet-coil.

The invention consists in the combinations and instrumentalities embodying this principle, as more particularly set out in the claims.

In the accompanying drawings, Figure 1 is a front elevation of our device, showing the electrical connections and the circuit-closer out of contact with the main circuit-terminals. Fig. 2 is a detail view of the upper part of the magnet in partial cross-section, showing the circuit-closer in contact with the main circuit-terminals. Fig. 3 is a detail view similar to Fig. 2, but illustrating a modified form of circuit-closer. Fig. 4 is a cross-section of the magnet on the line $x\ x$ of Fig. 1, showing the supporting-plate for the magnet and the brackets which carry the circuit-terminals. Fig. 5 is a top view of the magnet and a portion of the supporting-plate.

Similar characters of reference indicate like parts.

1 represents a portion of the supporting-plate for the magnet.

2 and 3 are rectangular frames of non-magnetic material, each provided with four projecting lugs 4. Between the frames 2 and 3 is placed a rectangular external core or frame 5 of laminated magnetic metal. The frame 5 is clamped between the two frames 2 and 3 by means of threaded bolts 6, which extend between the lugs 4 of said frames and are provided with setting-up nuts 7. The frame 5 is also held by means of the screws 8, Fig. 1, which enter holes made in said frame and the edge of the frames 2 and 3. On the outer side of each frame 2 and 3 are lugs 9, through which pass the bolts 10, which enter the supporting-plate 1 and have their heads 11 in countersunk openings in the back of said plate.

The laminated frame 5 incloses the solenoid 12, extending through which and also through the upper and lower members of frame 5 is a cylindrical opening which receives the armature 14, formed of longitudinally-extending iron wires inclosed in a tube 13, of non-inductive material, preferably wood fiber. Said tube is closed at its lower end by a plug 15, of non-inductive material, secured by the cross-pin 16. In its upper end above the wires is an elongated plug 18, of non-inductive material, secured by pin 17. Above this plug 18 there is a tubular flanged cap 19. Between the flange on cap 19 and the top of the armature is interposed a washer 37, which may be of elastic material. A screw 20 passes down through this cap and enters the body of the plug 18. Said screw is provided with a nut 21, which rests on the upper surface of the cap 19 and serves to hold the screw in adjusted position. Loosely fitting on the screw 20 is the circuit-closing plate 22, between which and the upper surface of the cap 19 is interposed a helical spring 23. The effect of the spring 23 is normally to hold the circuit-closing plate 22 against the polygonal screw-head 24. By setting the screw more or less inward by means of the head 24 the tension of the spring 23 may be regulated.

25 and 26 are bracket-arms provided with lugs 27, through which pass the fastening-bolts 28, by means of which said brackets are attached to the supporting-plate 1. At the end of each bracket-arm is a screw-clamp, through which passes a threaded contact-terminal 30. By loosening the clamps 28 the terminals 30 may be screwed up and down to adjust them and after adjustment they are held firmly in place by setting up the screw-clamps 29.

As shown in Fig. 1, the brackets 25 and 26 may be connected in any suitable circuit—for example, as one containing electric lights, illustrated diagrammatically at 32.

The terminals of the solenoid may be connected to the ends of the secondary coil 33. The primary coil 34 receives alternating current from any suitable source 31.

The operation of the device is as follows: Alternating current being established in the primary coil 34, a like current is induced in the coil 33 and the solenoid 12 to lift the armature 14, so bringing the circuit-closing plate 22 into contact with the terminals 30, thus establishing circuit through the plus and minus conductors to the lights 32. Inasmuch as the solenoid is energized by an alternating current, a vibration of the attracted armature due to the current alternations in the coil normally occurs. If the armature when in attracted position is not free, or, in other words, if it is permitted to meet a rigid unyielding abutment, it will by reason of its vibrations produce a chattering noise. It will be seen from Fig. 4 that the armature 14 when the magnet-coil is not energized has its upper extremity *c* below the upper member of the laminated frame or core 5 and its lower extremity *d* below the lower member of said frame. Obviously when the coil is energized the upper extremity *c* of the armature will rise until it reaches the plane of the upper surface of the upper member of frame 5, and at that point will remain the magnetic pull sustaining the armature in equilibrated position against the downward pull of gravity. The magnetic circuit through the frame or core 5 and the armature 14 will then be as indicated by the small arrows *a b*, and as the air-gap included in said circuit between armature and frame will be reduced to a minimum the magnetic resistance will similarly reduce. Under these circumstances the vibration of the armature due to current alternations in the coil will be very small and easily taken up by the spring 23. The spring is preferably to be adjusted in point of resiliency with respect to the highest position of the extremity *c* of the armature, so that no possible vibration of the latter can effect a compression of said spring sufficient to convert it into a substantially unyielding abutment. It will be observed, therefore, that the armature is, in fact, brought into an equilibrated position by the alternating current against a counteracting force—in the present case gravity—that it then, by closing to a minimum the air-gap in the magnetic circuit in which it is included, reduces the magnetic resistance in said circuit, and hence the current necessary for operating the device, and that finally the vibrations of the armature when in equilibrated position and due to the controlling alternating current are absorbed by the resilient abutment formed by the helical spring.

This construction and mode of making an electromagnet controlled by an alternating current we assert to be broadly new and pioneer invention.

In the modification shown in Fig. 3 the bracket-arms 25 and 26 carry at their ends contact-terminals in the form of spring-clips 35. The circuit-closing plate 22 and the spring 23 are omitted and the threaded screw 20 is provided with a knob 36, adapted to enter between the arms of the clip 35, which are suitably bent to receive it. In this construction it will be obvious that the armature may vibrate under the action of the alternating current and the knob 36 still be held by the clip 35, the arms of which will open and close sufficiently to permit of its movement. The said arms being themselves springs form, as before, a resilient abutment for said armature when the same is in attracted position and also take up the vibrations thereof due to alternations in the energizing-current.

We claim—

1. A movable body of inductive material, a source of alternating current, means controlled by said current for equilibrating said body, and means for taking up the vibrations of said equilibrated body due to current alternations.

2. A movable body of inductive material, a source of alternating current, means controlled by said current for equilibrating said body against the attraction of gravity, and means for taking up the vibrations of said equilibrated body due to current alternations.

3. A movable body of inductive material in magnetic circuit, a source of alternating current, means controlled by said current for moving said body to reduce the magnetic resistance in said circuit and for equilibrating said body, and means for taking up the vibrations of said equilibrated body due to current alternations.

4. The combination of a vertically-disposed solenoid-coil, a freely-movable armature therefor, a frame of laminated magnetic material surrounding the same and provided with openings coinciding with the axial armature-opening in said coil, frames disposed on opposite sides of said laminated frame, and means for clamping said laminated frame between said side frames.

5. The combination of a vertically-disposed solenoid-coil, a frame of magnetic material surrounding the same, and provided with openings coinciding with the axial armature-opening in said coil, and an armature freely movable and detachably suspended in said coil, and a resilient abutment receiving the thrust of said armature when attracted by said solenoid.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

AUGUST SUNDH.
DAVID LEONARD LINDQUIST.

Witnesses:
WM. H. SIEGMAN,
I. A. VAN WART.