Nov. 1, 1966 B. A. PALM 3,283,278

ELECTROMAGNETIC LIFTING DEVICE HAVING A MULTI-MEMBER CORE

Filed May 11, 1964

FIG_1

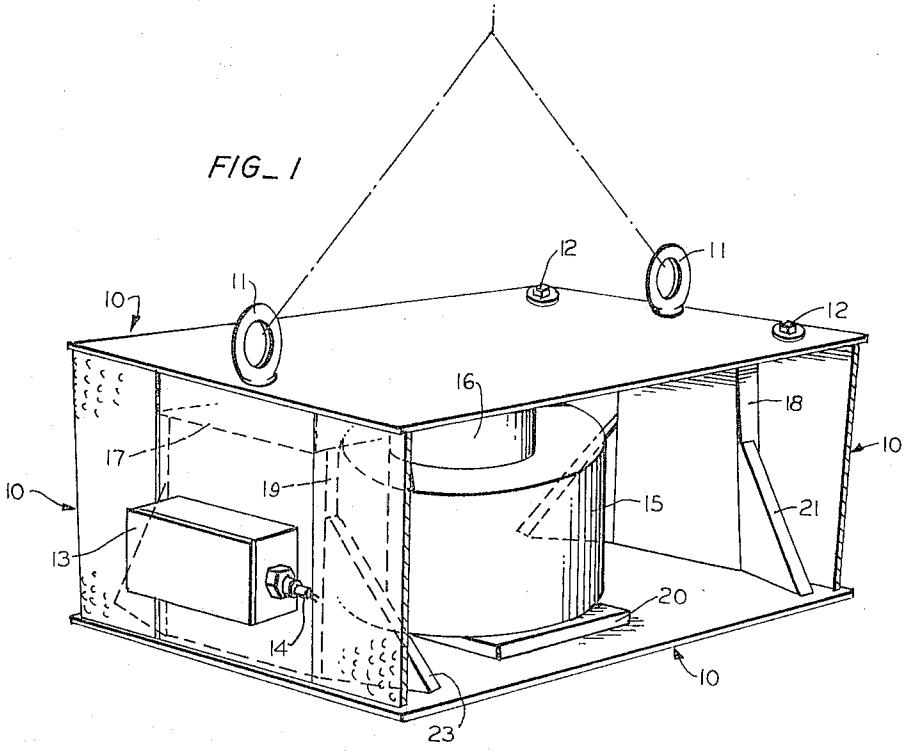


FIG_2

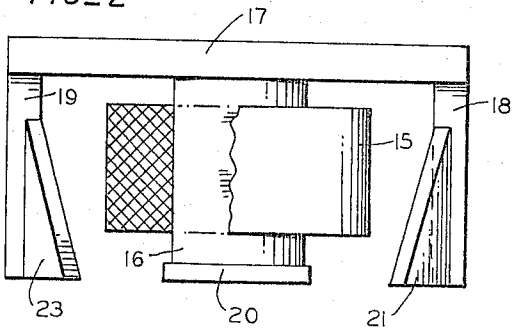


FIG_3

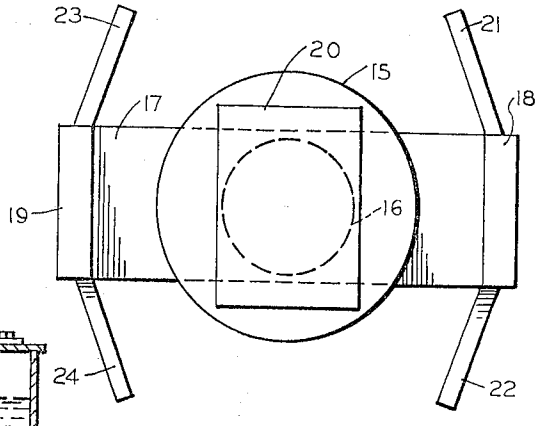
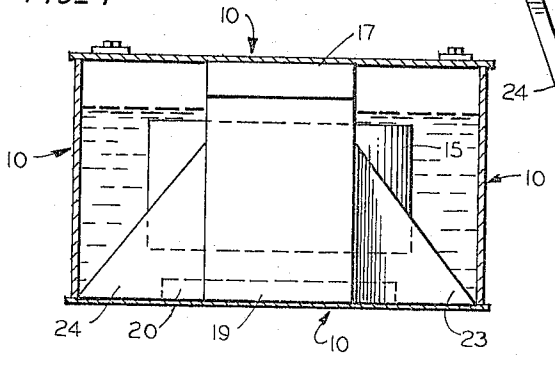


FIG_4



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ELECTROMAGNETIC LIFTING DEVICE HAVING A MULTI-MEMBER CORE

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This invention relates to suspension or lifting magnets in general. More particularly, this invention relates to electromagnets constructed to effect less magnetic flux leakage to improve the performance of the device.

An object of this invention is to provide an improved electromagnet provided with a core of magnetic material, which is shaped to attenuate magnetic fields of inadequate places and to obtain a denser field in the work zone of the magnet.

Another object of this invention is to provide a suspension or lifting magnet with improved electromagnet outer core structure having side members which extend the pole faces of the outer core structure and provide an improved distribution of the magnetic field in the air gap of the core structure and thus increase the efficiency of the electromagnet.

Still another object of this invention is to provide an improved electromagnet core structure in which the coil of the electromagnet is confined in an outer core which has a width commensurate with the diameter of the central core that is positioned in the coil, thereby increasing the flux and the strength of the magnet, and providing extensions to the outer core adjacent to the pole faces thereof which extensions effectively increase the areas of the pole faces of the outer core and thereby provide a more uniform distribution of the magnetic field in the air gaps between the pole face of the central core member and the pole faces of the outer core member.

Still another object of this invention is to proved an improved electromagnet core structure that is provided with an outer core member of reduced width so that it extends over substantially less than the total width of the electromagnet coil, thereby providing an air chamber at each length side of the electromagnet core structure for the purpose of increasing resistance to leakage flux in these areas and also providing room for oil expansion, said outer core member having a cross sectional area sufficient to provide a low reluctance path for the magnetic flux.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawing, in which, briefly:

FIG. 1 is a perspective view of an embodiment of this invention showing the housing of the device partially broken away to expose the electromagnet structure positioned inside;

FIG. 2 is a side view of the electromagnet of this invention removed from the housing;

FIG. 3 is a bottom view of the device shown in FIG. 2; and

FIG. 4 is a sectional view of the device shown in FIG. 1, illustrating the oil expansion chamber at each side of the top core.

Referring to the drawing in detail, reference numeral **10** designates a housing for the electromagnetic device of this invention, and this housing is provided with top, bottom and sides, all of which are welded together after the electromagnetic device is placed inside. The housing **10** may be made of suitable non-magnetic metal such as aluminum or the like. Suitable eye bolts **11** or other means are provided to the device whereby it may be

suspended from cables or hoists as desired so that it may be positioned over a conveyor from which tramp magnetic metal may be gathered thereby, or it may be supported from a crane to be used as a lifting magnet. These eye bolts **11** extend into the outer core structure **17** of the electromagnet and they are firmly attached thereto by suitable threads, welding or the like. The housing **10** also is provided with holes which are adapted to be closed by the breather plugs **12**, and cooling oil or other liquid is placed into the housing through these holes after the electromagnet is assembled therein and the housing is sealed. An electrical junction box **13** is attached to the side of the housing, and this box is provided with a suitable outlet through which the cable **14** is inserted into the box so that electrical connections may be made to the coil **15** of the electromagnet.

The electromagnet is provided with a coil **15** that is space-wound upon a suitable bobbin or form and covered with suitable insulating material. The coil **15** is positioned on the central core member **16** of magnetic material and does not extend all the way to the ends thereof, as shown. The central core member is attached by welding suitable bolts or the like to the top core structure **17** that includes the outer core members **18** and **19**. The width of the outer core structure **17** is substantially equal or slightly greater than the diameter of the central core member **16**. Thus the outer core structure **17** does not extend over the sides of the coil **15** to any appreciable extent and leakage magnetic flux which would normally thread from the sides of the core structure through the coil and on to the central core member is reduced. In order to provide the outer core structure **17** of sufficient cross-sectional area so that it will provide a path for the magnetic flux of low reluctance, the thickness of this outer core structure is substantially increased to compensate for the reduced width thereof. Also the coil **15** does not extend over the entire length of the central core member **16**.

The side core members **18** and **19** are made integral with the top part of the outer core structure, and these side members may be welded thereto or the entire outer core structure may be made of one piece, as desired. These side members **18** and **19** are made of substantially the same cross-sectional area as the outer part **17**. A pole face **20** which is of substantially rectangular shape is attached by welding or the like to the end of the central core member **16**. Auxiliary core members **21**, **22**, **23** and **24**, each of which is of substantially triangular shape are provided to the outer core structure. Triangular members **21** and **22** are attached to the sides of core member **18**, and triangular members **23** and **24** are attached to the sides of core member **19**. These triangular members extend outwardly and inwardly from the side members so that they, together with the side members, form a partial enclosure for the core **16** when viewed from the bottom, as shown in FIG. 3. The effect of this configuration is to provide an air gap between the outer pole faces formed by these triangular members and side members on the one hand, and the center pole face **20** on the other, with the result that the magnetic flux is spread out more toward the sides of the pole face **20** inasmuch as areas of the triangular members **21–24** approach areas of pole piece **20** closer than do areas of sides **18** and **19**. By using these triangular side members, it is possible to obtain a more uniform distribution of the magnetic flux in the air gap and at the same time use the narrower outer core structure which reduces the magnetic leakage through the coil where it does no work. Also the thickness of the triangular members **21–24** is about one-half that of the sides **18** and **19** to prevent too large a component of the magnetic

flux from passing between these members 21–24 and pole piece 20.

While I have shown a preferred embodiment of the invention it will be understood that the invention is capable of variation and modification from the form shown so that its scope should be limited only by the scope of the claims appended thereto.

What I claim is:

1. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising a coil having connections through which an electric current is supplied thereto, a central core member positioned in said coil and one end of said member having a pole face, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to one end of said central core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around the pole face of said central core member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap.

2. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising an annularly shaped coil having connections through which an electric current is supplied thereto, a central core member positioned in said annularly shaped coil, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to one end of said central core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, a magnetic shoe member attached to the other end of said central core member, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around said magnetic shoe member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap.

3. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising an annularly shaped coil having connections through which an electric current is supplied thereto, a central core member positioned in said annularly shaped coil, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to one end of said central core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, the other end of said central core member having a magnetic pole face, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around said pole face to form an air gap therebetween and the length of the air gap between areas of said auxiliary core members and said pole face is shorter than the part of the air gap between the ends of the outer core member and said pole face so that the work producing magnetic flux is more uniformly spread in said air gap.

4. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising an annularly shaped coil having connections through which an electric current is supplied thereto, a central core member positioned in said annularly shaped coil, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to one end of said central core member, said outer core member having a width substantially equal to the diameter of said central core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, a magnetic shoe member attached to the other end of said central core member, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around said magnetic shoe member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap.

5. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising a coil having connections through which an electric current is supplied thereto, a central core member positioned in said coil and one end of said member having a pole face, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to the other end of said central core member, the width of said outer core member being substantially equal to the diameter of said central core member so that magnetic leakage flux from the sides of said outer core member to said central core member is minimized, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around the pole face of said central core member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap.

6. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising a coil having connections through which an electric current is supplied thereto, a central core member positioned in said coil and one end of said member having a pole face, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to the other end of said central core member, the width of said outer core member being substantially equal to the diameter of said central core member so as to provide open spaces along the sides of said outer core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around the pole face of said central core member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap, and a tank for enclosing said coil and said core members, said tank having oil therein filling the space around said coil and said core members up into said open spaces part of which are provided for oil expansion.

7. An electromagnet for lifting magnetic articles or for attracting tramp magnetic material comprising a coil having connections through which an electric current is supplied thereto, a central core member positioned in said coil and one end of said member having a pole face, said core member having a diameter such that said coil fits closely thereon, an elongated outer core member having the central part thereof attached to the other end of said central core member, the width of said outer core mem-

ber being substantially equal to the diameter of said central core member, said outer core member having the opposite ends thereof disposed on opposite sides of said coil and said opposite ends being of like magnetic polarity when said coil is energized, said outer core member having auxiliary core members on said opposite ends extending outwardly and inwardly therefrom so that the pole faces of said opposite ends and said auxiliary core members extend partially around the pole face of said central core member to form an air gap therebetween, said auxiliary core members being shaped to more uniformly spread the work producing magnetic flux in said air gap, and a tank for enclosing said coil and said core members, said tank having a top wall engaging the outer surfaces of said outer core

member and a bottom wall engaging said pole faces, said tank having oil therein in which substantially all of said coil is immersed for cooling.

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