No. 837,174. PATENTED NOV. 27, 1906.

C. E. F. AHLM.

LIFTING MAGNET.

APPLICATION FILED MAY 22, 1906.

Fig. 1.

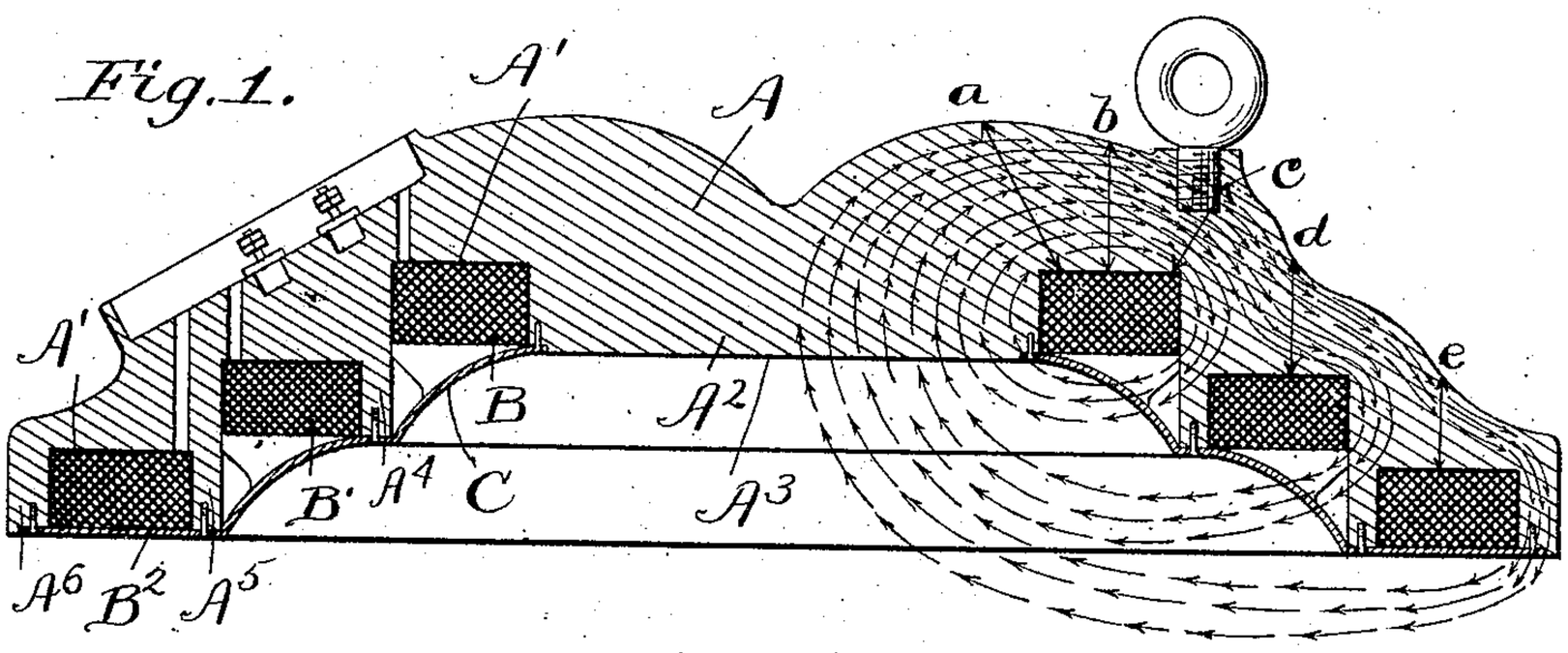
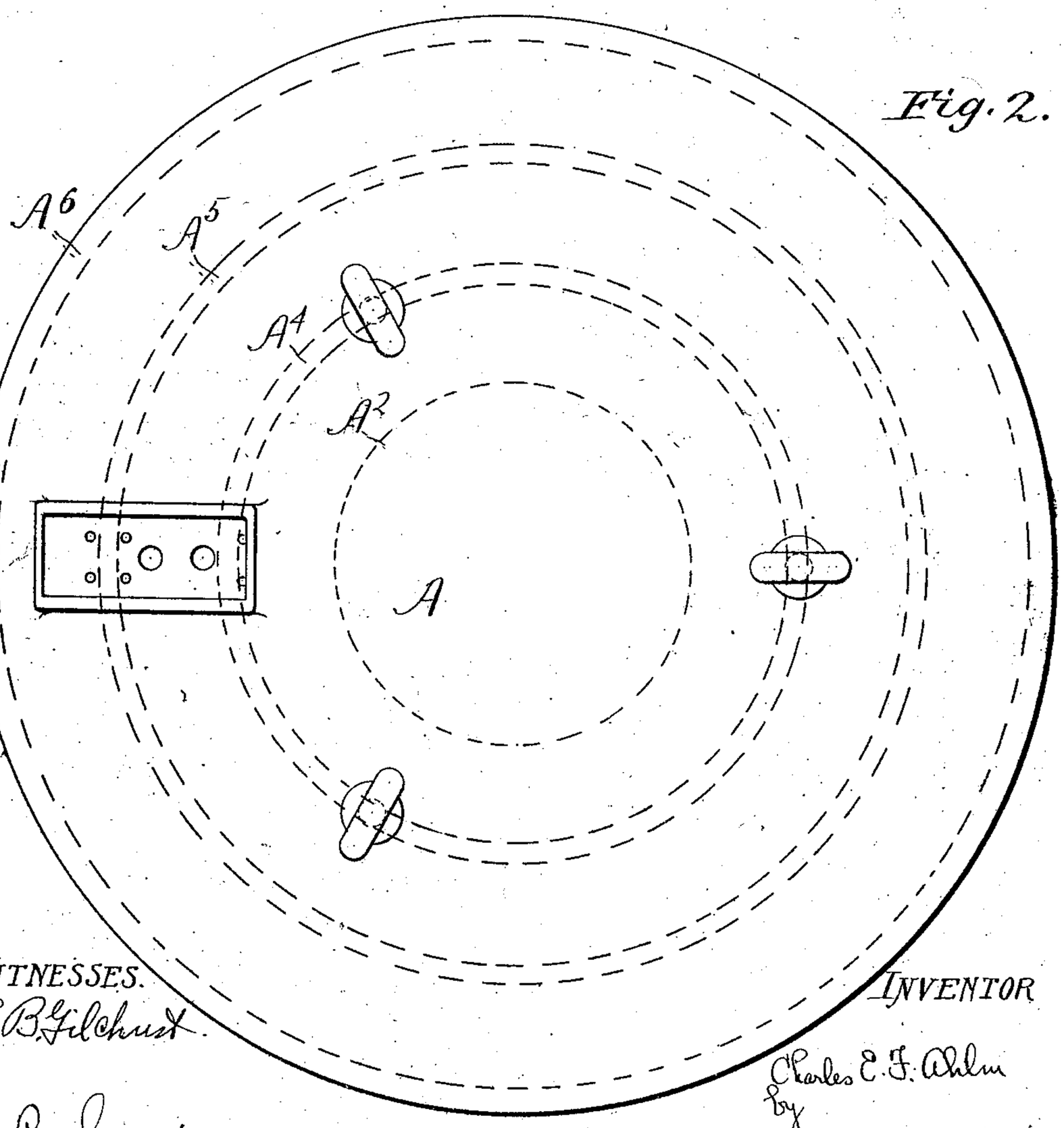



Fig. 2.

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## LIFTING-MAGNET.

No. 837,174. Specification of Letters Patent. Patented Nov. 27, 1906.

Application filed May 22, 1906. Serial No. 318,117.

*To all whom it may concern:*

Be it known that I, CHARLES E. F. AHLM, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Lifting-Magnets, of which the following is a full, clear, and exact description.

This invention relates to certain improvements designed to be used in loading and unloading and transferring pig-iron and scrap and articles capable of magnetization, and more particularly relates to a construction whereby small articles packed in piles—such as nails, axles, and castings—may be handled in bulk. Heretofore when flat-bottomed magnets have been employed for this purpose the results have not been satisfactory, owing to the fact that the magnetic flux would travel in the path of least reluctance between the separate poles and thus skim merely the surface of the pile. It has been attempted to overcome this defect by causing the flux to approach the central pole normal to the surface thereof, and it has been sought to accomplish this effect by constructing the magnet so that the frame extends both outside of the coil and partly through the same. This last-mentioned structure I have not found satisfactory and do not use, as it does not seem to me to be based on the essential principles, and I have designed a magnet which causes the flux to enter deep into the pile of material and exert a greater lifting effect than has been hitherto obtained and in which I employ a plurality of coils, some of which are below the plane of the others. These coils have separate outer poles which extend over and embrace their respective coils, and they are each wound so that the magnetic flux passes to a common inner pole which extends entirely through the upper coil and does not extend within the lower coil or coils. This construction is not so subject to loss in leakage as the type previously referred to, in which a single coil is used, with one of the poles extending outside of the coil and the other partly through the same. My construction is attended by further advantages, which will appear from the description below, whereby it will be shown how the magnetic flux is forced to enter deep into the mass of the material instead of being allowed to pass merely over the surface.

In the accompanying drawings, Figure 1 is a vertical cross-section of a magnet in which I have used three separate coils placed concentrically about a common central pole-piece, each succeeding coil being below the plane of the inner coils. Fig. 2 is a plan view of the same.

Referring to the figures, it will be seen that the frame A of the magnet, which is preferably a casting of great magnetic permeability, is, as shown in Fig. 1, provided with three annular concentric magnetic coils B B′ B², held in channels A′ on its lower face by a retaining-frame C, suitably shaped, which bracket is of brass or some equivalent material. It will be seen that the frame is cup-shaped and that the inner or central pole-piece $A^2$ extends entirely through the inner coil, so that its polar face $A^3$ is on the same plane with or slightly below the plane of the lower face of the inmost coil B, thus avoiding any waste in the way of leakage. The upper plane of the next outer coil B′ is below the plane of the said polar face $A^3$ and is embraced on each side by depending annular pole-pieces $A^4$ $A^5$. The outermost coil $B^2$ is likewise below the pole-piece $A^4$ and the lower plane of the intermediate coil B′ and is embraced on each side by the depending annular pole-pieces $A^5$ and $A^6$. It is obvious that this structure can be expanded to any amount within practical limits and any number of coils be used according to the requirements of the magnet. Any suitable means may be employed for retaining the coils in their grooves; but the frame C which I have shown is annular and has upwardly-extending braces at intervals to support the innermost and intermediate coils and a flat ring for supporting the outermost coil and is a simple form easily and cheaply constructed; but it is obvious that other means may be employed.

The several coils are so wound that the magnetic flux passes around each in the same direction, thus enabling me with a properly-constructed magnet to have the central pole-piece of one polarity and each of the outer pole-pieces of a polarity opposite to that of the central pole-piece. While it has hitherto been thought that this condition of affairs could not be maintained, such opinion has been based upon the idea that if currents were passed through a plurality of coils in the

same direction their combined effects on the intervening pole-piece would be neutralized. Such, however, is not the case if the magnet is properly constructed.

I have indicated in Fig. 1 proportionate dimensions of certain parts of the path which the magnetic flux must take in passing through the body of the magnet. The total area of the face of the inner pole is two hundred and fifty-four square inches in one of the magnets I have constructed. If a circular section of this magnet be taken at the radial distance *a*, the cut surface will present approximately two hundred and fifty-four square inches. A circular section around the magnet at the radial distance *b* and *c* will each present about two hundred and eighty-five square inches in cross-section. A similar cut on the line *d* will give two hundred and seven square inches in cross-section. A similar cut on the line *e* will give one hundred and ten square inches in cross-section. Thus it will be seen that the magnetic capacity passing from the central pole-piece through the body of the magnet to the outermost pole-piece is diminished to such an extent that while the entire flow can pass through the body of the magnet over the innermost coil B the resistance will become so great in passing over the second coil B′ that a portion of the flux will pass out through the intermediate pole-piece $A^4$ between the first and second coils, and the same division of the flow will take place in passing over the third coil $B^2$, as indicated by dotted arrows in Fig. 1. With the proportions indicated this action inevitably takes place.

When such a magnet is lowered onto the material to be lifted and the inner coil energized, the upper layer of the material is magnetized and is drawn into the cup against the inner pole-piece. The second coil being energized causes another and lower layer of the material to be magnetized and pulled upward, and if more than two coils are used the action and result are the same.

The magnetism created by each coil saturates each successive layer and forces the magnetic flux of each succeeding outer coil to penetrate deeper and deeper into the pile, thus magnetizing a greater quantity of the material and causing the flux from the outer poles by reason of being forced inward toward the center of the pile of material to approach the central or inner pole along lines normal to the surface of the latter. This results in endowing the magnet with the highest lifting capacity.

I preferably connect up the coils in parallel in order to obtain a certain manipulative advantage in handling small articles. When such articles are transferred to the point of discharge, either the entire lot may be dropped at once by opening the circuits of the coils at the same time or the material may be dropped gradually by opening the circuits of each coil successively, beginning with the outer coil. This latter procedure may be used to advantage where it is desired to distribute the material handled.

Having thus described my invention, I claim—

1. A lifting-magnet having a central pole-piece and two or more pole-pieces encircling said central pole-piece, being of a polarity opposite to that of the central pole-piece and having their polar faces below the plane of the face of the central pole-piece.

2. A lifting-magnet having a central pole-piece, and two or more pole-pieces enveloping said central pole-piece, and depending below the polar face of the central pole-piece.

3. A lifting-magnet having a central pole-piece and two or more depending pole-pieces extending below the polar face of the central pole-piece and enveloping the latter, each of said depending pole-pieces having a polarity opposite to that of the central pole-piece.

4. A lifting-magnet having a central pole-piece and two or more surrounding pole-pieces depending below the plane of the polar face of the central pole-piece, and coils for said depending pole-pieces, said coils being in parallel.

5. A lifting-magnet comprising a top plate having three or more pole-pieces depending therefrom, one of which pole-pieces is enveloped within the others, coils arranged on said depending pole-pieces, each of the inner pole-pieces passing entirely through the coil arranged thereon and terminating above the plane of the next outer coil.

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

CHARLES E. F. AHLM.

Witnesses:
J. M. WOODWARD,
H. R. SULLIVAN.