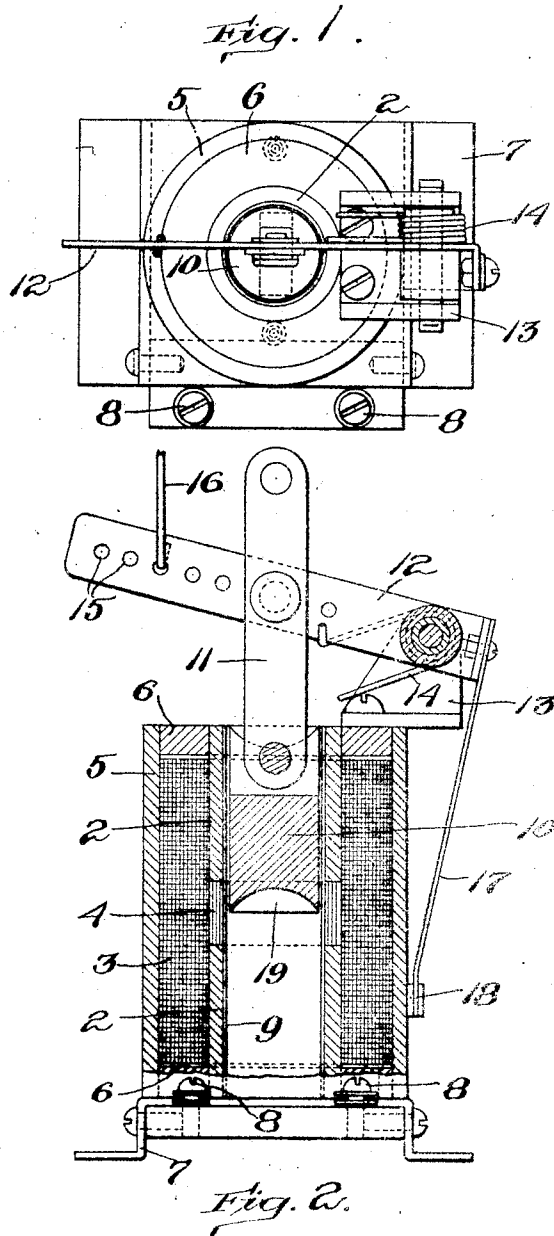


1,209,646.

Patented Dec. 19, 1916.



Witnesses:
Mary A. O'Brien.
Joseph T. Brennan.

Inventor:
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by E. D. Chadwick, atty.

UNITED STATES PATENT OFFICE.

WALTER C. REED, OF DALTON, MASSACHUSETTS, ASSIGNOR TO THE TELELECTRIC COMPANY, OF PITTSFIELD, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

ELECTROMAGNET.

1,209,646.

Specification of Letters Patent.

Patented Dec. 19, 1916.

Application filed January 30, 1913. Serial No. 745,095.

To all whom it may concern:

Be it known that I, WALTER C. REED, a citizen of the United States, residing at Dalton, in the county of Berkshire and State of Massachusetts, have invented new and useful Improvements in Electromagnets, of which the following is a specification.

This invention is particularly intended to provide an electro-magnet which will be serviceable in connection with automatic piano-playing apparatus for operating a pedal of the piano. Such a magnet should be capable of exerting a strong pull and of operating very quickly, and these characteristics are found to a marked degree in the magnet hereinafter described, which also has the advantage that it is very economical as regards the consumption of electric current.

The features of construction and arrangement in which my invention resides are hereinafter described in connection with the accompanying drawing, in which—

Figure 1 is a top plan view of my pedal-operating magnet as preferably constructed; and Fig. 2 is a central longitudinal section through the same, showing certain associated parts in side elevation.

The magnet shown in the drawing, which is of the solenoid type, comprises two tubular soft iron cores 2—2 surrounded by the wire coil 3 of the magnet and separated within the coil by a space 4 which may be filled with non-magnetic material if desired but is in effect a gap. The coil 3 is surrounded by a soft iron shell or jacket 5, and the spaces between the cores 2 and the jacket 4 at the ends of the coil are bridged by soft iron disks 6, thus forming a magnetic circuit around the coil 3 which is complete except at the gap 4, where a high reluctance exists. The parts above described are secured to a suitable base 7 having binding posts 8 through which the circuit wires are connected to the ends of the coil, and preferably the cores 2 are lined with a very thin brass tube 9.

In the hollow interior of the magnet is located a soft iron plunger 10, which is adapted to slide longitudinally in the tube 9 and is connected by suitable means to the part which is to be operated by the magnet. In the example represented, in which the magnet occupies a vertical position, a link 11 is pivoted at its lower end within a vertical slot in the upper end of the plunger and

is also pivoted above the plunger to a lever 12 pivotally mounted on a fixed bracket 13, which lever is provided with a lifting spring 14 and with a series of holes 15 for connecting it to a pull wire 16 or the like. This wire 16 is intended to be connected to the damper mechanism of the piano, and by locating said wire in a suitable one of the holes 15 the extent of its movement may be regulated as circumstances may require. An additional capacity for adjustment of these parts is secured by providing the link 11 with a perforation at each end and also with an intermediate perforation located at different distances from the end perforations, so that said link may be pivoted to the plunger at either end and to the lever 12 at its opposite end or between its ends, as desired.

For arresting the upward movement of the plunger 10 and connected parts I prefer to employ a stop consisting of a spring strip 17 secured to the lever 12 and having its free end located in position to abut against the exterior of the magnet when the plunger is in its uppermost position. The yielding character of the strip 17 prevents shock and noise in the operation of the magnet, and for the same purpose the free end of said strip is provided with a felt tip 18.

The fixed soft iron parts included in the magnetic circuit are preferably given such dimensions that their cross-sectional area at any point in the circuit is at least equal to the cross-sectional area of the plunger 10, which has a greater length than the gap 4 and a diameter substantially equal to the internal diameter of the cores 2, so that when said plunger is in its uppermost or normal position, in which it is located mainly within the upper core 2, there is practically no reluctance between it and said core. When in this position the lower end of the plunger is located somewhat above the lower core 2 and preferably about midway of the gap 4, as shown in Fig. 2.

The result of the construction above described is that when the magnet is energized the magnetic stress is concentrated within a very small space, namely, the space between the lower end of the plunger 10 and the upper end of the lower core 2, and the stress thus concentrated exerts on the plunger a powerful attracting effect which grows greater as the plunger moves downward and reaches its maximum when the lower end of

the plunger enters the plane of the upper end of the lower or attracting core. From this point the plunger moves into said core until a sufficient area of the plunger has been enveloped thereby to satisfy the magnetic flux through the iron circuit, which requires but a short movement of the plunger, and hence said plunger is not only subjected to a powerful pull but also has a relatively small range of movement. These facts, in connection with the fact that the plunger is comparatively light as compared with the total weight of the magnet, result in giving the magnet the capacity to operate very rapidly with all the force required for actuating the damper mechanism of a piano. Magnets of similar construction may also be used with good results for operating the keys of a piano, and in fact in various other situations where strength and rapidity of action are desirable, as will be evident.

The lower end of the plunger 10 is preferably concaved as shown at 19 in order to increase the concentration of the magnetic stress at this point, but this is not essential, nor is it essential that the gap 4 occupy a position midway between the ends of the magnet.

Various other changes in the construction and arrangement of the parts may be made without departing from my invention.

I claim:—

1. An electro-magnet comprising a cylindrical coil, a soft iron casing including a tubular core and completely inclosing the coil externally and internally except for an annular gap within the coil, the width of the gap being much less than the length of said coil, a soft iron plunger arranged to slide longitudinally within the tubular core and substantially filling the latter transversely, said plunger having a greater length than the gap and being movable across the latter,

means for connecting the plunger to the part to be operated thereby, and a spring for normally maintaining said plunger with its forward end located opposite said gap.

2. An electro-magnet comprising a cylindrical coil, a soft iron casing including a tubular core and completely inclosing the coil externally and internally except for a gap within the coil, the width of the gap being much less than the length of said coil, a soft iron plunger arranged to slide longitudinally within the tubular core and substantially filling the latter transversely, said plunger being movable across the gap and having a greater length than the latter and a cross-sectional area not exceeding the cross-sectional area of the casing at any point in the magnetic circuit, means for connecting the plunger to the part to be operated thereby, and a spring for normally maintaining said plunger with its forward end located opposite said gap.

3. An electro-magnet comprising a cylindrical coil, a soft iron casing completely inclosing the same externally and internally except for a gap the width of which is much less than the length of the coil, a soft iron plunger movable across the gap in proximity to the casing, a pivotally-mounted arm and connections between the same and the plunger, means for elevating said plunger, and a spring strip secured to said arm and constituting a stop located in position to maintain the forward end of the plunger opposite said gap.

In testimony whereof, I have hereunto subscribed my name this 24th day of January, 1913.

WALTER C. REED.

Witnesses:

PHILIP W. GOEWEX,
GEORGE P. REES.