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ELECTROMAGNETIC DEVICE.

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946,215.

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Fig. 2

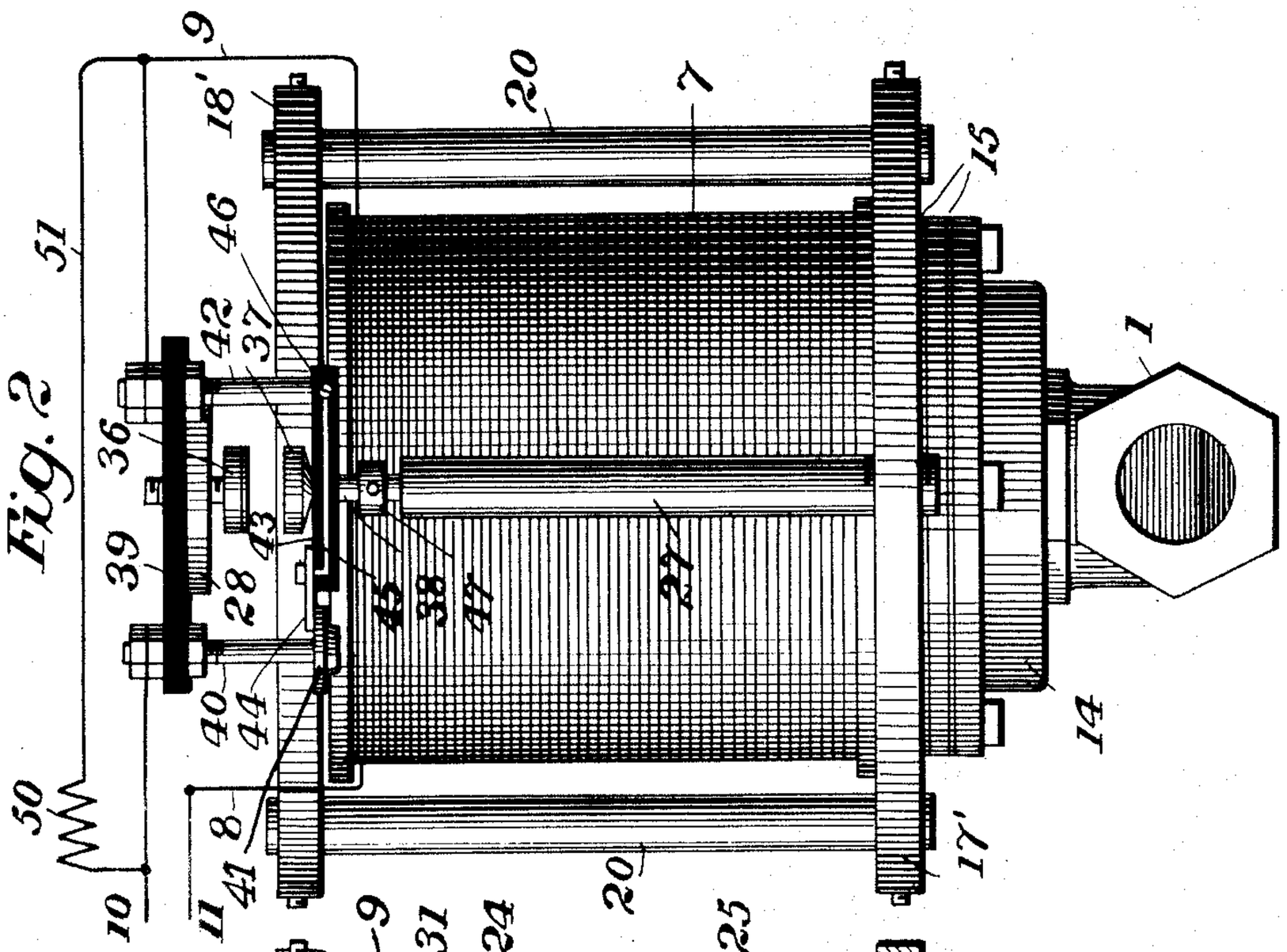

Fig. 1.

Witnesses

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ELECTROMAGNETIC DEVICE.

946,215. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed April 12, 1909. Serial No. 489,370.

To all whom it may concern:

Be it known that I, HARRY GRANT GEISSINGER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electromagnetic Devices, of which the following is a specification.

My invention relates to electro-magnetically operated devices and especially to electro-magnetic valves.

One of the objects of my invention is to provide an electro-magnetic device which shall have a large lifting power or attractive force, and for this purpose I provide for a large flow of current through the magnet coil while the load upon the armature is being lifted and an immediate diminution of the current after the armature has reached its attracted or holding position, such decrease in current being effected automatically by the change in the magnetic flux through the magnetic circuit.

Another object is to effect the regulation of the current without the use of switches mechanically operated by the movement of the armature or plunger of the magnet.

Another object is to provide a magnetically operated valve in which the moving parts are entirely incased and in which provision is made for the adjustment of the lift or stroke of the armature.

Other objects will appear from a consideration of the invention hereinafter described.

In order that my invention may be better understood, reference is made to the following description in connection with the accompanying drawings, in which—

Figure 1 is a vertical cross-section of one embodiment of my electro-magnetic valve; and Fig. 2 is an elevation of the same taken at right angles to Fig. 1.

It is well known that the operation of moderately sized valves under the ordinary steam pressures employed in engineering, by electro-magnetic means, presents unusual difficulties. In the majority of cases, the steam is withdrawn through the valve from a high to a low pressure and the pressure upon the valve-disk will be practically equal whether the valve is on or off its seat. Accordingly the electromagnet operating the valve-disk will be required to exert a pull, at a distance equal to the lift of the valve, as great as that required to hold or sustain the disk in its raised position. Now it is known that the attractive force or pull of an electro-magnet varies practically inversely as the square of the distance from its armature, and it will therefore be apparent that a much larger current will be required to start the armature from its distant position than will be required to maintain it in its position of closed contact. If the starting current is three times the amount of the holding or normal current, then the heat generated at the start will be nine times the normal. It is therefore necessary to provide some means for automatically reducing the current as soon as the armature has assumed its holding position. Various devices have been employed for introducing a resistance into the circuit, but in so far as I am aware, this has been accomplished by operatively connecting a switch or circuit-controlling device with the plunger to be operated upon completion of its stroke. I have found that such constructions are inapplicable to valves intended for high fluid pressures, by reason of the difficulty of maintaining the stuffing boxes. I have therefore devised an electromagnetic valve in which the plunger and valve operate within a closed chamber and the movement of the switch controlling the resistance or circuit connections is effected by a change in the magnetic condition of the magnetic circuit. I am thus enabled to operate the plunger and valve in a closed compartment without any exterior connections and thereby dispense with the use of stuffing boxes, and the structure can be readily made absolutely steam tight.

It is essential in valve operating devices that some means shall be provided for adjusting the lift or travel of the valve-disk, in order to provide for any alterations in the thickness of the disk or of the gaskets used in sealing the joints in assembling the parts. I have therefore provided an adjusting device to vary the lift or travel of the armature connected with the valve-disk. I also provide means to absorb the shock of the armature against the magnetic core, thereby avoiding any injury or stretching of the casing or plunger tube and also preventing any tendency to spread or "mushroom" the top of the plunger.

Referring to the accompanying drawings, 1 indicates the steam or fluid supply con-

nection forming the valve casing, having a valve seat 2 upon which the valve disk 3 is adapted to rest, said valve disk being connected by a stem to the plunger or armature 5 of a solenoidal magnet, which is provided with one or more energizing windings 7, the leads 8, 9 of which are adapted to be connected in a controlling circuit with a suitable source of electric energy by means of suitable conductors 10, 11. I have shown the plunger 5 operating within a plunger tube 13, constructed of non-magnetic material, said tube extending through the hollow magnet core and secured to the open top of the valve bonnet 14, and also to the magnet core, the joints being made steam tight by means of gaskets 15. I have shown the magnet core formed of two hollow alined magnetic members 17, 18, separated by an air-gap and provided with flanges 17′ and 18′ which are joined outside of the winding or coil 7 by means of yoke-bars 20 of such size that they may be magnetically saturated when the plunger is drawn up against the pole-piece 22. I have also provided adjustable yoke-bars 24, 25, which are separated by an air-gap, the amount of which may be varied by raising or lowering the bar 24, for the purpose of varying the magnetic reluctance of this path and determining the proportion of the magnetic flux that shall pass through the other paths of the yoke.

The path of the magnetism which actuates the switch operating device comprises an auxiliary yoke-bar 27, connected with core-portion 17, and the magnetic arm or plate 28, which projects from the opposite end of the magnet and extends over the bar 27, and is connected by means of a bolt 29, with the internal pole-piece 22. It will be observed that the pole-piece 22 is inside of the closed non-magnetic plunger-tube and is adjustable vertically by means of the bolt 29, which is screw threaded in tube 13, this arrangement being for the purpose of varying the amount of travel or lift of the plunger 5. For the purpose of absorbing the shock of the plunger, the pole-piece is recessed and contains a spring 30 against which the bolt 29 is adapted to rest and provision is made for the necessary yielding movement of the pole-piece by means of an enlarged cross-recess 31 in which the securing pin 32 is secured. The plunger may carry a non-magnetic plate 33, to prevent adhesion to the pole-piece.

The switch and its operating mechanism are carried by the bar or plate 28, and comprise an adjustable magnetic piece 36 having a stem screw-threaded into plate 28, and constituting a pole-piece for this auxiliary magnetic circuit; and a movable piece 37, constituting an armature and having a stem 38 mounted for vertical movement in a recess in the upper end of the yoke-bar 27. An insulating block 39, secured to the plate 28, carries binding post 40, having a contact 41 at its lower end, and binding post 42, to which is pivoted the insulating switch arm 43. A contact 44 secured on the outer end of the arm 43, coöperates with the contact 41, and is electrically connected with the binding post 42 by means of a conductor 45 and pivot pin 46. An adjustable stop 47 on the stem 38 engages the switch arm 43, when the armature 37 is attracted and raised against the pole-piece 36, thereby separating the contacts 41, 44.

The electrical circuits are clearly indicated in Fig. 2. When the armature and switch arm are in the lower position, as indicated, the current entering the lead 10, passes by way of binding post 40, contacts 41, 44, switch arm conductor 45, binding post 42 and terminal conductor 9 to the magnet coil 7 and returns by the other terminal 8 to the return lead 11. When, however, the armature 37 is attracted, raising the switch arm and separating the contacts 41, 44, the circuit previously traced is broken and the current from the lead 10 must first pass through a resistance 50 and conductor 51 to the magnet terminal 9, whereby the current through the magnet is reduced in proportion to the resistance thus introduced into the circuit. The switch operates to open the contacts and introduce the resistance after the plunger 5 has been raised, as will hereinafter appear.

By reference to Fig. 1, it will be seen that the magnetic flux or field generated by the current traversing the coil 7, passes from one core-part 17 to the other 18, mainly through the plunger 5, and the pole-piece 22 and the intervening air-gap, causing the plunger to be attracted, the return path of the flux being through the yoke-bars 20. Now, when the plunger has moved upwardly into contact with the pole-piece, the reluctance of the magnetic circuit will be greatly reduced, thereby causing such a large increase in the magnetic flux that the path through the yoke-bars 20 will become saturated, forcing a portion of the flux through the divided yoke-bars 24, 25, and the switch operating path through the bars 27, 28, including the pole-piece 36 and movable armature 37. The amount of flux passing through the latter path may be increased or diminished by adjusting the length of air-gap between the auxiliary divided yoke-bars 24, 25.

The operation of my electromagnetic valve will be understood from the foregoing description. The valve casing 1, is connected in the pipe in which the passage of steam or other fluid is to be controlled, and the leads 10, 11, are connected to the thermostat or other electric controlling device. When the valve-disk 3 is to be lifted from its seat, the full strength of the current flows through

the magnet coil and exerts the maximum power to lift the plunger. As soon as the plunger has lifted the valve-disk and has closed the air-gap between the plunger and the pole-piece 22, thereby decreasing the reluctance through the core, the increase in magnetic flux will saturate the yoke-bars 20, and cause a marked increase in the flux through the bolt 29, arm 28, switch parts 36, 37, and yoke-bar 27, thereby causing the movable switch member 37 to move upward into contact with pole 36. This raises the switch arm 43 and introduces the resistance 50 into the circuit, cutting down the current through the magnet coil to any predetermined amount, depending upon the pull necessary to maintain the plunger in its raised position. The switch armature 37 is maintained in contact with the pole piece 36 by a magnetic flux, mainly due to magnetic reluctance of the gap between pole-piece 22 and core part 18, carrying the major portion of the magnetic flux. My invention thus provides a means for operating a current-controlling switch which depends upon the movement or position of the plunger or armature of the magnet, but is independent of any mechanical connection therewith.

My electromagnetic valve is especially adapted to control steam or other fluid-controlling valves, because I am enabled to inclose the plunger in a sealed chamber directly connected with the valve chamber and to dispense with stuffing boxes and their attendant difficulties of maintaining tight joints under pressure.

It will be apparent to engineers in this art, that many changes may be made in the structure of the device or in the arrangement of circuits while retaining the salient features of my invention.

I claim:—

1. An electromagnetic device comprising an electromagnet, means for varying the amount of current flowing through the energizing windings thereof, an armature, and means for operating said current-varying means responsive to a change of magnetic flux in the core of the magnet.

2. An electromagnetic device comprising an electromagnet, an armature and means mechanically independent of the armature for varying the current through the energizing windings thereof, dependent upon the position of the armature.

3. An electromagnetic device comprising an electromagnet, an armature, and means for varying the strength of the electric current passing through the windings of the magnet comprising means responsive to a change in the reluctance of the magnetic circuit.

4. An electromagnetic device comprising an electromagnet, an armature, a pole-piece, a support for said pole-piece, cushioning means between the pole-piece and its support and means for adjusting the support to cause the pole-piece to move toward or from the armature.

5. An electromagnetic device comprising an electromagnet, an armature, a sealed tube surrounding said armature, a magnet pole-piece within said tube, a support for said pole piece adjustable within said tube, and cushioning means between the pole-piece and its support.

6. An electromagnetic device comprising an electromagnet, an armature, a switch connected to the energizing windings of the electromagnet and adapted to vary the current flowing through said windings, main and auxiliary magnetic circuits, and means in said auxiliary magnetic circuit for operating said switch.

7. An electromagnetic device comprising an electromagnet, an armature, a switch connected to the energizing windings of the electromagnet and adapted to vary the current flowing through said windings, a sealed chamber inclosing said armature, a plurality of magnetic paths for the magnetic flux of the magnet, means in one of said paths for operating said switch, and means for varying the relative proportion of the magnetic flux traversing said paths.

8. In an electromagnetic device, an electromagnet, an armature, a switch controlling a circuit connected with the energizing windings of the magnet, and means for operating said switch dependent upon the magnetic saturation of a portion of the magnetic circuit of the magnet.

9. In an electromagnetic device, an electromagnet, an armature, a switch controlling a circuit connected with the energizing windings of the magnet, means for operating said switch dependent upon the magnetic saturation of a portion of the magnetic circuit of the magnet, and adjustable means for controlling the saturation of said portion of the magnetic circuit.

10. In an electromagnetic device, an electromagnet, an armature, and a switch member arranged to vary the resistance of the energizing circuit of the magnet, said switch being caused to operate by the magnetic saturation of a portion of the magnetic circuit of the magnet.

11. In an electromagnetic device, an electromagnet, having a plurality of magnetic paths, one of said paths comprising a portion having a substantially fixed magnetic reluctance and another portion having a reluctance depending upon the magnetic saturation, an armature, a switch for controlling the circuit of the electromagnet, and means for operating said switch depending upon the magnetic saturation of one of said paths and maintained in position by reason of the fixed magnetic reluctance of said other path.

12. In an electromagnetic device, an electromagnet, having a plurality of magnetic paths, one of said paths comprising a portion having a substantially fixed air-gap and another portion having a reluctance depending upon the magnetic saturation, an armature, a switch for controlling the circuit of the electromagnet, and an auxiliary armature operatively connected to said switch, said auxiliary armature being raised by the increased magnetic flux caused to pass therethrough by the magnetic saturation of a portion of one of said paths and maintained in its raised position by reason of the reluctance of said fixed air-gap.

13. An electromagnetic device comprising an electromagnet, a reciprocable member, an armature operatively connected to the reciprocable member, a sealed tube surrounding said armature, a magnet pole-piece within said tube, and means for varying the strength of the electric current passing through the windings of the magnet comprising means responsive to a change in the reluctance of the magnetic circuit.

14. An electromagnetic device comprising an electromagnet, a reciprocable member, a casing surrounding said member, an armature operatively connected to the reciprocable member, a sealed tube surrounding said armature and communicating with said casing, a magnet pole-piece within said tube, and means for varying the strength of the electric current passing through the windings of the magnet comprising means responsive to a change in the reluctance of the magnetic circuit.

In testimony whereof I affix my signature, in presence of two witnesses.

HARRY GRANT GEISSINGER.

Witnesses:
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