No. 794,086. PATENTED JULY 4, 1905.

A. C. EASTWOOD.

LIFTING MAGNET.

APPLICATION FILED DEC. 27, 1904.

3 SHEETS—SHEET 1.

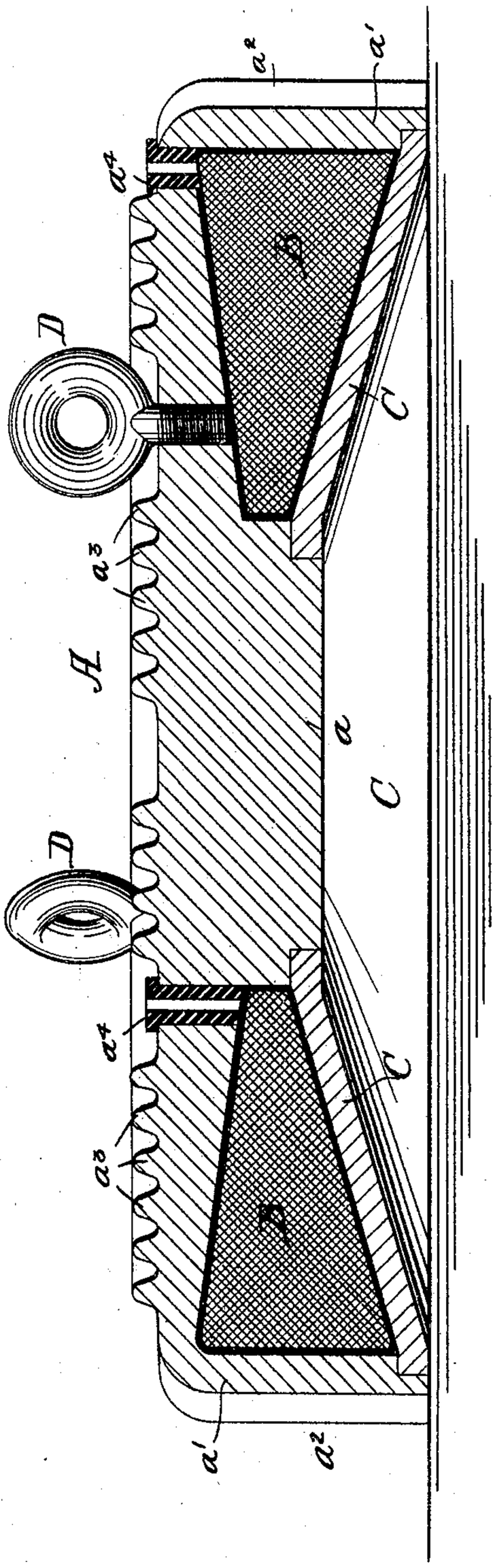


Fig. 1.

Witnesses:
Hw. E. Dupee.
Wm. A. Barr.

Inventor:
Arthur C. Eastwood
by his Attorneys,
Howson & Howson

No. 794,086. PATENTED JULY 4, 1905.

A. C. EASTWOOD.

LIFTING MAGNET.

APPLICATION FILED DEC. 27, 1904.

3 SHEETS—SHEET 2.

Fig. 2.

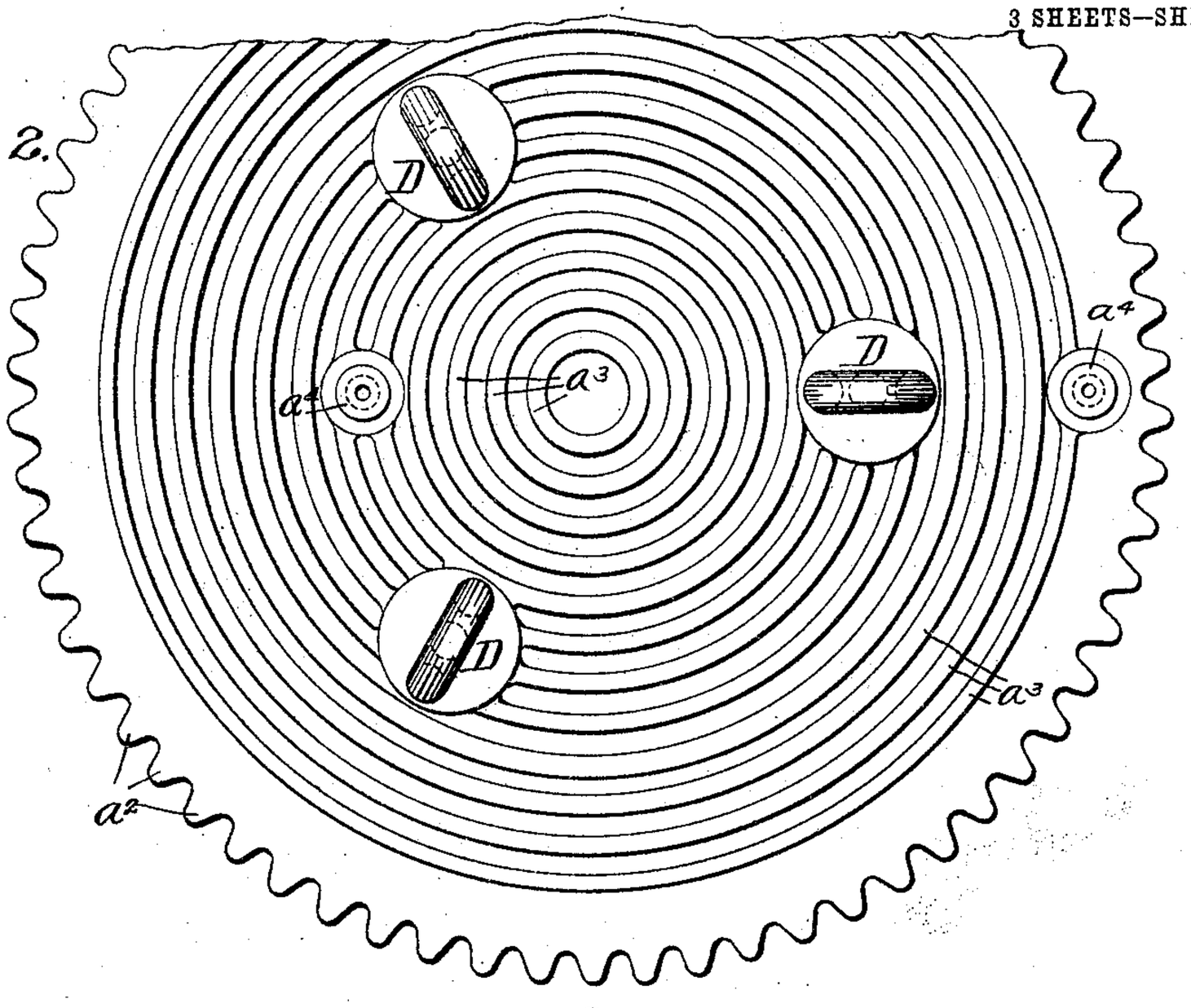
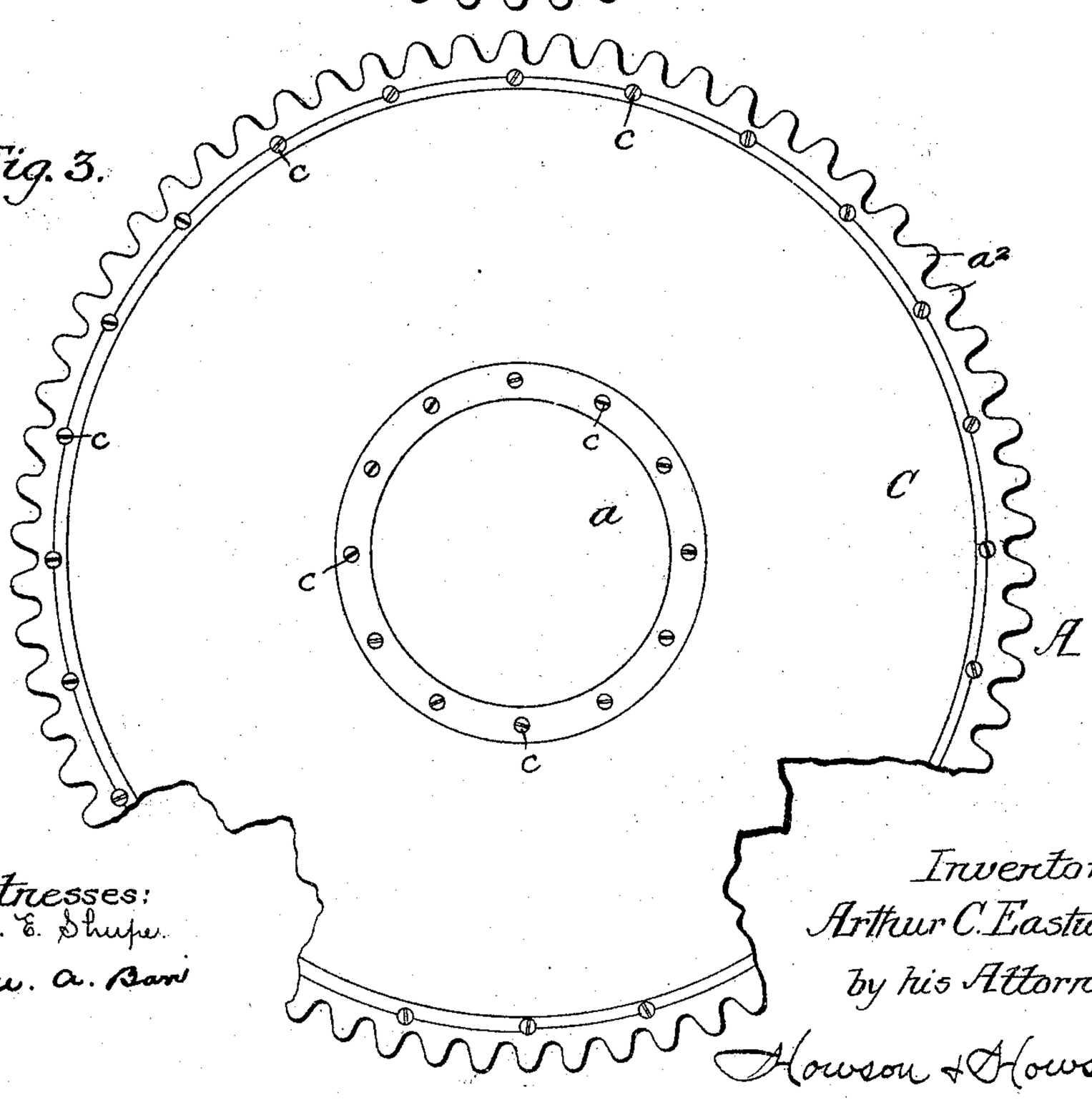


Fig. 3.



Witnesses:
Wm. E. Shupe.
Wm. A. Barr

Inventor:
Arthur C. Eastwood
by his Attorneys.
Howson & Howson

No. 794,086. PATENTED JULY 4, 1905.

A. C. EASTWOOD.

LIFTING MAGNET.

APPLICATION FILED DEC. 27, 1904.

3 SHEETS—SHEET 3.

Fig. 4.

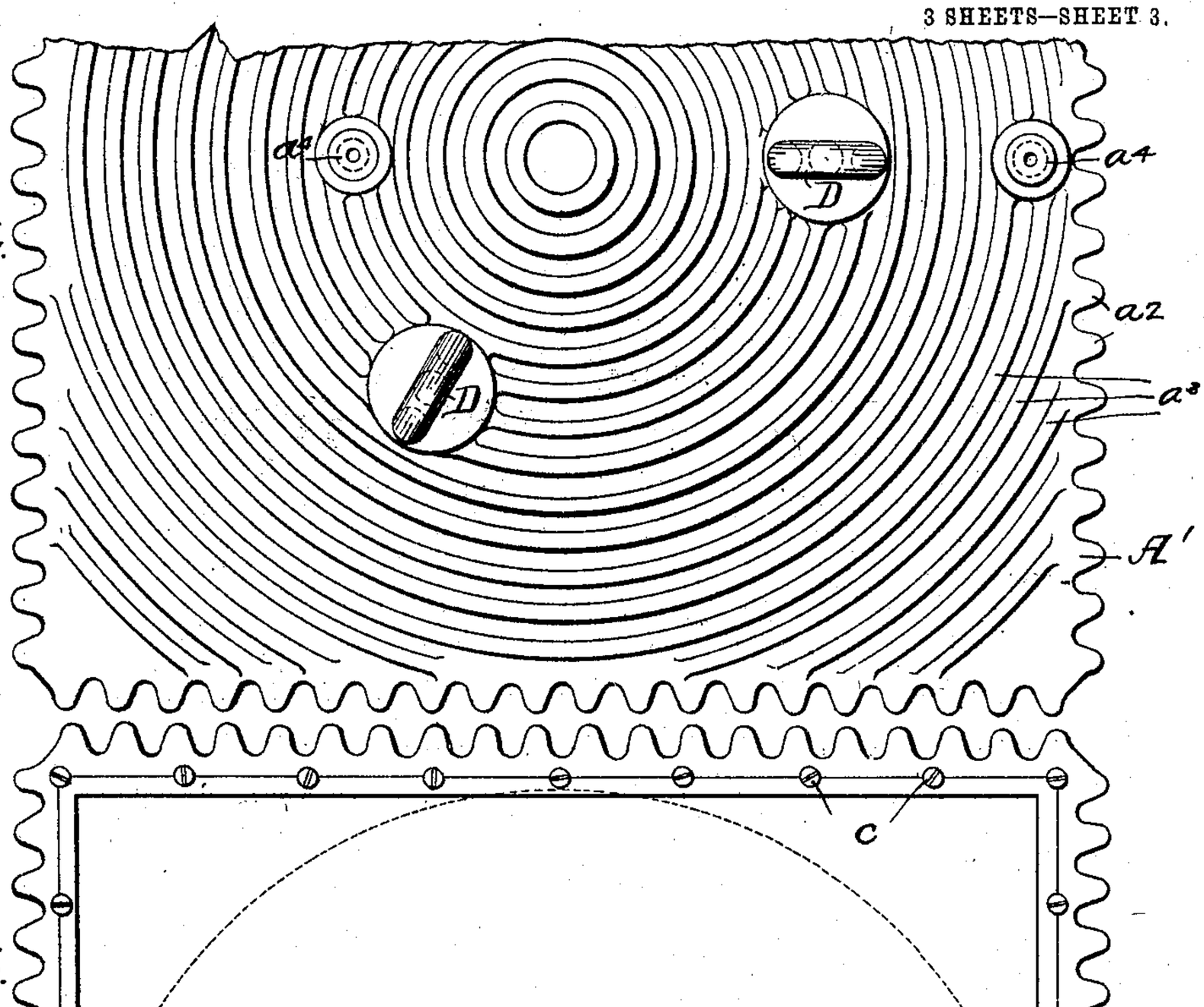
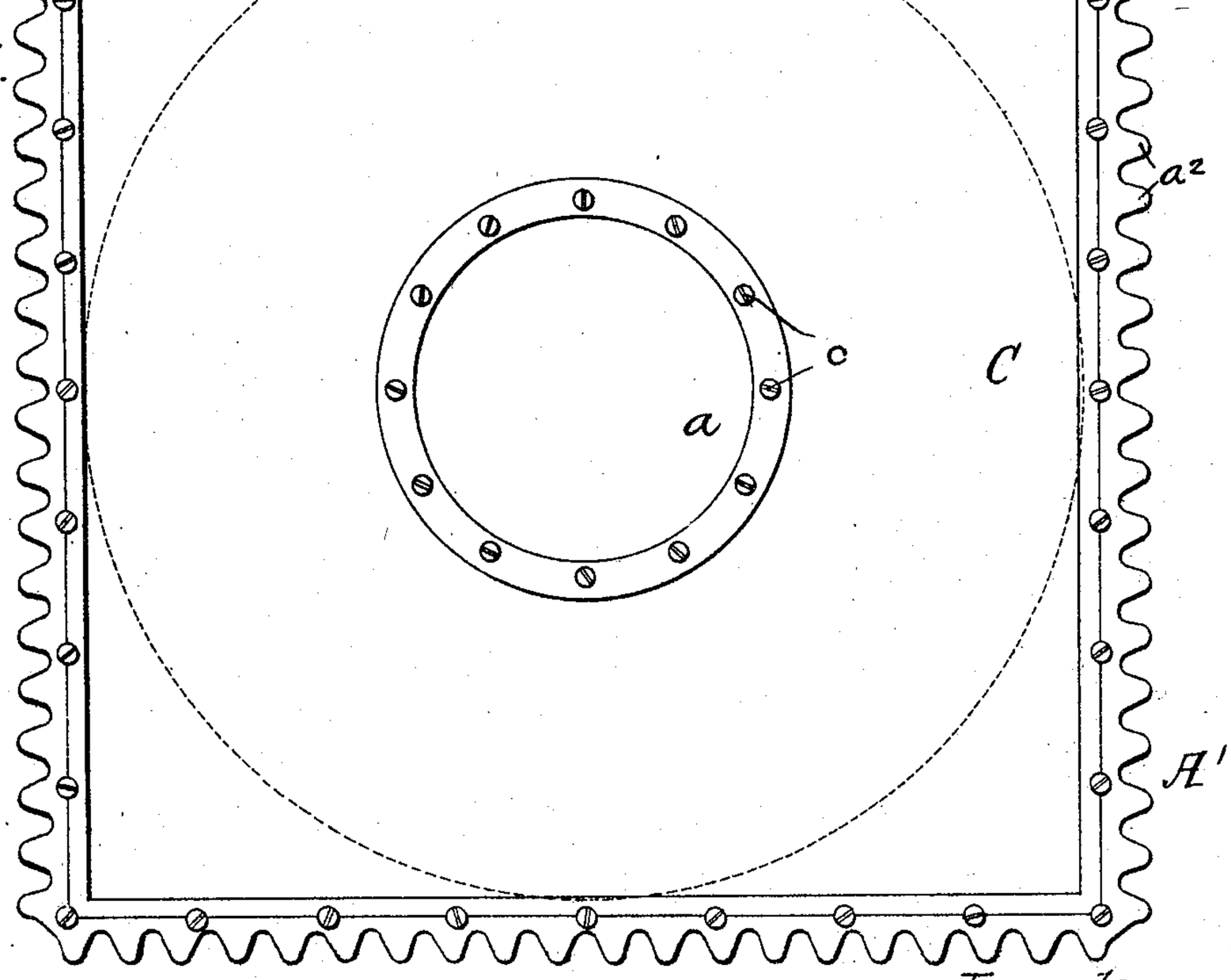


Fig. 5.



Witnesses:
Wm. E. Shupe.
Wm. A. Barr

Inventor:
Arthur C. Eastwood
by his Attorneys.
Howson & Howson

No. 794,086. Patented July 4, 1905.

UNITED STATES PATENT OFFICE.

ARTHUR C. EASTWOOD, OF CLEVELAND, OHIO.

LIFTING-MAGNET.

SPECIFICATION forming part of Letters Patent No. 794,086, dated July 4, 1905.

Application filed December 27, 1904. Serial No. 238,407.

To all whom it may concern:

Be it known that I, ARTHUR C. EASTWOOD, a citizen of the United States, residing in Cleveland, Ohio, have invented certain Improvements in Lifting-Magnets, of which the following is a specification.

The invention relates to certain improvements in magnets for attracting and holding for purposes of transfer from one point to another various products of iron and steel.

While in the past magnets have been employed in transporting such objects as plates, billets, blooms, ingots, &c., with consequent material saving in time and labor otherwise expended in attaching and detaching the load from the transporting device, very poor success has been met with in the handling of such material as pig-iron, scrap, nails, bolts, rivets, &c., when such material must be attracted and lifted by the magnet from a pile.

One object, therefore, of my invention is to provide an electromagnet having such an arrangement of coil and poles as to render possible the safe and economical handling of detached material of the general nature above noted.

Hitherto when a lifting-magnet of the ordinary construction has been energized and moved to a position adjacent to a pile of detached pieces of steel or iron, such as pig-iron, the magnetic flux following paths of lowest reluctance strays through a considerable area of the pile with the result that its density at any given point is relatively low and the lines of force are without definite or uniform direction. Since the lifting power of a magnet depends upon the density of magnetic flux normal to the plane of engagement between the material to be lifted and the magnet and also varies directly as the square of the normal flux density, it is essential in order to secure economical operation that means be provided for securing a relatively high-flux density and definitely directing the same. The parts of the magnet must also be so disposed that its magnetic circuit without the load attached will be of very high reluctance, the difference between the reluctance before and after the attachment of a load being a measure of the effectiveness of the magnet in attracting the material to be transported. It is likewise desirable that the magnet be so designed as to cause the largest possible percentage of the magnetic flux to be effective in lifting the load. In other words, the magnetic leakage should be reduced to a minimum.

My invention embraces means for securing the above-noted desired results, in addition contemplating other improved details of construction, as set forth hereinafter.

In the drawings herewith, Figure 1 is a sectional elevation of one form of my improved lifting-magnet, illustrating its detail construction. Fig. 2 is a plan view of the magnet shown in Fig. 1. Fig. 3 is an inverted plan view of the same magnet; and Figs. 4 and 5 are respectively a plan and an inverted plan of a special form of my invention, whose vertical section, however, is substantially the same as shown in Fig. 1.

Referring to Figs. 1 to 3, inclusive, of the above drawings, A is the frame of the magnet, preferably consisting of a single casting of a steel of high permeability. This casting may be described as consisting of a body portion from the central part of which projects the inner pole-piece a, preferably of a circular section, while from the same side of said body there extends an annular flange a'. This flange forms the outer pole of the magnet and is preferably formed with external ribs or corrugations a^2 for the purpose of increasing the effective heat-dissipating surface. There are also ribs or corrugations a^3 on the face of the magnet opposite to that having the pole-piece a, which, like the ribs a^2, assist in dissipating whatever heat may be generated in a coil B, constituting the winding of the magnet. This coil is wound between the pole-piece a and the flange or outer portion a' and, while being annular, preferably has fewer turns and is consequently of less thickness at its inner portion than where it is adjacent to said flange or outer pole a'. As a result, and, indeed, one object of this construction, the lower face of the magnet is concave and may be roughly described as "funnel-shaped," the inner pole-piece a not extending out so far as does the flange a'. The coil B is held in position and protected from injury by means of

a dished brass or other non-magnetic plate C, which may be held to the frame A by screws or bolts *c*, as shown in Fig. 3. Eyebolts D, screwed into the upper corrugated face of the frame A, are provided for the reception of the chains by which the magnet may be hung from the hook of a crane. There are openings extending through the body of the frame A, in which are placed insulating-bushings a^4, to permit of the passage of the wires through which current flows for the energization of the coil B. It will be seen that the outer portions of the coil B extend considerably below and beyond the inner pole *a*, so that the polar face of this latter part is within the magnetizing-coil B—that is, on one side of the plane of the lower face of the coil—and this feature constitutes one of the essential features of my invention, being employed because by it I secure extreme uniformity of the direction of the magnetic lines of force at all points within the central bore of the coil B. As a further result of this construction it will be seen that the magnet is relatively short or thin in proportion to its diameter and has a very wide air-gap between its poles *a* and *a'*. The main object of this construction is to reduce the area of surface exposed to magnetic leakage and also to give the magnetic circuit a high initial reluctance, which latter is secured by the wide air-gap between the poles *a* and *a'*, with the result that the magnetic flux extends deeply into a pile of material to be lifted. Under operating conditions the lines of force leaving the face of the outer pole *a'* curve downwardly and converge upon the central or inner pole *a* at a high density and substantially uniform direction, raising and carrying a much greater weight of material than has hitherto been considered possible.

When it is desired that the magnet shall pick up pieces of iron or steel from the corners of a car or bin, it may be made in the form shown at A' in Figs. 4 and 5—that is, substantially rectangular in plan, its other features being substantially the same as indicated in connection with Figs. 1 to 3, inclusive.

I claim as my invention—

1. A portable lifting-magnet having a magnetizing-coil and a frame of magnetic material extending outside of the coil and also partly through the same, the magnetic circuit of said magnet being normally incomplete, substantially as described.

2. The combination in a lifting-magnet of a frame including a central pole and an annular pole, with a winding surrounding the central pole and surrounded by the annular pole, said winding extending beyond the central pole so that the face of said pole is within said winding, and the magnetic circuit of the magnet being normally open between the central pole and the annular pole, substantially as described.

3. The combination in a lifting-magnet of a frame having a flange portion forming one pole, and a winding surrounded by said flange portion, a portion of said frame being extended into the winding and forming the second pole of the magnet, said flange portion and the coil projecting beyond the said second pole, and the magnetic circuit of the magnet being normally open between the second pole and the flange portion, substantially as described.

4. The combination in a lifting-magnet of a frame including a central pole and an annular pole, with a winding surrounding the central pole and surrounded by the annular pole, said winding being annular in form and having a greater number of turns in that portion adjacent to the annular pole than in the portion adjacent to the central pole, substantially as described.

5. A portable lifting-magnet having a magnetizing-coil whose turns decrease in number from its periphery inwardly, and a frame of magnetic material extending outside of the coil and partly through the same, substantially as described.

6. In a lifting-magnet the combination of a frame of magnetic material including a central pole-piece, a body-section and an outer pole-piece, a frusto-conical ring of non-magnetic material extending between the central and the outer pole-pieces so as to form a casing, and a winding in said casing, substantially as described.

7. The combination in a lifting-magnet of a winding, a frame including an annular body of magnetic material surrounding said winding, a core extending partly through the winding, and a body portion on one side of the winding extending between the core and the annular portion, with a plate of non-magnetic material on the other side of the winding and extending between the core and the annular part of the frame, substantially as described.

8. The combination in a lifting-magnet of a frame including a central and an outer pole-piece, a winding around the central pole-piece and within the outer pole-piece, said winding extending beyond said central pole-piece so that the face of said pole is within said winding, and means on the frame for the attachment of a device for lifting the magnet, substantially as described.

9. The combination in a lifting-magnet of a frame including a central and an outer pole-piece, a winding around the central pole-piece and within the outer pole-piece, said winding extending beyond said central pole-piece so that the face of said pole is within said winding, and a plurality of eyebolts on the frame for the attachment of lifting means, substantially as described.

10. The combination in a lifting-magnet of a frame including a central pole and an annular pole, with a winding surrounding the central pole and surrounded by the annular pole,

said winding extending beyond the central pole so that the face of said pole is within said winding, and the frame being substantially rectangular in plan, substantially as described.

11. The combination in a lifting-magnet of a frame including a central pole and an annular pole, with a winding surrounding the central pole and surrounded by the annular pole, said winding extending beyond the central pole so that the face of said pole is within said winding, and the frame having angular corners constructed to permit of its entrance into angular recesses, substantially as described.

12. A lifting-magnet having a normally open magnetic circuit and including a central portion forming one pole, an annular portion forming the other pole, with a winding disposed between said poles and made with a portion extending below the face of the central pole, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ARTHUR C. EASTWOOD.

Witnesses:
E. R. LOUGHERY,
JOS. H. KLEIN.