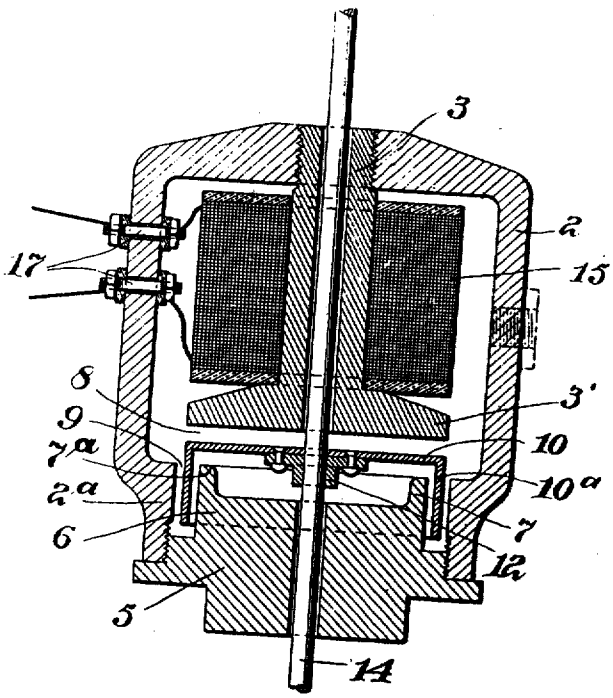
H. G. GEISSINGER.

LIFTING MAGNET.

APPLICATION FILED JULY 1, 1918.

1,333,542.

Patented Mar. 9, 1920.



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UNITED STATES PATENT OFFICE.

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LIFTING-MAGNET.

1,333,542. Specification of Letters Patent. Patented Mar. 9, 1920.

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To all whom it may concern:

Be it known that I, HARRY G. 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 Lifting-Magnets, of which the following is a specification.

This invention relates to lifting or pulling magnets provided with an armature the movement of which through a predetermined air gap is utilized to perform work.

Every electro-magnet has two air-gaps in the magnetic circuit and in the majority of cases, represented by the plunger type, only one of the gaps is utilized to exert a tractive effort but the other gap, due to its magnetic reluctance, absorbs a certain proportion of the energy of the magnetizing coil. The object of my invention is to provide a construction which greatly reduces the magnetic reluctance of the idle gap over prior constructions and to secure the greatest tractive effort with the minimum expenditure of electrical energy.

The tractive effort exerted between two poles or across a variable gap, with the number of lines of force per unit area remaining the same, depends upon the square of the magnetic force across the gap and the square of the diameter of the gap. If the reluctance of the idle gap is equal to that of the tractive gap, the magnetic force acting across the active gap would be represented by 0.5, and the tractive effort by 0.25 of the pull, which would be exerted if there were no idle gap, neglecting of course the slight amount absorbed by the reluctance of the iron of the magnetic circuit. This represents the best practice in magnetic structures. If the reluctance of the idle gap is reduced to one quarter of that of the active gap, the magnetic force at the active pole will be 0.8 and the tractive effort 0.64 of the theoretical magnetic structure.

From the foregoing facts regarding magnetic structures it is evident that the tractive effort is increased by increasing the diameter of the pole or gap, the number of lines of force per unit area remaining the same. Owing to mechanical difficulties of increasing the area of the poles by means of polar extensions in the ordinary forms of magnetic structures, together with the necessity of increasing the area of the idle gap, polar extensions are rarely employed and in consequence the magnet cores are worked at low-flux density. My improvement in the arrangement of the magnetic structure provides an extended pole piece and an enlarged idle gap which is mechanically convenient, occupies a minimum of space and permits the use of an armature of minimum weight. These several advantageous features are of importance where small forces are available.

My invention will be understood from the following detailed description in connection with the accompanying drawing, which represents a longitudinal vertical sectional view of a lifting or traction magnet embodying the features claimed.

The magnetic structure comprises a cylindrical shell or casing 2, having an aperture in its closed end into which the core 3 is threaded or otherwise secured, the lower or polar end having an extension 3′. The base 5, also of magnetic material, is preferably threaded to the outer annular rim of the shell and is provided with an inwardly projecting cylindrical extension 6, which is cupped or hollowed out to form an annular lip or ring portion 7, said cylindrical extension forming with the throat portion 2^a of the shell, an annular air gap 9. The armature 10 may be conveniently formed by drawing a disk of magnetic material into the shape of a shallow cup, the annular flange portion 10^a extending into the annular air-gap 9, which constitutes the idle gap of the magnetic circuit. The armature may be attached to a boss 12, carried by an operating stem 14. The stem may be connected in any suitable manner to a valve, switch, or any other mechanism to be actuated. It is shown as sliding through the core 3 and base member 5, but it is evident that it may only slide within the core if desired, depending upon the duty of the magnet. In fact, this magnetic structure can be readily made air tight and the armature stem may act as the valve stem where the valve seat is made a part of the magnetic structure. The energizing coil or winding 15 surrounds

the core as usual and may be supported upon the polar extension 3'. The terminals of the coil may be connected to binding posts or bolts 17, which pass through insulating bushings located in apertures in the wall of the shell.

It will be understood by those familiar with magnetic devices that the lines of force or magnetic flux generated by the current flowing in the energizing coil 15, traverse the core, spread out through the pole piece 3', bridge the active gap 8, and thereby create a stress or pull which results in lifting the armature to the pole piece. The lines of force spread out radially in the armature, passing into the annular flange 10^a and then jumping the double gap in opposite directions to the cylindrical base extension and the neck of the shell respectively, the lines completing the circuit through the shell to the core.

It is apparent that the degree of saturation of the armature is uniform throughout the diameter of the pole and only decreases to zero in the annular flange or lip 10^a, and hence the mass or weight of the armature is effectively used in carrying the flux lines.

In actual construction the armature may readily be formed with the flange or lip portion about equal in height to one-third of the diameter of the top or main body portion, or to provide a flange area within the annular idle gap between the base and shell, about equal to twice the area of the active polar gap between the top of the armature and the pole piece. The clearance between the annular lip of the armature and the opposite walls of the annular gap can usually be reduced to one half the length of the active polar gap: so that, as in the example taken above, the reluctance of the idle gap would be one quarter of that of the active gap. The oppositely acting stresses in the annular idle gap are balanced and therefore neither add to nor subtract from the tractive effort of the magnet. The small stress in the gap between the top edge 7^a of the cylindrical lip of the base extension and the under side of the armature is so slight as to be practically negligible as will be apparent from a consideration of the relation of parts. The distance between the lip edge 7^a and the armature is at least twice as great as the distance laterally or radially in the annular gap from the armature flange to the walls of the gap. Now, the distribution of flux is inversely as the magnetic reluctance of the several paths or length of the gap. If the vertical gap distance be twice the radial gap distance and the edge surface 7^a of the lip is one-eighth of the armature surface extending within the annular gap, then the proportion of flux lines between the lip edge and the lower side of the armature would be one-sixteenth of that passing through the annular gap or the active gap.

The pull of the magnet is in proportion to the

$$\frac{\text{square of the flux lines}}{\text{area of the gap}}.$$

As the area of the lip edge gap is one-quarter of that of the working gap, the downward or negative pull would be equal to $\frac{(1/16)^2}{\frac{1}{4}}$ or $\frac{1}{64}$th of that of the active gap. The efficiency of the system is therefore, $\frac{63}{64}$.

The manner in which I am enabled to obtain the several advantages above enumerated and to greatly enhance the efficiency of electro-magnetic devices and which is due to the structural arrangement of parts of the magnetic circuit will now be apparent to engineers.

I have described in detail the particular construction illustrated in the accompanying drawing for the purpose of clearly disclosing an embodiment of my invention, but it will be evident that various modifications and changes may be made without departing from my invention.

I claim:—

1. A lifting or traction magnet having a magnetic structure provided with an active gap across which the tractive effort is exerted and an idle gap, and an armature operative within the active gap and having an offset portion extending within the idle gap.

2. A lifting or traction magnet having a magnetic structure provided with an active gap across which the tractive effort is exerted and an annular idle gap, and an armature operative within the active gap and having an annular offset lip portion or flange projecting into the idle gap.

3. A lifting or traction magnet having a magnetic structure provided with a shell portion constituting the return for the magnetic circuit, a pole piece extending inwardly from the closed inner yoke end of the shell, and an armature operative in the active gap in front of the pole piece and having an offset lip portion extending adjacent the inner wall of the outer end of the shell, the space between said lip and said inner shell wall constituting an idle gap.

4. A traction magnet having a magneti structure provided with a shell portion, a core portion extending inwardly from the inner yoke end of the shell and having an enlarged pole piece, an energizing winding surrounding the core portion, a base member fitting within the outer end of the shell and having an inwardly projecting part extending adjacent the inner shell wall, the annular space therebetween constituting the idle gap, and an armature operative in front

of the pole piece and having a flanged annular lip or skirt portion extending within said idle gap.

5. A traction magnet of the shell type having a closed magnetic circuit provided with interior active and idle gaps, the latter being in the form of an annular space, and a cup-shaped armature having the annular side or lip portion extending within said annular space and the main body portion operative within the active gap.

In testimony whereof I affix my signature.

HARRY G. GEISSINGER.