L. D. ROWELL.

LIFTING MAGNET.

APPLICATION FILED OCT. 7, 1907.

1,325,914.

Patented Dec. 23, 1919.

5 SHEETS—SHEET 1.

Fig. 1.

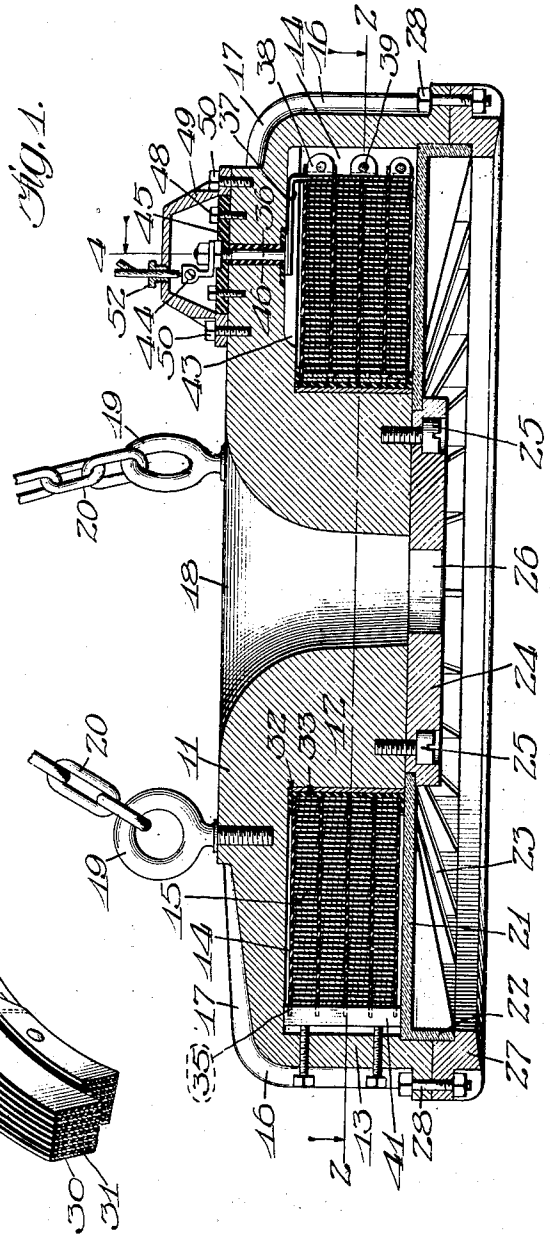
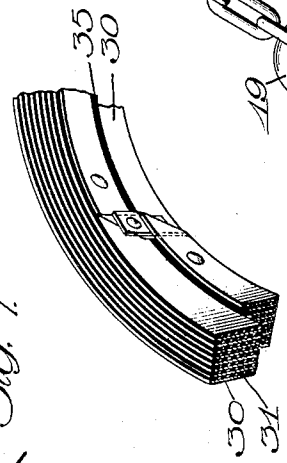


Fig. 7.



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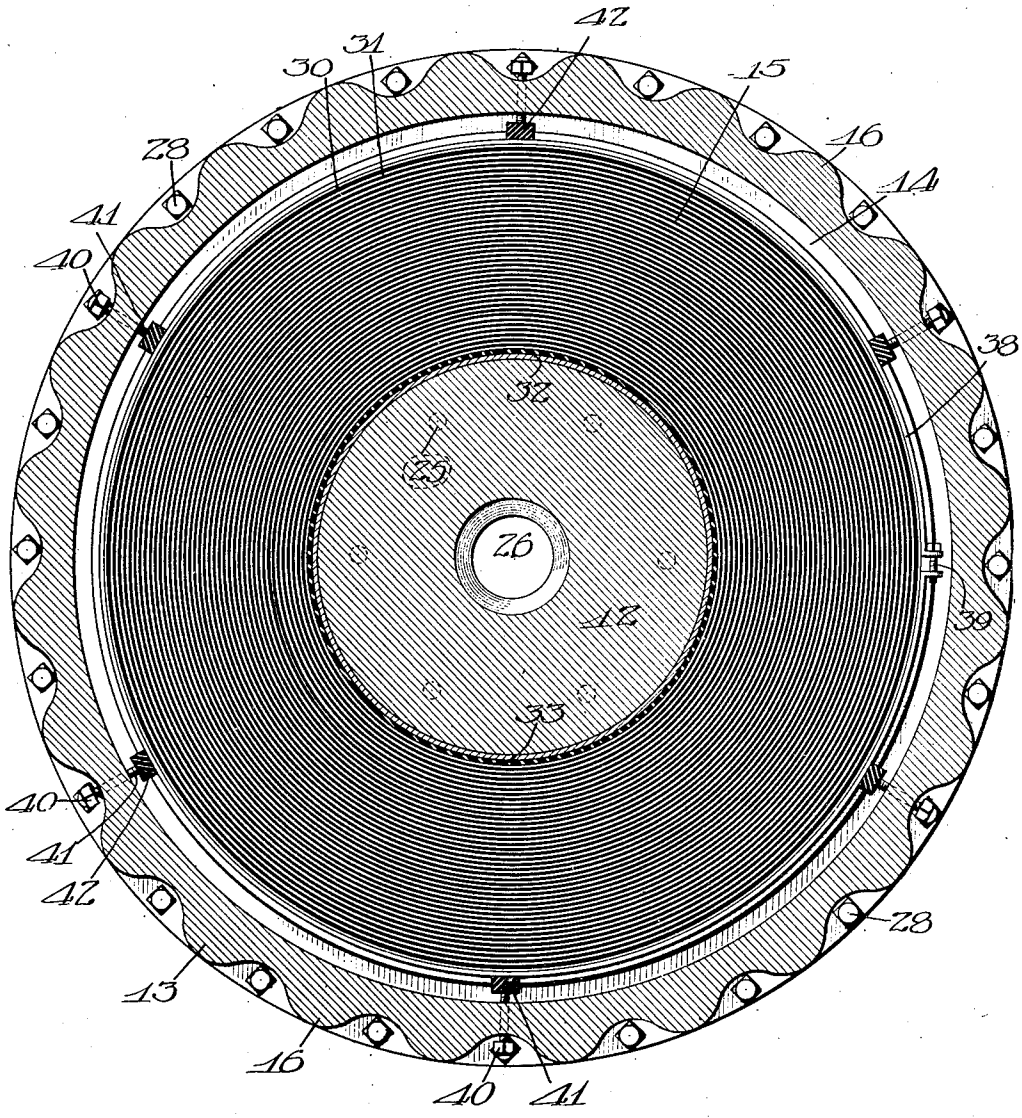
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5 SHEETS—SHEET 2.

Fig. 2.



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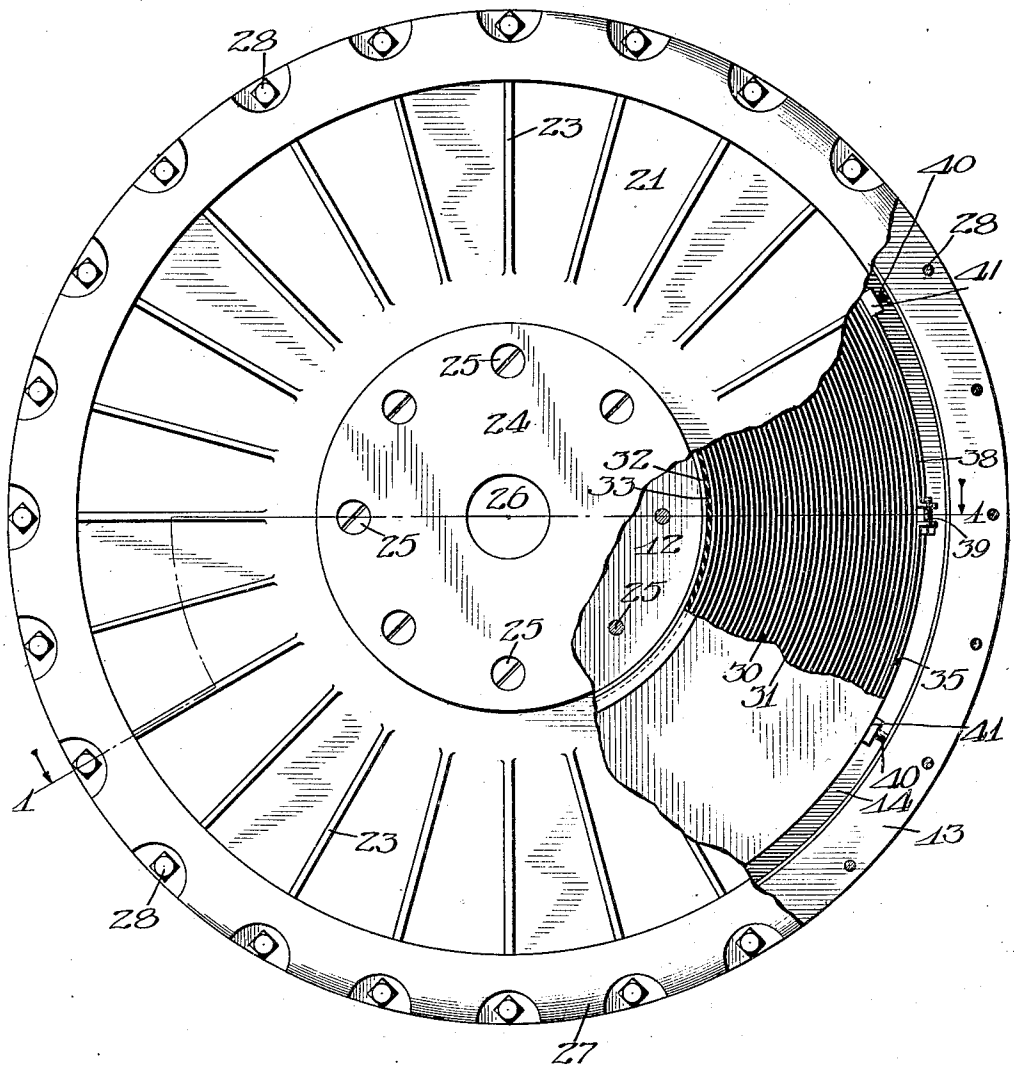
APPLICATION FILED OCT. 7, 1907.

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5 SHEETS—SHEET 3.

Fig. 3.



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5 SHEETS—SHEET 4.

Fig. 4.

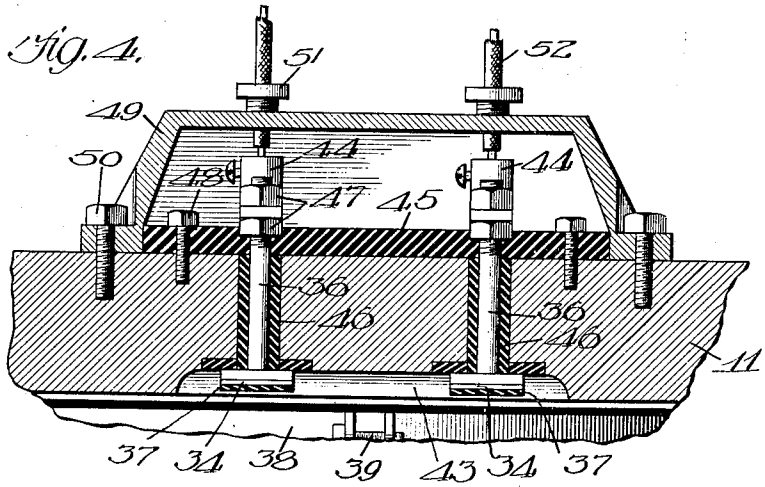


Fig. 5.

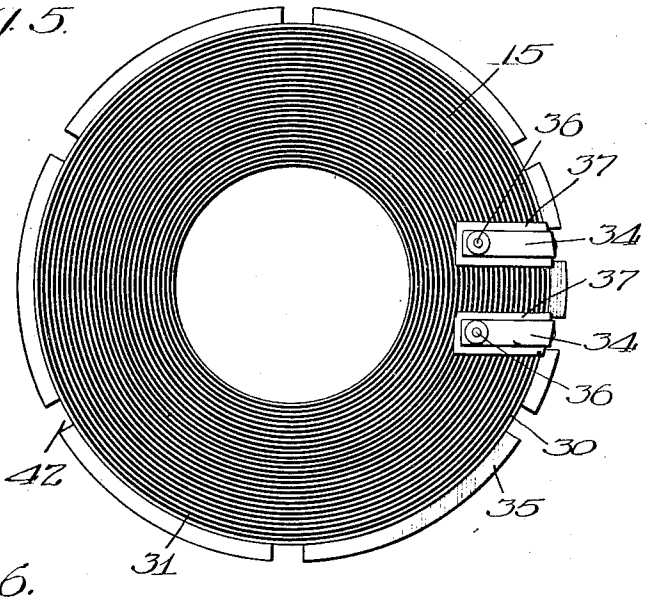
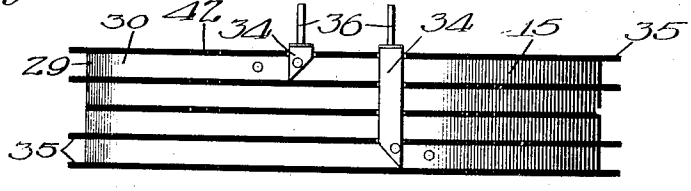


Fig. 6.



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5 SHEETS—SHEET 5.

Fig. 8.

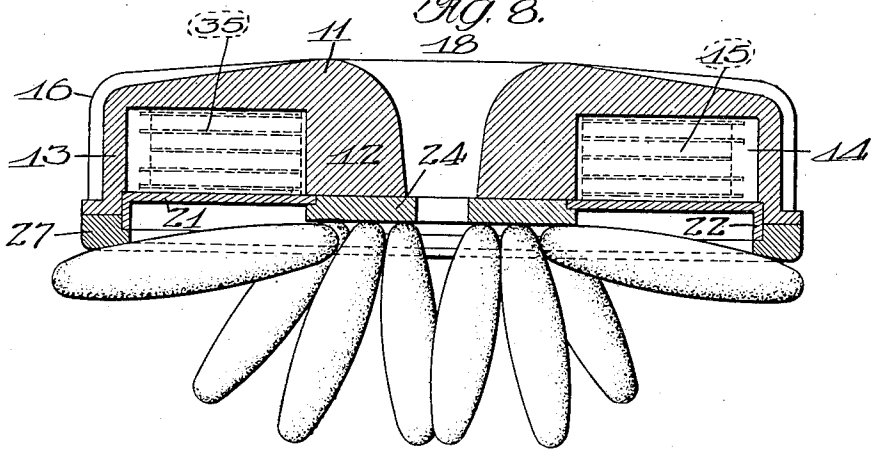


Fig. 9.

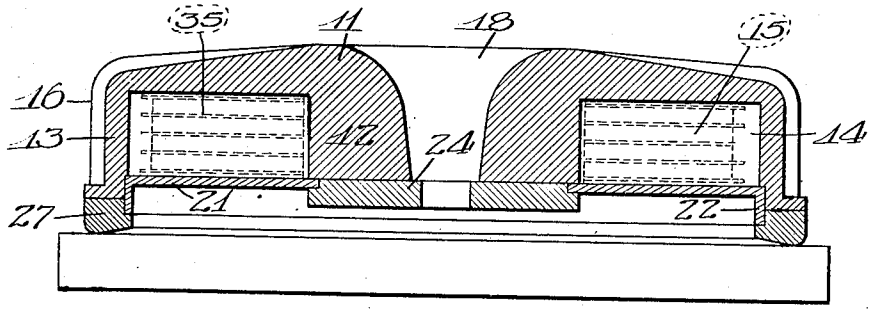
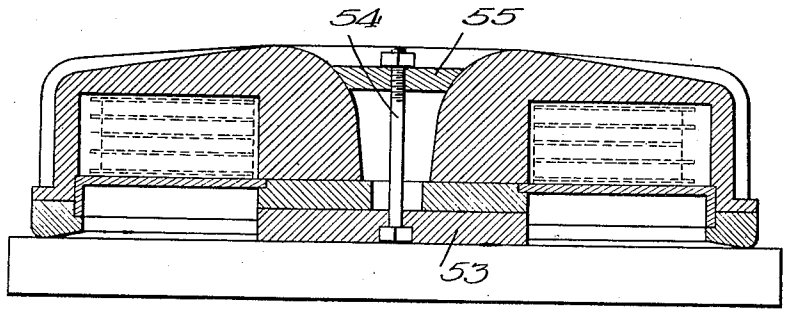


Fig. 10.



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UNITED STATES PATENT OFFICE.

LEWIS D. ROWELL, OF MILWAUKEE, WISCONSIN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

LIFTING-MAGNET.

1,325,914. Specification of Letters Patent. **Patented Dec. 23, 1919.**

Application filed October 7, 1907. Serial No. 396,187.

To all whom it may concern:

Be it known that I, LEWIS D. ROWELL, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Lifting-Magnets, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to lifting magnets.

One of the objects of the invention is to provide a lifting magnet which will readily withstand the shocks and strains to which it is subjected.

Another object is to provide a lifting magnet which will have a large lifting power for its size and weight.

Another object is to provide a lifting magnet in which the energizing winding is thoroughly protected.

Another object is to provide an efficient magnet which will stand severe service and not require constant repair.

Another object is to provide a lifting magnet which will cause its load to be concentrated as it is released.

Various other objects and advantages will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention, and in said drawings:

Figure I is a cross-sectional view on the line 1—1, Fig. III,

Fig. II is a horizontal sectional view on the line 2—2, Fig. I.

Fig. III is a bottom plan view with the outer parts broken away to expose the interior parts,

Fig. IV is a sectional view on the line 4, Fig. I, showing the terminal housing.

Fig. V is a plan view of the energizing coil with one of the outside insulating disks removed,

Fig. VI is a side view of the coil,

Fig. VII is a perspective view looking at the inside of two adjacent inner sections of the energizing coil,

Fig. VIII is a diagrammatic cross-sectional view of the magnet showing it lifting pig-iron,

Fig. IX is a similar view showing it attracting a large plate, and

Fig. X is a diagrammatic cross-sectional view showing the magnet lifting a large plate and having an adapter applied to the inner pole to eliminate the air gap between the inner pole and the plate.

The magnet has a cast steel frame 11 provided with a central or inner pole piece 12, and an outer pole piece 13. Between the outer and inner pole pieces is an annular channel or recess 14 in which is located the energizing winding 15.

The outer periphery of the frame is provided with axial corrugations 16 which merge into radial corrugations 17 on the top of the frame. These corrugations increase the radiating surface of the magnet. The magnet frame is further provided with a central opening or aperture 18 through which air may circulate to assist in cooling the magnet, and the walls of this opening serve to increase the radiating surface. Eye-bolts 19 are preferably threaded into the top of the frame and chains 20 are attached to these eye-bolts for suspending the magnet.

Over the annular recess 14 is placed a non-magnetic circular cover plate or ring 21, which covers supports, and protects the energizing winding. This cover plate is provided at its outer edge with a downwardly extending flange 22, and radial ribs 23 extend across the lower face of the cover plate to strengthen it.

The inner pole piece 12 carries a magnetic pole shoe 24 which is held in place by means of bolts 25, threaded into the inner pole piece. This pole shoe is provided with a central opening 26, which communicates with a central opening in the magnet frame. The outer pole piece 13 is provided with a magnetic pole shoe 27, which is in the form of a ring, and is held in place by means of through-bolts 28. The heads of the bolts set on a flange formed on the pole piece 13 and are arranged in the indentations between the corrugations 16, so as to be protected from injury. The nuts of the bolts are set in notches formed in the pole shoe 27 and are thus protected from injury. The cover plate 21 is held in place by means of the inner pole shoe 24 and the outer pole shoe 27, the inner pole shoe being formed with a shoulder in its outer periphery upon which the inner periphery of the cover plate rests, and the pole shoe 27 being provided with a

shoulder in its inner periphery upon which the flange 22 of the cover plate rests, said flange also engaging the inner periphery of the pole piece 13. The flange 22 thereby prevents lateral movement of the pole shoe 27. The lateral support thus provided relieves the shearing strain on the bolts 28 when the magnet is in use. It also aids in making the magnet a solid, compact structure.

The outer pole shoe 27 is made thick and rugged to withstand the shocks and strains to which it is subjected. It projects downwardly sufficiently to ordinarily engage the material to be lifted before any other part of the magnet. It also extends downwardly a sufficient distance to protect the winding.

The outer pole piece 13 and its pole shoe 27 form an outer pole having its polar face at the bottom of the outer shoe. The inner pole piece 12 and its pole shoe 24 form an inner pole having its polar face at the bottom of the inner shoe.

The pole shoes are rigidly mounted upon their respective pole pieces and directly or closely engage these pole pieces so that the poles will have a low reluctance and the magnetic flux may readily pass between the pole pieces and the pole shoes.

The poles are of opposite polarity, and the flux created by the winding passes from the frame and out through one pole, then across the space between the poles and back through the other pole.

The attraction produced by the flux is toward the polar faces and not the intervening space between the poles. In consequence, when the material is attracted, it is pulled toward the polar faces.

The poles project sufficiently below the winding and cover plate to protect the winding from damage and the plate from wear when the material is attracted, and only occasionally will any material engage the cover plate.

If pig iron is being lifted some pigs will bridge the poles, being attracted at one end to the outer pole and at the other end to the inner pole, and others will simply hang down from the poles and the pigs directly in engagement therewith, the entire load being penetrated by the magnetic flux to keep it attracted to the magnet.

The pole shoes are rugged and strong so as to withstand the blows, shocks and wear occurring in service, particularly in lifting rough material, such as pig iron and scrap.

The outer pole extends sufficiently below the winding and cover plate to engage the material first when the magnet is lowered or swung against the same, so as to save the winding and cover plate from blows and wear. This pole acts like a guard to ward off the material from engagement with the cover plate.

When the magnet is employed to lift rough material the inner pole does not project ordinarily as low as the outer pole but has its polar face receded so as to make the magnet face somewhat concave. This structure enables the outer pole to come more readily in contact with the material and attract the same thereto. Where the polar faces are in the same plane, the inner pole is liable to engage the material first and thus keep the outer pole so far from engagement therewith as to lessen the material it will attract.

The energizing coil or winding is located in the annular space or channel between the inner and outer poles. It surrounds the inner pole and is surrounded by the outer pole.

The winding is composed of sections, one placed upon the other, four sections being shown. Each section of the winding comprises a flat strip of copper 30 wound flatwise in the form of a spiral and having a strip of asbestos or other insulating material 31 wound therewith so as to insulate the turns from each other. The sections are preferably wound upon a metallic tube 32, which is surrounded by a mica or other insulating covering 33. The tube 32 fits over the inner pole piece 12 of the magnet. The adjacent sections of the winding are wound in different directions so that the same will produce like polarity. For instance, the first section is wound clockwise and the next section counter clockwise, and so on alternately in reverse direction. The outer ends 34 of the top and bottom sections form the terminals of the winding. Insulating disks 35 are placed above and below the winding and between its several sections. The inner ends of the top and bottom sections are connected to the inner ends of the adjacent sections, and the outside ends of the two intermediate sections are connected to each other.

The manner of connecting two sections of the winding is illustrated in Fig. VII, which is a perspective view looking at the inside of the top section and its adjacent intermediate section. The inner end of each section is folded to extend at an angle and thus the inner ends of the two sections are overlapped, these overlapping ends being joined by a rivet or in any other suitable way. The outer ends of the two intermediate sections are joined in a similar manner. In each section, the inner end of the coil is preferably riveted, or otherwise fastened, to the strip after it has been run once around so as to form a ring on the inside of the spiral, and similarly the last turn is riveted to the outer end of the spiral so as to form a ring on the outside. The outer ends 34 of the top and bottom sections are folded at right angles to extend upwardly and are then bent over the top of the winding and attached to

terminal bolts 36. Insulating pieces 37 are preferably placed between the top disk 35 and the bent-over portions of the ends 34. I preferably place bands 38 around the outside of the winding the ends of which bands are drawn together by bolts 39 to firmly bind the bands around the winding. I preferably place one band around each of the top and bottom sections between the insulating disks and a single band around the two intermediate sections. These bands are insulated from the sections by some suitable material.

The winding is firmly held in place by means of bolts 40 threaded through the outer pole piece and preferably equally spaced around the winding. These bolts bear upon blocks of asbestos-board 41, which bear upon the outside of the winding, these blocks being set in notches 42 in the insulating disk 35. A space is left between the energizing winding and the outer pole in order that the portions of the winding between the spacing blocks 41 may spread outwardly when the winding expands. The space between the winding and the walls of the annular recess may be filled with sand or other suitable material which will readily conduct heat from the winding to the magnet frame from which it will be dissipated.

The top of the annular recess 14 is provided with an indentation 43 to receive the bent-over portion of the terminal ends 34 of the winding. The terminal bolts extend upwardly through the magnet frame and are fastened to binding posts 44, which rest upon an insulating block 45 placed upon the top of the magnet frame. The bolts 36 are insulated from the frame by insulating tubes 46. These bolts are preferably attached to the binding posts 44 by means of nuts 47. The insulating block 45 is preferably attached to the magnet frame by means of bolts 48. Over the binding posts 44 extends a housing 49 which is secured to the top of the magnet frame by means of bolts 50. The top of the housing is provided with water proof bushings 51, through which run the supply wires 52 from which power is taken to energize the winding. These wires are connected to the binding posts 44.

The energizing winding composed of sections, each comprising a flat strip in the form of a spiral coil, gives a greater number of ampere turns for a given voltage and a winding of a given diameter and cross sectional area than can be obtained under the same conditions with insulated circular wires.

The inner polar face is of less area than the outer polar face so that the density of the magnetic flux will be greater at the inner pole than at the outer pole. Accordingly the inner pole is stronger than the outer pole. The inner polar face is receded or set back of the plane in which the outer polar face is located, so that the face of the magnet is what may be termed concave. These features make the magnet especially adapted to lift loose material from a pile, such as pig-iron and other material of less length than the diameter of the magnet.

Among the advantages and results which this magnet obtains over prior magnets, is that it has greater efficiency and a higher lifting capacity for a given weight and size. It has greater strength and will withstand more shocks, blows, and strains. It will give longer continuous service, and require less repair. Its winding is thoroughly protected and is less liable to damage.

Fig. 8 shows the magnet lifting pig-iron. A number of pigs bridge the inner and outer poles and complete the magnetic circuit. These pigs are thereby firmly held to the magnet. The inner pole is strong enough to hold a number of pigs which hang down. It is found in practice that with the inner pole receded and of greater strength than the outer pole, a greater number of pigs will bridge the two poles and that the load of loose material the magnet will lift from a pile will be greater than would be the case if the relative strength and position of the poles were otherwise. This may be accounted for by the fact, that the outer pole will directly engage the material, while the inner pole is sufficiently strong to draw up the pieces that are attracted by the outer pole, and cause them to bridge the two poles and be firmly held, and further by the fact that the inner pole will hold a number of pieces alone. In other words the load is concentrated toward the center. If the inner pole were not receded the chances are that it would directly engage the pile of material and prevent the outer pole from coming sufficiently close to the material, to attract as many pieces. Moreover the outer pole would not be sufficiently strong to draw up the pieces attracted by the inner pole so that these pieces would bridge the two poles and be firmly held. Hence the fact that my magnet is especially adapted for lifting pig-iron and other loose material.

My magnet possesses another advantage in handling loose material, and this advantage appears when the material is dropped from the magnet. When the material is released from the magnet the pieces fall inwardly toward each other because the outer pole, which is weaker than the inner pole, will release the pieces first, and they will therefore swing inwardly. Accordingly if the load is delivered to the ground it will be deposited in a compact pile, or if it is delivered to a hopper it will not fly over the edges of the hopper.

Where the magnet is used to lift steel in-

gots, blooms, slabs or other material of greater length than its diameter, it is preferable that the inner polar face and the outer polar face should be in the same plane, so that there will not be an air gap between the inner pole and the load.

In Fig. 9 I have diagrammatically illustrated the magnet lifting a slab. In order to eliminate the air gap between the inner pole and the slab, I may place an adapter or supplemental pole shoe 53 upon the inner pole shoe. This supplemental pole shoe may be held in place by means of a bolt 54 which connects said shoe to a cross piece 55 set in the central opening 18 in the magnet frame.

It is manifest that the invention as defined is susceptible of various embodiments other than that selected for the purpose of explanation.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A lifting magnet having a frame, rigid inner and outer poles of opposite polarity depending from said frame, and a winding arranged within the space between said poles, the outer pole projecting sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

2. A lifting magnet having a frame, rigid inner and outer poles of opposite polarity depending from said frame, a winding arranged within the space between said poles, and a cover plate for said winding, the outer pole projecting sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

3. A lifting magnet having a frame, rigid inner and outer poles of opposite polarity depending from said frame, a winding arranged within the space between said poles, and a cover plate for said winding, with the poles projecting sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

4. A lifting magnet having a pair of rigid magnetic poles for engaging the material to be lifted, an energizing winding arranged between said poles, and a non-magnetic cover for the winding, one of said poles projecting sufficiently below the winding and cover to protect the same and take the shocks and strains to which the magnet is subjected.

5. A lifting magnet having a pair of rigid magnetic poles of low reluctance for engaging the material to be lifted, an energizing winding located between said poles, and a non-magnetic cover plate for the winding and supported by the poles, one of said poles projecting sufficiently below the cover plate to guard the same and protect the winding and take the shocks and strains to which the magnet is subjected.

6. A lifting magnet having a frame, rigid magnetic poles of opposite polarity depending from said frame, a winding located in the space between said poles, and made up of sections, each section formed of spirally wound flat strips, the outer pole projecting sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

7. A lifting magnet having a frame, rigid magnetic poles of opposite polarity depending from said frame and having shoulders near their bottom ends, an energizing winding arranged between said poles, and a non-magnetic cover plate resting upon the shoulders and covering the winding, the outer pole projecting sufficiently below the plate to protect the plate and winding, and take the shocks and strains to which the magnet is subjected.

8. A lifting magnet having a frame, rigid pole pieces of opposite polarity depending from said frame, a winding arranged within the space between said poles, and massive removable magnetic pole shoes projecting from said pole pieces, the outer pole shoe extending sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

9. A lifting magnet comprising a frame having an inner pole surrounded by an outer pole with an annular recess between said poles, a flat spiral energizing winding arranged in said recess, said winding being wound from a flat strip of conducting material and carried by a spool adapted to surround said inner pole and be readily removable therefrom, a non-magnetic plate covering said recess and removable pole shoes of magnetic material covering the active faces of said poles, said shoes being adapted to support said nonmagnetic plate.

10. A lifting magnet comprising a cylindrical frame having an annular recess in one of the end faces thereof, an energizing winding in said recess comprising a plurality of flat spiral coils wound from a flat strip of conducting material and arranged one above another on a supporting spool and connected together so that their effect is cumulative, a non-magnetic plate covering said recess and removable pole shoes of magnetic material covering the portions of said face adjacent said recess, said shoes being adapted to support said non-magnetic plate.

11. A lifting magnet having a frame, rigid pole pieces of opposite polarity depending from said frame, a winding arranged within the space between said poles, a non-magnetic cover plate for said winding, and massive removable magnetic pole shoes projecting from said pole pieces and holding said cover plate in place, the outer pole shoe extending sufficiently below the cover plate to protect the plate and winding and take

the shocks and strains to which the magnet is subjected.

12. A lifting magnet having a frame provided with an inner pole surrounded by an annular outer pole, an energizing winding arranged in an annular recess between said poles, and a heavy removable magnetic pole shoe on the active face of the outer pole to protect the winding and to take the shocks and strains to which the magnet is subjected.

13. A lifting magnet having a frame provided with an inner pole surrounded by an annular outer pole, an energizing winding arranged in an annular recess between said poles, a non-magnetic plate covering said recess, and a heavy removable magnetic pole shoe on the active face of the outer pole to protect the magnet against the shocks and strains to which it is subjected.

14. A lifting magnet having a frame provided with an inner pole surrounded by an annular outer pole, an energizing winding arranged in an annular recess between said poles, a non-magnetic plate covering said recess, and a heavy removable magnetic pole shoe on the active face of one of said poles to take the shocks and strains to which the magnet is subjected, said shoe projecting sufficiently below the winding to protect the same.

15. A lifting magnet having a frame provided with an inner pole surrounded by an annular outer pole, an energizing winding arranged in a recess between said poles, said outer pole being heavy and projecting sufficiently below the winding to protect the same and take the shocks and strains to which the magnet is subjected.

16. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, an energizing winding in a recess between said poles, and independently removable pole shoes of magnetic material on the bottom faces of both of said poles, the under face of the shoe on the outer pole being lower than the under face of the shoe on the inner pole.

17. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, an energizing winding in a recess between said poles, a non-magnetic plate covering said recess, and independently removable pole shoes of magnetic material on the bottom faces of said poles, said shoes being adapted to support said plate, the under face of the shoe on the outer pole being lower than the under face of the shoe on the inner pole.

18. A lifting magnet provided with a frame having an inner pole surrounded by a continuous outer pole, an energizing winding arranged in a recess between said poles, the area of the inner pole face being less than that of the outer pole face whereby when the magnet is deënergized the outer pole releases its load before the inner pole.

19. In a lifting magnet, in combination, a magnet frame having an inner and an outer pole, an energizing winding arranged in an annular recess formed between said poles, and a non-magnetic ribbed plate arranged in the face of said magnet between said poles and covering said recess to protect said coil.

20. In a lifting magnet, in combination, a magnet frame having an inner and an outer pole, an energizing coil arranged in an annular recess formed between said poles, removable pole shoes fastened to said poles and a plate covering said recess and held in position by said pole shoes, said plate being arranged to hold said pole shoes against lateral movement.

21. In a lifting magnet, in combination, a magnet frame having an inner and outer pole, an energizing coil arranged in an annular recess formed between said poles, a nonmagnetic plate arranged in the face of said magnet between said poles and covering said recess to protect said coil, removable pole shoes arranged on said poles for supporting said plate, said plate having an angularly disposed annular flange overlapping the inner faces of the outer pole and its pole shoe.

22. In a lifting magnet, a magnet frame having an inner and outer pole, an energizing winding arranged in an annular recess formed between said poles, removable pole shoes covering the active faces of said poles, the shoes on said poles being out of alinement, and the active face of the outer pole shoe being inclined toward the active face of the inner pole shoe.

23. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, an energizing coil arranged in an annular recess between said inner and outer pole, a space being left between said coil and said outer pole, means passing through said outer pole and coöperating with the periphery of the coil for centering said coil and for holding it in position, a non-magnetic plate covering said recess and removable magnetic pole shoes on the active faces of said poles arranged to hold said plate in position.

24. A lifting magnet having a frame provided with an inner and an outer pole, one of said poles being receded, pole shoes of magnetic material covering the active faces of said poles, and a supplemental pole shoe arranged on the receded pole so as to locate the polar faces in substantially the same plane.

25. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, the face of the inner pole being receded, pole shoes of magnetic material covering the active faces of said poles and a

supplemental pole shoe on said inner pole for locating the inner polar face in substantially the same plane as the outer polar face.

26. In a lifting magnet, in combination, a magnet frame provided with a central opening and having an inner and an outer pole, the face of said inner pole being receded, an energizing winding arranged in an annular recess formed between said outer and inner poles, a supplmental pole shoe placed upon said inner pole to locate the inner polar face in substantially the same plane as the outer pole face, a cross piece extending across the opening in said magnet frame, and a bolt connecting said cross piece and said supplemental pole shoe.

27. In a lifting magnet, in combination, a magnet frame having an inner and an outer pole, an energizing winding arranged in a recess formed between said poles, the inner polar face being receded and being of less area than the outer polar face.

28. A lifting magnet having a central pole, an outer pole concentric with and surrounding said central pole and removable pole shoes on the bottom faces of both of said poles, the pole shoe on the outer pole being deeper than the pole shoe on the central pole, such that its under face is lower than the under face of the pole shoe on the central pole.

29. A lifting magnet having a central pole, an outer pole and removable pole shoes on the bottom faces of said poles, one of said shoes projecting below and being thicker than the other of said shoes.

30. A lifting magnet provided with inner and outer poles having an annular space between the same, an energizing winding comprising a plurality of coils of flat conducting strips wound flatwise, said coils being arranged one above another in the annular space between said poles, an annular non-magnetic plate arranged between said poles to support said winding and magnetic pole shoes detachably secured in close magnetic contact with said poles, said shoes supporting said plate at its inner and outer peripheries.

31. A lifting magnet provided with a circular magnet frame having concentric inner and outer poles presenting a concave active face, an energizing winding comprising a plurality of flat coils formed of flat conducting strips, said coils being placed one upon another in the annular space between said poles, a non-magnetic plate arranged between said poles for supporting and protecting said winding and removable pole shoes detachably secured to said poles, said plate being supported by said pole shoes.

32. A lifting magnet provided with a circular magnet frame having concentric inner and outer poles presenting a concave active face, an energizing winding comprising a plurality of flat coils formed of flat conducting strips, said coils being placed one upon another in the annular space between said poles, a non-magnetic plate arranged between said poles for supporting and protecting said winding and removable pole shoes detachably secured to said poles, said plate being supported by said pole shoes, and engaging said frame and said shoes to resist lateral movement of the latter.

33. A lifting magnet having a magnet frame provided with inner and outer poles, the inner polar face being receded with respect to the outer polar face, coils in the inter-polar space, said coils being spaced from the outer poles to permit expansion of said coils, means for securing said coils in said spaced relation, protecting plates filling the inter-polar space to protect said coils and removable inner and outer pole shoes attached to the respective poles.

34. A lifting magnet having a magnet frame provided with inner and outer poles, the inner polar face being receded with respect to the outer polar face, coils in the inter-polar space, said coils being spaced from the outer poles to permit expansion of said coils, means for securing said coils in said spaced relation, protecting plates filling the inter-polar space to protect said coils and removable inner and outer pole shoes attached to the respective poles, said outer pole shoe having its active face inclined toward said inner pole shoe whereby a concave active face is provided for said magnet.

35. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, an energizing winding comprising a coil wound of flat strips arranged in an annular recess between said poles, a non-magnetic plate covering said recess, and a heavy removable magnetic pole shoe on the outer pole to support said plate and to protect the magnet against the shocks and strains to which it is subjected.

36. A lifting magnet having a frame provided with an inner pole surrounded by an outer pole, an energizing winding in an annular recess between said poles, a non-magnetic retaining plate covering said annular recess and supported by a shoulder on the outer pole, and a removable magnetic pole shoe on the inner pole supporting the inner edge of said plate.

37. A lifting magnet having a frame provided with an inner pole, an energizing winding surrounding said pole, said frame having an outer pole surrounding said winding and projecting sufficiently below the same to protect it, a non-magnetic plate supported by a shoulder on said outer pole, and a removable magnetic pole shoe on the inner pole for supporting the inner edge of said plate.

38. A lifting magnet having a frame pro-

vided with an inner pole surrounded by an outer pole, an energizing winding arranged in an annular recess between said poles, a non-magnetic retaining plate covering said recess to support and protect said winding, removable pole shoes of magnetic material on the faces of the poles having shoulders engaging and holding said plate, said plate also engaging the outer pole whereby the pole shoes are held against lateral movement.

39. A lifting magnet having a frame, rigid pole pieces depending therefrom, a winding arranged within the space between said pole pieces and formed of sections, each section comprising a spirally wound flat strip, a cover plate arranged below said winding, removable magnetic pole shoes fastened directly upon said pole pieces so that the pole pieces and pole shoes form poles, the cover plate being held in place by the pole shoes and the outer pole shoe projecting sufficiently below the plate and winding to protect the same and take the shocks and strains to which the magnet is subjected.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

LEWIS D. ROWELL.

Witnesses:
OSCAR A. KELLER,
WALTER E. SARGENT.

Corrections in Letters Patent No. 1,325,914.

It is hereby certified that in Letters Patent No. 1,325,914, granted December 23, 1919, upon the application of Lewis D. Rowell, of Milwaukee, Wisconsin, for an improvement in "Lifting-Magnets," errors appear in the printed specification requiring correction as follows: Page 2, line 11, commencing with the article "The" strike out the paragraph to and including the word "winding," line 17; page 6, line 10, claim 26, for the word "supplmental" read *supplemental;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of March, A. D., 1920.

[SEAL.]

M. H. COULSTON,
Acting Commissioner of Patents.

Cl. 175—367.