A. C. EASTWOOD.

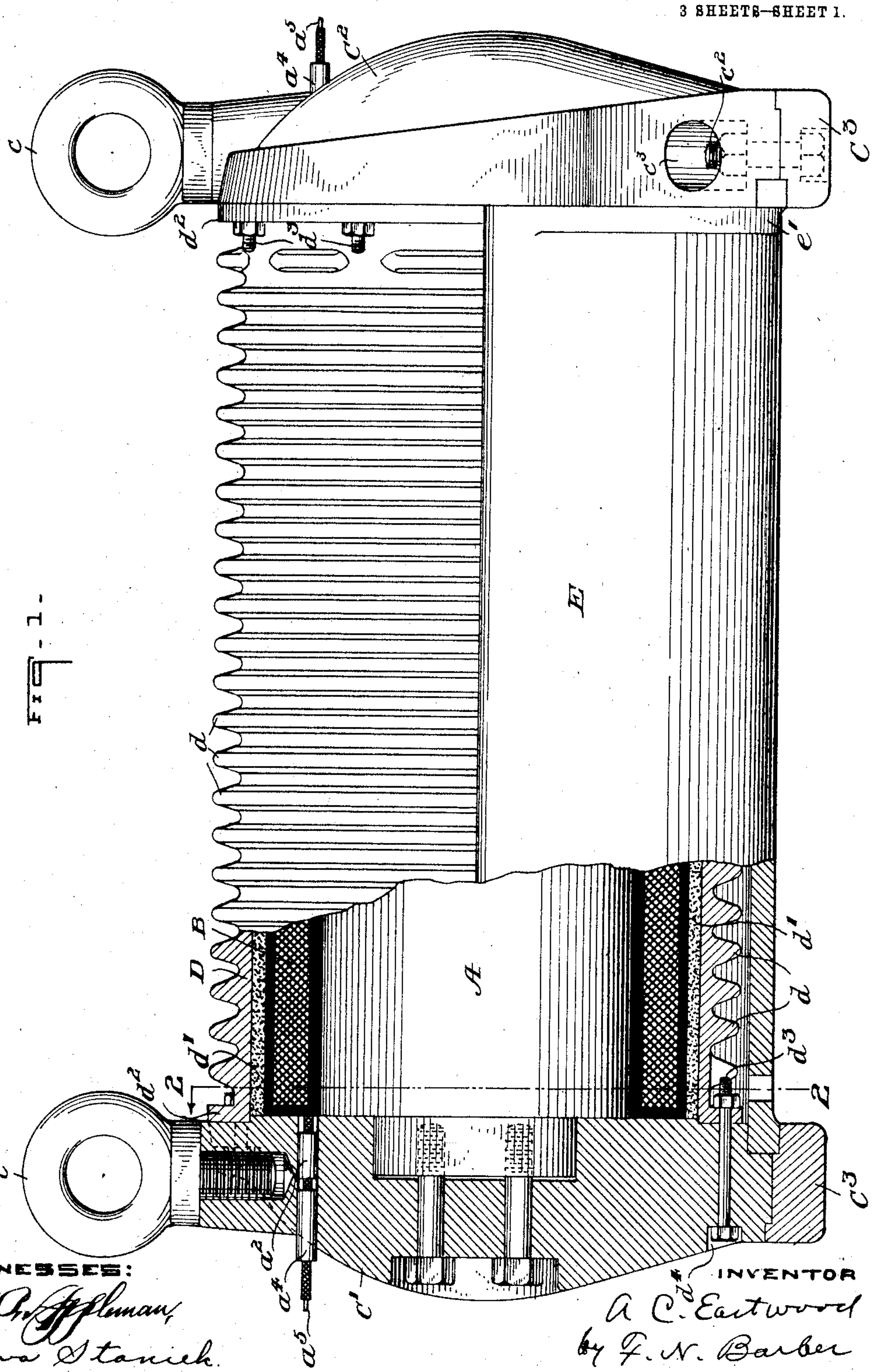
LIFTING MAGNET.

APPLICATION FILED JULY 17, 1908.

979,750.

Patented Dec. 27, 1910.

3 SHEETS—SHEET 1.



WITNESSES:

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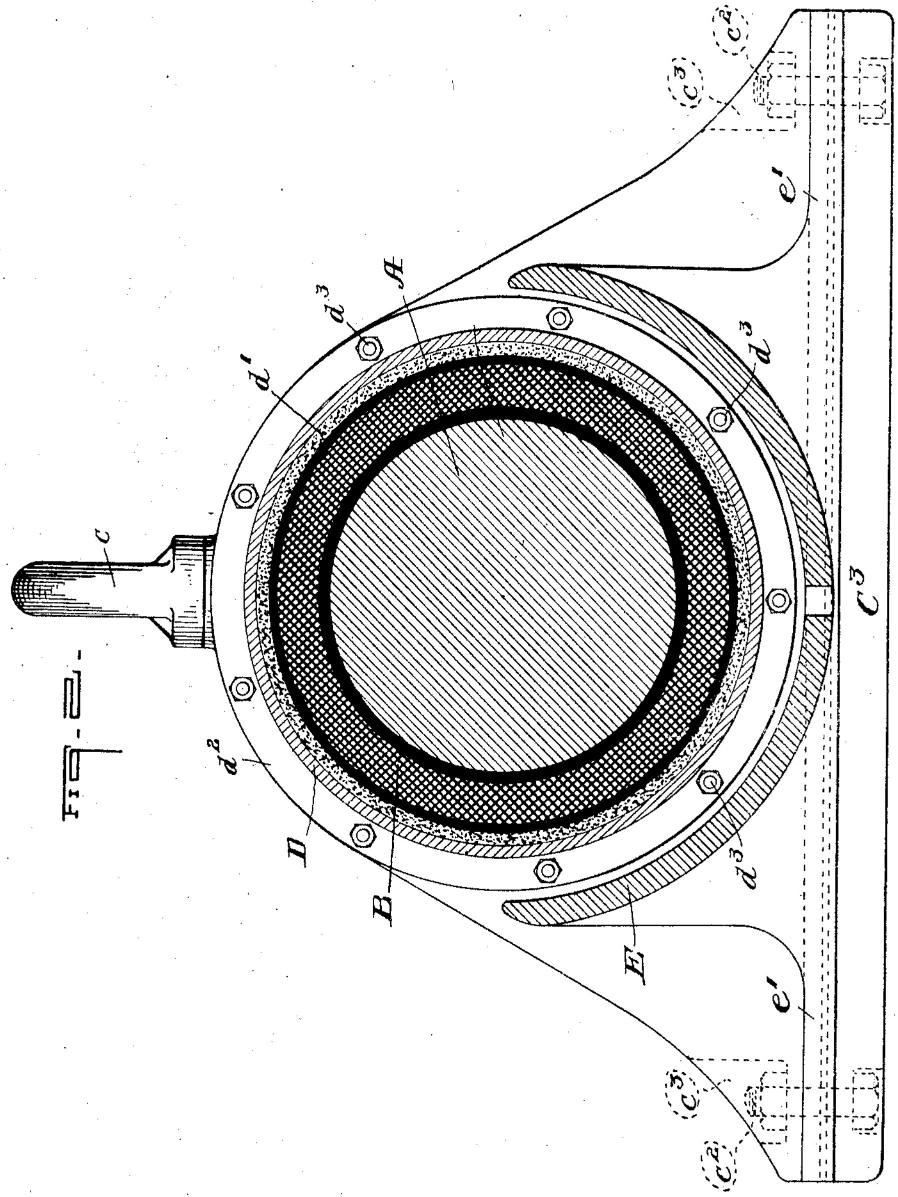

Fig-2-

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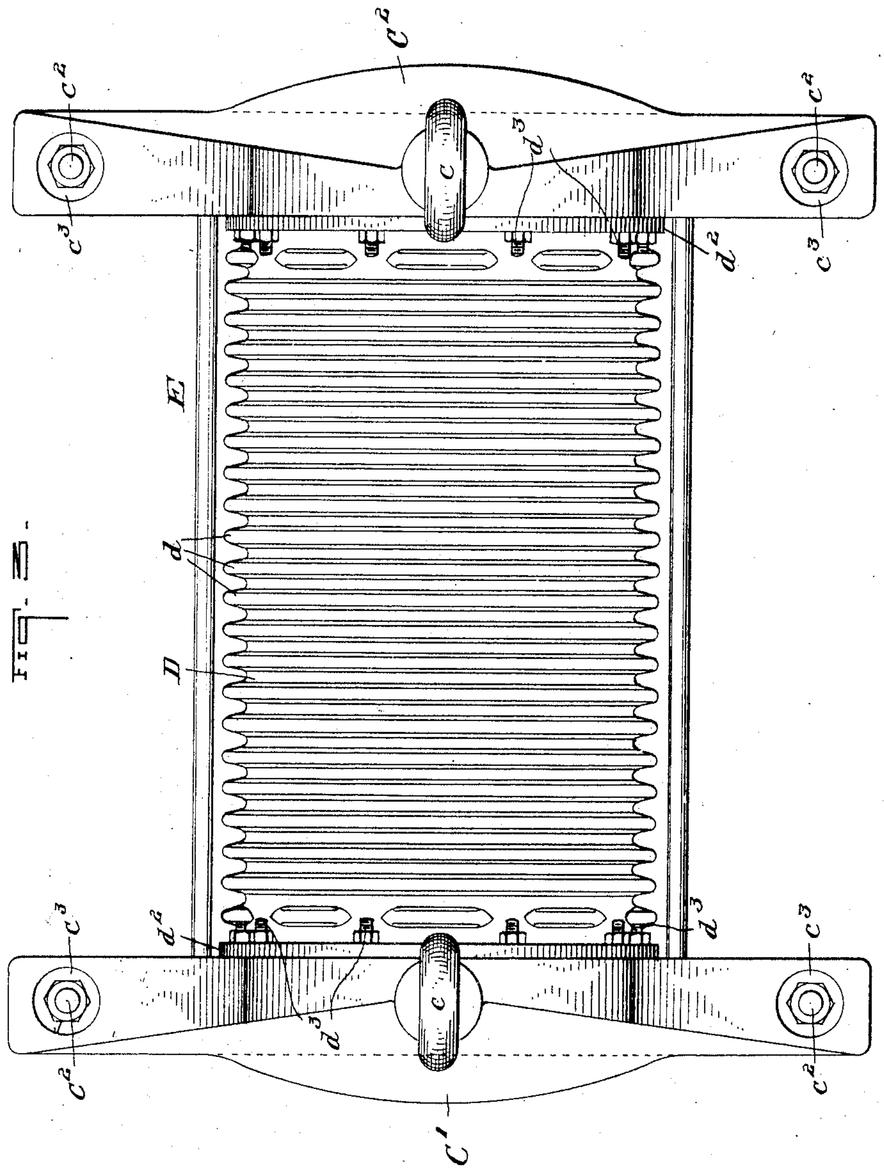
3 SHEETS—SHEET 3.

FIG. 3.



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UNITED STATES PATENT OFFICE.

ARTHUR C. EASTWOOD, OF CLEVELAND, OHIO.

LIFTING-MAGNET.

979,750. Specification of Letters Patent. Patented Dec. 27, 1910.

Application filed July 17, 1908. Serial No. 443,974.

To all whom it may concern:

Be it known that I, ARTHUR C. EASTWOOD, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented or discovered new and useful Improvements in Lifting-Magnets, of which the following is a specification.

My invention relates to an improved form of lifting magnet and particularly to that class of lifting magnets adapted to lifting iron or steel products, such as pig iron from an indiscriminate pile. It has been demonstrated that a lifting magnet which will lift ten tons in the form of a relatively smooth homogeneous piece of steel, such as an ingot or a bloom, may not lift a single pig of iron weighing 100 pounds from an indiscriminate pile of pigs. This, of course, shows that there must be essential differences between a lifting magnet for handling pig iron and other miscellaneous products of iron and steel and a lifting magnet for holding homogeneous material such as plates, blooms, billets, ingots, etc. In fact, up to within five years ago it was considered commercially impossible to handle miscellaneous magnetic material, such as pig iron with a lifting magnet, although lifting magnets for handling plates, blooms, etc. have been in commercially successful operation for more than fifteen years. In the past, as far as I know, all commercially successful lifting magnets for handling pig iron and similar bulk magnetic material have been of annular form. Such a lifting magnet is illustrated and described in United States Patent, No. 794,086 issued to me July 4, 1905.

The form of lifting magnet with which this application is concerned possesses the following advantages: 1st. The initial reluctance of the magnetic circuit of the lifting magnet without its load is high, thus adapting it to the handling of material of high reluctance, such as pig iron. 2nd. The air gap between the poles is large and the surface of the poles exposed to leakage from pole to pole is very small, thus reducing the amount of magnetic leakage and increasing the efficiency of the magnet. 3rd. The coil or magnetizing winding is of small depth compared with its length thus permitting of a minimum weight of conductor in the winding and also providing for the rapid dissipation of the heat generated within the winding. 4th. The poles of the magnet are symmetrically arranged with respect to the magnetizing winding and are normally of the same lifting power. 5th. The larger part of the impact due to lowering the magnet upon the load to be lifted comes upon the polar faces, thus relieving the magnetizing winding from the effects of such impact. 6th. The form of the magnet is such that both poles almost invariably come into contact with the surface of an irregular pile. 7th. The magnet is of light weight for a given lifting capacity.

In general terms, my improved magnet has a horizontal core of considerable length compared with its diameter. The magnetizing winding has its axis horizontal and surrounds the core and pole pieces depend from either end of the core.

In an annular form of magnet, it will be understood that the leakage between the core and the outer pole varies directly with the area of the cylindrical outer surface of the core and the inner surface of the outer pole and varies inversely as the distance between these surfaces. If the magnet is made shallow to reduce leakage to a minimum, the winding must be of large diameter in order to accommodate the required number of turns of the conductor in the winding. This large diameter, of course, means that the length of the average or mean turn will be great, and the more the diameter is increased to reduce leakage and to give the magnetic circuit a high initial reluctance the greater this length of mean turn will become. A winding of great weight is thus required and the consumption of current is necessarily high. It will be understood that in the form of magnet which I have discovered to be well adapted to the purpose, the length of the winding may be increased to any required extent without increasing its depth so that the length of the mean turn will not be increased while the leakage from pole to pole will be decreased and the initial reluctance of the magnetic circuit may be efficiently and economically brought to the desired point.

Referring to the accompanying drawings, Figure 1 is a side elevation partly in section. Fig. 2 is a vertical cross section and Fig. 3 is a top plan of my improved form of lifting magnet.

In these drawings, A is the horizontal core which I make preferably of circular cross section and of an area of cross section depending upon the weight of material which is required to be handled at each lift. The core A is surrounded by the magnetizing winding B, which is properly insulated as shown.

C′ and C^2 are pole pieces which are at the ends of the core A. The lower or active ends of these pole pieces are extended horizontally in a direction at right angles to the axis of the core and are tapered in thickness so as to preserve as nearly as practicable a cross-section equal to that of the core in a direction at right angles to the path of the magnetic flux. The active faces of the pole pieces are extended horizontally to a distance very much greater than their thickness. I find that a lifting magnet having this construction of pole pieces has a much greater lifting capacity in miscellaneous magnetic material than a lifting magnet similar in other respects, but not having the pole pieces similarly extended.

The core of the magnet is preferably made circular in cross section, as this section gives a minimum length of turn in the magnetizing winding. If, however, the pole pieces be given the same cross section, the magnetic flux set up by the magnetizing winding will be caused to flow through a minimum mass of material to be lifted, and this material will be held by a force of attraction many times greater than required to safely lift and hold it while being transported by the magnet. By extending the pole pieces the flux set up in the core is distributed through a greater mass of material to be lifted, and while the flux density through the load is reduced, with proper design, it is still sufficient to safely attract and hold a much larger load. The upper ends of the pole pieces are provided with eye bolts c to which chains may be connected for attaching the magnet to the hook of a crane or equivalent hoisting device.

The ends of the winding B terminate in plugs a^2 (only one shown) adapted to receive detachable terminals a^4 to which are attached flexible wires a^5 for connecting the winding to a source of electric current. The lower or active ends of the pole pieces C′ and C^2 are provided with renewable pole shoes C^3 held in place by bolts c^2, the heads and nuts of these bolts being located in pockets c^3 to prevent their becoming battered and abraided. The winding B is protected by a cylindrical casing D which I preferably provide with ribs d to increase the heat-radiating surface. The space between the outer surface of the winding and the casing D is filled with a plastic insulating compound d'. The casing D terminates in flanges d^2, through which it is bolted to the pole pieces C′ and C^2 by bolts d^3. These bolts are spaced sufficiently close together to insure a water tight joint, their heads being located in the pockets d^4 in the pole pieces, and the nuts are protected by the adjacent ribs d.

To protect the lower part of the casing D from abrasion with possible injury to the winding, I provide a buffer E, preferably made of manganese steel, which is practically a non-magnetic material of great toughness. This buffer I prefer to make substantially semi-circular in section so that the sides of the casing and the winding may be protected against impact with cars and other objects when the magnet is being rapidly moved by a crane. The lower ends of the buffer are provided with extensions e' so that the buffer may be clamped in place by the pole shoes C^3, as shown in Fig. 1, where the pole pieces and shoes are recessed to receive the ends of the buffer.

My improved lifting magnet is simple in form and construction. I have actually constructed and tested a magnet of this form which weighed less than an annular magnet of approximately the same lifting capacity, and, for the same current consumption and weight lifted, the copper in the magnetizing winding of my improved magnet weighed less than one third as much as that in the annular magnet.

I claim—

1. A lifting magnet specifically adapted to the handling of miscellaneous products of magnetic material, said magnet having a core, a pole piece depending from either end of said core, and a magnetizing winding surrounding the said core, said winding when energized producing a magnetic flux substantially uniform in direction through the length of said core.

2. A lifting magnet specifically adapted to the handling of miscellaneous products of magnetic material, said magnet having a core, a magnetizing winding surrounding the said core and a pole piece at either end of said core, substantially all of the magnetic flux set up in said core when said winding is energized passing also through each of said pole pieces.

3. A lifting magnet adapted to the handling of magnetic material, said magnet having a core and a pole piece depending from either end of said core, the lower faces of said pole pieces being wider than the diameter or width of said core, so that the magnetic flux set up in the core may be distributed through a greater mass of material to be lifted.

4. A lifting magnet adapted to the handling of magnetic material, said magnet having a horizontal core and magnetizing winding surrounding said core, and a pole piece depending from either end of said core, said pole pieces increasing in width and decreasing in thickness from their junctions with the core downward.

5. A lifting magnet adapted to the handling of magnetic material, said magnet having a core and a magnetizing winding surrounding said core, and a pole piece depending from either end of said core, said pole pieces being wider at their faces than at their junction with said core, but of substantially the same area as the cross section of said core.

6. A lifting magnet adapted to the handling of magnetic material, said magnet having a core and magnetizing winding surrounding said core, and a pole piece depending from either end of said core, said pole pieces being wider at their faces than at their junctions with said core, the cross section of said core and each of said pole pieces being substantially uniform at right angles to the direction of the magnetic flux set up by said winding.

7. In a lifting magnet for lifting miscellaneous iron and steel products, a horizontal core, a magnetizing winding surrounding said core, and pole pieces at the ends of the said core, the lower or active faces of said poles being extended in a horizontal plane to a distance relatively very much greater than their thickness.

8. A lifting magnet specifically adapted to the handling of miscellaneous products of magnetic material, said lifting magnet having but a single core and a single magnetizing winding surrounding said core and two pole pieces depending from said core, said pole pieces being so disposed with reference to said core and with reference to each other that they will exert approximately equal attraction upon the load to be lifted.

9. In a lifting magnet for lifting miscellaneous magnetic material, the combination of a horizontal core, a magnetizing winding surrounding the said core, pole pieces at the ends of said core, a non-magnetic casing for surrounding and protecting said winding, and a non-magnetic buffer extending between the lower ends of the pole pieces and beneath the casing.

10. In a lifting magnet for lifting miscellaneous material, the combination of a horizontal core, a magnetizing winding surrounding the said core, pole pieces at the ends of the said core, a non-magnetic casing for surrounding and protecting the winding, removable pole shoes on the lower faces of the pole pieces, and a non-magnetic buffer extending between the lower ends of the pole pieces and beneath the casing, the said buffer being provided at its ends with extensions adapted to be engaged by the said pole shoes.

Signed at Cleveland, Ohio, this 15th day of July, 1908.

ARTHUR C. EASTWOOD.

Witnesses:

H. M. DIEMER,

F. W. JESSOP.