June 4, 1957 A. ANDERSON 2,794,941

MAGNETIC LIFTING UNIT

Filed July 8, 1953 2 Sheets-Sheet 1

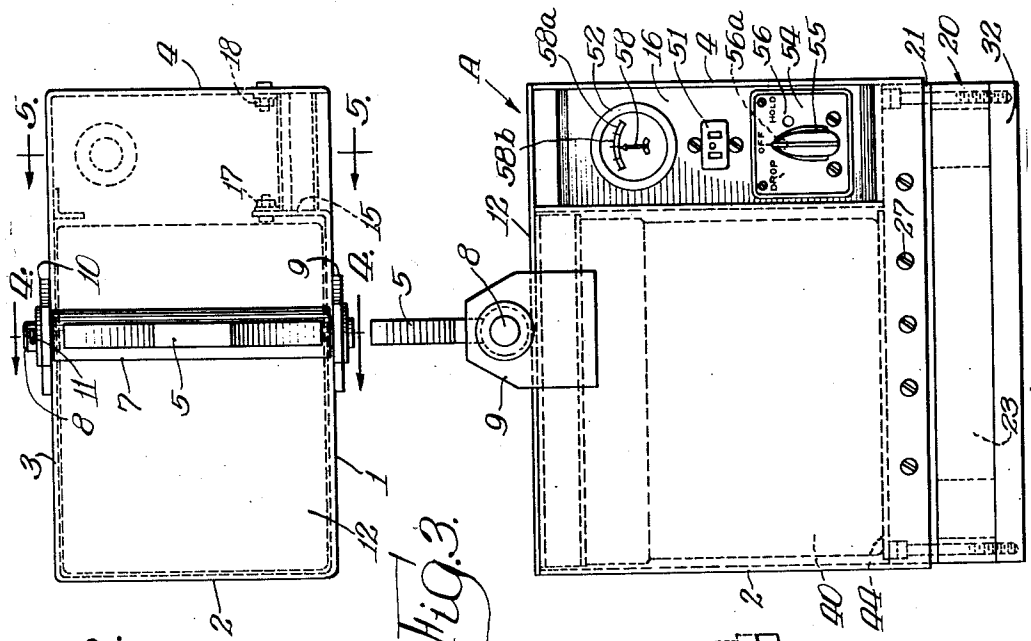


Fig. 2.

Fig. 3.

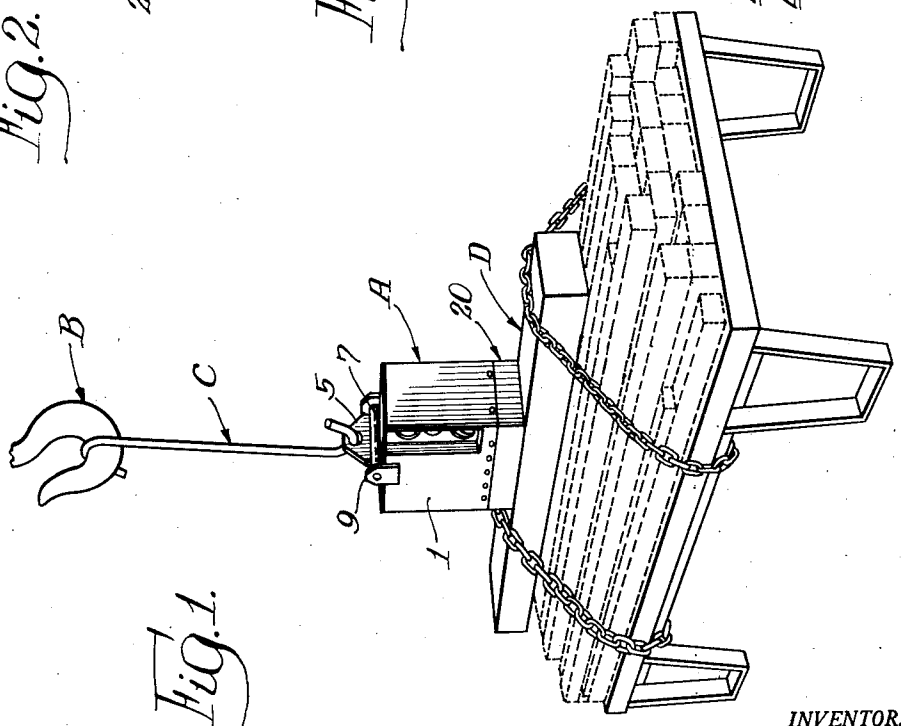


Fig. 1.

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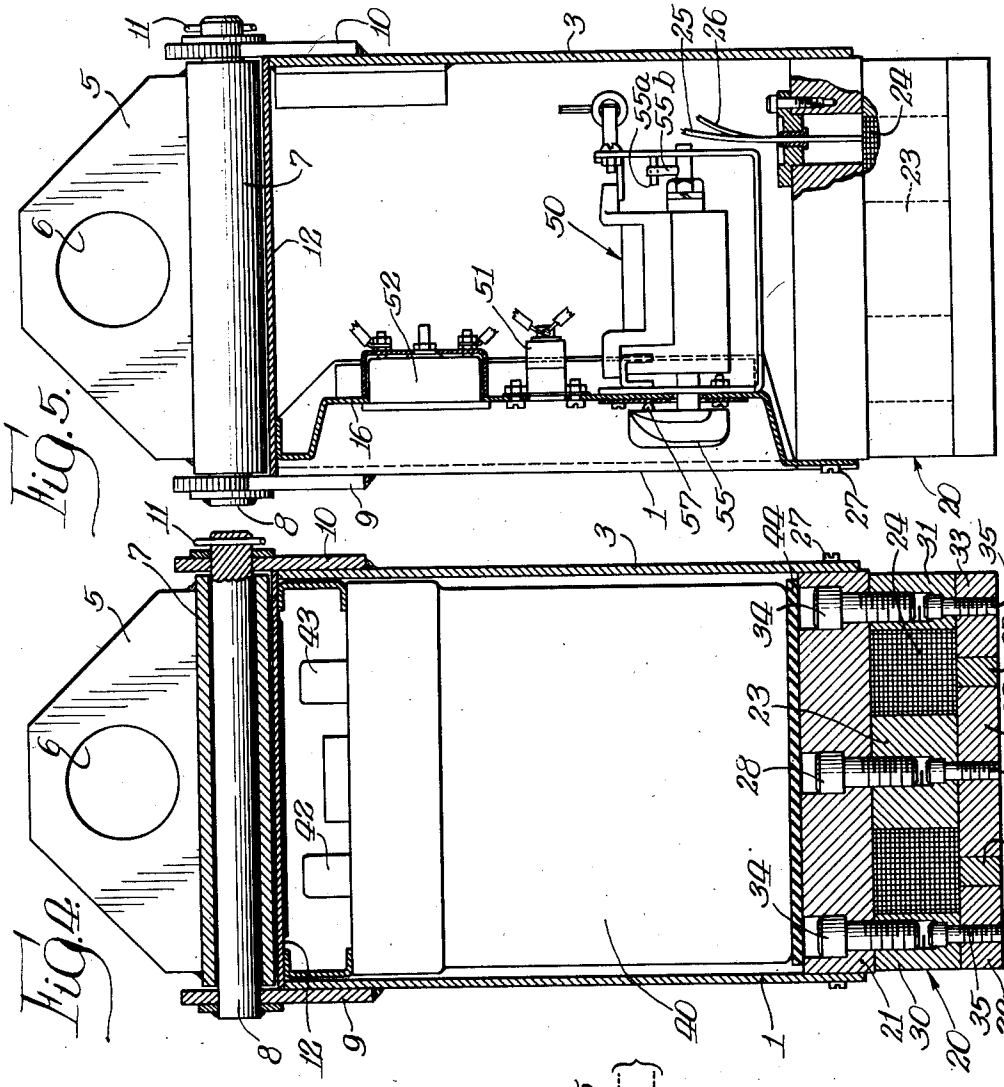


Fig. 5.

Fig. 4.

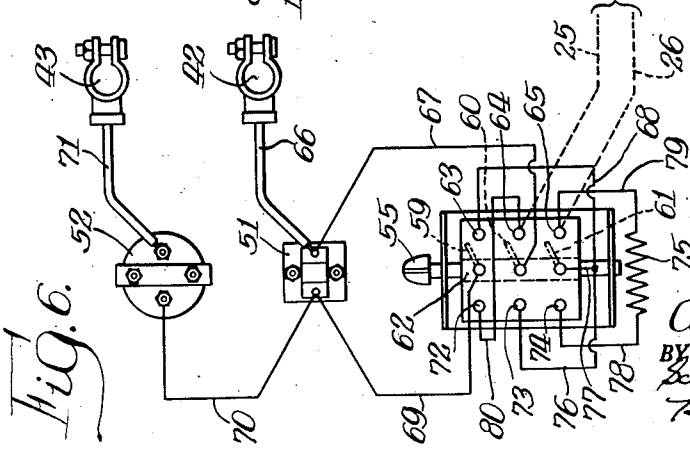


Fig. 6.

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United States Patent Office

2,794,941

Patented June 4, 1957

2,794,941

MAGNETIC LIFTING UNIT

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Application July 8, 1953, Serial No. 366,643

2 Claims. (Cl. 317—123)

This invention relates to magnetic lifting units and more particularly to magnetic lifting units for use with material handling cranes or conveyors.

A general object of this invention is to provide a new and novel magnetic lifting unit.

Another object of this invention is to provide a low voltage electromagnetic lifting unit associated with a crane or conveyor for holding heavy objects such as iron or steel bars while they are transported by the conveying mechanism.

Another object of this invention is to provide a magnetic lifting unit wherein an electromagnet, an electrical power source and a control switch for the magnet, in combination, constitute a self contained magnetic lifting unit.

Another object of the invention is to provide a magnetic lifting unit having a storage battery therein for energizing the electromagnet and which will render the unit free from hazard due to power failure and which may be readily recharged when the unit is not in use.

Another object of the invention is to provide a self-contained magnetic lifting unit comprising a container or casing having an electromagnet and carrying therewithin a storage battery for supplying low voltage power to the electromagnet, a switch for controlling the energization of the magnet by the battery, a battery charging plug receptacle for connection to a battery charging device when the unit is not in use and an ammeter to indicate operative energization of the magnet.

The objects of the invention thus generally set forth together with other and ancillary advantages are attained by the construction and arrangement shown by way of illustration in the accompanying drawings, in which:

Fig. 1 is a perspective view of the magnetic lifting unit magnetically holding a group of metal bars.

Fig. 2 is a plan view of the magnetic lifting unit showing in broken line the battery located within the container.

Fig. 3 is a front elevation of the magnetic lifting unit.

Fig. 4 is a vertical section through the container taken along line 4—4 of Fig. 2 and showing the battery in side elevation.

Fig. 5 is a vertical section taken along the line 5—5 of Fig. 2 and showing the electromagnet in side elevation.

Fig. 6 is a schematic wiring diagram for the magnetic lifting unit.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one specific embodiment of the invention, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

The magnetic lifting unit A is shown in Fig. 1 supported by a crane hook B, through the intermediary of a rod C, magnetically holding a bundle of metal bars D which are to be transported by the crane from one place to another in a fractory or other location.

The magnetic lifting unit A is shown more particularly in Figs. 2 to 6. This unit comprises a casing or container having sides 1, 2, 3 and 4. A plate 5 having an opening 6 therein through which the crane attaching rod C may pass is pivotally secured to the container by a tubular sleeve 7 affixed to the plate 5. The sleeve 7 is rotatably mounted on a pin 8 which is loosely mounted in a pair of plates 9 and 10 attached as by welding to the sides 1 and 3 of the container. The pin 8 may be axially withdrawn by removal of a cotter key 11 which permits disassembly of the plate 5 from the container and access to the inside of the container upon removal of a top cover 12 which is loosely mounted on the sides of the container and held in place by the sleeve 7.

The front side of the casing has an inwardly turned flange 15 at one end thereof to which a control panel 16 is attached by suitable means such as bolts 17. The control panel is also attached to side 4 of the container by bolts 18. The purpose of the control panel 16 will be more fully set forth hereinafter.

An electromagnet 20 is attached to the lower extremities of the casing sides 1 to 4 and constitutes a bottom for the container. The container could be provided with a bottom plate and the electromagnet attached thereto if such an expedient were found to be desirable.

The electromagnet 20 utilizes a single core winding coacting with components of magnetic material which permit the establishment of a plurality of magnetic circuits directed to the face of the magnet for magnetically holding metal objects for transport thereof or for other material lifting or handling functions. As illustrated in Figs. 3, 4 and 5 of the drawings, the magnet comprises a base plate 21 and a lower plate 22 composed of magnetic material which are disposed in parallel relationship and are rigidly secured to a central plate 23 which is also of magnetic material.

The base plate 21 is secured to the side of the container by a plurality of cap screws 27 and the central plate 23 and lower plate 22 are securely held together by a plurality of screws 28 and 29. About the central plate 23 and between the base and lower plates 21 and 22 is a simple winding 24. The latter is adapted to be connected to a source of electric current by means of wires 25 and 26 whereby the magnet can be energized.

To establish a plurality of magnetic circuits directed to the lower surface of the magnet, magnetic poles of the polarity opposite to that of the lower plate 22 are provided in such surface. To this end side plates 30 and 31 and pole pieces 32 and 33 rigid with the plates 30 and 31 respectively, are secured to the base plate as by means of a plurality of screws 34 and 35. The said plates and the pole pieces are of magnetic material and the latter extend throughout the full length of the magnet in the lower surface thereof. Thus, upon energization of the winding 24 through the provision of a low reluctance flux flow path formed by the base plate 21, magnetic circuits are directed to the pole pieces 32 and 33 and the lower plate 22 by the central plate 23 and side plates 30 and 31 to cause the pole pieces 32 and 33 to assume a polarity which is opposite to that of the lower plate 22.

The pole pieces 32 and 33 and the lower plate 22 are spaced apart by means of inserts 36 and 37 of non-magnetic material, thus providing high reluctance gaps between the pole pieces and the lower plate which insure inclusion of the material to be lifted in the magnetic circuits established upon energization of the magnet. The non-magnetic inserts may be secured to the base plate 22 and pole pieces 32 and 33 by silver soldering and thus effect a smooth lower surface for the magnet.

A storage battery **40** which may be a conventional lead plate battery having three cells has terminals **42** and **43** and is mounted in the casing or container and supported on a cushion **44** which may be a mat of sponge rubber or other suitable cushioning material.

This battery is connected in a circuit with the electromagnet **20** as shown in Fig. 6, and the operation or function thereof will be more fully set forth hereinafter in connection with the description of said circuit. It should be noted that the use of a storage battery rather than an outside power source prevents possible hazard to employees due to a power failure with consequent deenergization of the magnet.

The control section located at one end of the casing and which has the control panel **16** forming a portion of one wall of the casing has mounted therein a double-throw, triple-pole switch **50**, a battery charging plug receptable **51** and an ammeter **52**, all of which are in the magnet energizing circuit. They are secured to the control panel by suitable securing means such as cap screws or nuts and bolts. The face plate **54** for the switch **50** has suitable indicia thereon to indicate the various positions of the rotatable switch as is shown in Fig. 3. The switch has an operating knob **55** which may be manually moved to position the switch in any of the three following positions: "Hold," "Drop" or "Off." The knob has a spring urged detent **57** on the inner surface thereof which cooperates with notches **56** and **56***a* in the face plate **54** to maintain the switch in either the "Hold" or "Off" positions, respectively. The switch may be manually moved from the "Drop" to "Off" position or a spring such as leaf spring **55***a* engaging a movable part **55***b* of the switch may be provided to move the switch from the "Drop" to the "Off" position.

The ammeter **52** has a needle **58** which will extend upwardly in a vertical direction when there is no current flow and will move in one direction to indicate the current flow from the battery **40** to the electromagnet **20**. One portion **58***a* of the scale may be colored green which will indicate that the electromagnet **20** is receiving sufficient current to properly energize the electromagnet for holding the material to be lifted thereby and another area **58***b* of the ammeter may be colored red to indicate a reduced current not sufficient to properly energize the electromagnet.

The battery charging plug receptacle **51** is provided to enable recharging the storage battery from a low voltage source when the magnetic lifting unit is not in use. In actual operation it has been found that the battery will energize the electromagnet for a period of 10 to 17 hours of actual use before a recharge of the battery is necessary.

The electrical circuit for the magnetic lifting unit is shown in Fig. 6 and includes as elements thereof the rotatable double-throw, triple-pole switch **50**, the battery charging plug receptacle **51**, the ammeter **52** and the terminals **42** and **43** of the storage battery. This circuit is designed to provide a "Hold" circuit wherein a low voltage is applied to energize the electromagnet for holding material. When it is desired to release the material, a "Drop" circuit is completed and reduced and reversed current is then directed through the electromagnet to counteract the residual magnetism in the magnet. Although not limiting the invention to the exact circuit values, it has been found that with the particular electromagent structure herein described having a resistance of 1 ohm, proper operation of the electromagnet may be achieved with a six volt D. C. source which provides a current of 6 amps.

When the switch **50** is positioned by knob **55** to complete the "Hold" circuit, a plurality of rotatable contacts **59**, **60** and **61** mounted on a rotatable core **62** of the switch (Fig. 6) are moved into engagement with a plurality of stationary contacts **63**, **64** and **65** and thus the "Hold" circuit for the electromagnet is completed. This circuit may be traced as follows: from battery terminal source **42**, battery lead **66** to the charging receptacle **51**, lead **67**, movable contact **60**, stationary contact **64** and wire **25** (shown in broken line in Fig. 6) which is connected to the coil **24** of the electromagnet **20**. To complete the circuit wire **26** (shown in broken line in Fig. 6) leads from the coil of the electromagnet to stationary contact **65**, movable contact **61**, lead **68**, stationary contact **63**, movable contact **59**, lead **69** to the plug receptacle **51**, lead **70** to the ammeter **52** and battery lead **71** to the other terminal **43** of the battery.

When it is desired to release a load held by the electromagnet, the switch **50** is moved to place the movable contacts **59**, **60** and **61** in contact with stationary "Drop" contacts **72**, **73** and **74** which will result in reversing the current through the electromagnet.

There is a resistor **75** in the "Drop" circuit which provides for a reduced current as compared with the current in the circuit during a "Hold" operation. The reversed and reduced current counteracts the residual magnetism in the electromagnet and permits release of the engaged material. With the electromagnet having a resistance of one ohm and using a 6 volt source, it has been found that when the resistor **75** has a resistance of 25 ohms the time interval for deenergization of the magnet will be 3 to 4 seconds.

The drop circuit may be traced as follows: from battery terminal **42**, battery lead **66** to plug receptacle **51**, lead **67** to movable contact **60** and stationary contact **73**, lead **76**, lead **77**, movable contact **61**, stationary contact **74**, lead **78**, resistor **75**, lead **79**, contact **65** and wire **26** which is connected to the coil **24** in the electromagnet **20**. The circuit is completed by lead wire **25** extending from the coil **24**, contact **64**, lead **80**, stationary contact **72**, movable contact **59**, lead **69**, plug receptacle **51**, lead **70**, ammeter **52**, and battery lead **71** which is attached to battery terminal **43**.

During operation, a person on the factory floor will stand adjacent the magnetic lifting unit and locate the unit in contact with one of the bars in the bundle or the object which is to be lifted. It should be noted that for proper operation the object should be of steel or iron or other material having a high permeability which will be securely held by the magnet. In the event that none of the bars or objects in the bundle are of such material, a steel or iron bar may be inserted in the chained-together bundle and provide a mode of enabling the magnet to lift the bundle of bars which are of non-magnetic material. When the magnet is placed properly on the bar material, the operator will move the knob **55** of the switch **50** from the inoperative "Off" position to the "Hold" position wherein movable contacts **59**, **60** and **61** are in contact with stationary contacts **63**, **64** and **65**. This will complete the "Hold" circuit described above and the switch will remain in the "Hold" position by means of detent **57** until such time as the operator moves the switch away from the position.

After the bundle has been transported to the desired place or position, the knob **55** of the switch **50** is moved to the "Drop" position wherein the movable contacts **59**, **60** and **61** engage the stationary "Drop" contacts **72**, **73** and **74** which will direct a reduced and reversed current to the electromagnet and counteract the residual magnetism therein to release the magnet from the material. After release of the magnet from the material, the operator may release the knob **55** which will permit the spring **55***a* to return the switch to "Off" position or the spring may be omitted and the switch manually moved to "Off" position. With the switch in the "Off" position the movable contacts **59**, **60** and **61** are in a position wherein they will not contact either the "Hold" contacts or the "Drop" contacts. It would be within the scope of the invention to provide a time delay mechanism which would automatically move the switch from

"Drop" to "Off" position after the magnet is demagnetized.

I claim:

1. A self-contained electromagnetic lifting unit for transporting heavy metal loads, comprising, in combination, an open top boxlike container for supporting elements of the unit and providing access to such elements inside the container, a removable top cover closing the top of said container, means secured to the container adjacent the top for attaching the container to any one of a plurality of lifting mechanisms, an electromagnet constituting the bottom of the container and including an exposed substantially flat load-engaging bottom surface formed by a plurality of elongated, spaced, parallel magnetic pole pieces having non-magnetic material positioned therebetween, an electric winding effective when energized to establish electromagnetic flux patterns passing through the pole pieces and outwardly beyond the said bottom surface so as to pass through a metallic load to provide a strong magnetic grip on such loads, a storage battery in the container for supplying electric power to energize said winding, an electric circuit connecting the battery and the winding to energize the winding independently of connections to an external source of electricity, a control panel forming a portion of one exterior wall of said container, a control switch mounted on said panel, said switch being connected in said circuit and having an exteriorly accessible part for manual operation to control energization of said winding, an exteriorly visible ammeter mounted on said panel, said ammeter being connected in said circuit and having means to indicate the strength of current flow through said circuit, and an exteriorly accessible battery recharging plug receptacle mounted on said panel and connected in said circuit for connection with an external source of power to recharge the battery when the unit is not in use.

2. A self-contained electromagnetic lifting unit for transporting heavy metal loads, comprising, in combination, a container for supporting elements of the unit, means secured to the container adjacent the top for attaching the container to any one of a plurality of lifting mechanisms, an electromagnet constituting the bottom of the container and including an exposed substantially flat load-engaging bottom surface, an electric winding effective when energized to establish electromagnetic flux patterns passing outwardly beyond the said bottom surface so as to pass through a metallic load to provide a strong magnetic grip of such loads, a storage battery in the container for supplying electric power to energize said winding to energize the winding independently of connections to an external source of electricity, an electric circuit connecting the battery and the winding, a control panel forming a portion of one exterior wall of said container, a control switch mounted on said panel, said switch being connected in said circuit and having an exteriorly accessible part for manual operation to control energization of said winding, and an exteriorly visible ammeter mounted on said panel, said ammeter being connected in said circuit and having means to indicate the strength of current flow through said circuit.

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