United States Patent

Le Gloan

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[54] **ELECTRIC CONTROL MOUNTING, NOTABLY FOR MOTORIZED LIFT TRUCK**

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[52] **U.S. Cl.** **318/139,** 318/440, 290/50, 290/17

[51] **Int. Cl.**.....**H02p 7/00**

[58] **Field of Search** 290/50, 17; 318/139, 440

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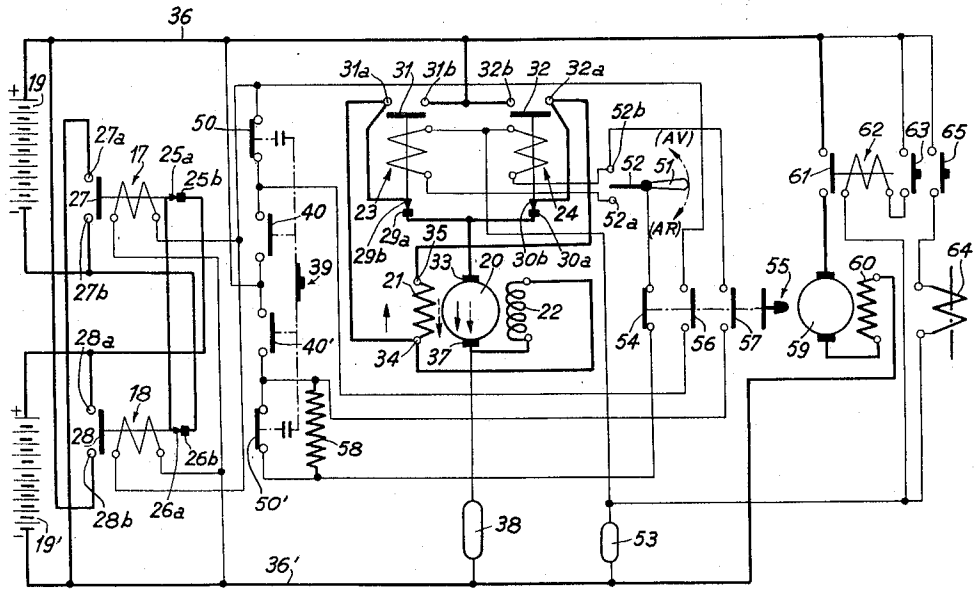
[57] **ABSTRACT**

This electric mounting, including a coupler and a reversing switch, is intended primarily but not exclusively for controlling the operation of a fork lift truck and comprises essentially in a twin-battery and d.c. motor driving assembly incorporating a two-position switch providing a low starting speed and a higher or normal travel speed, a reversing switch for operating the motor in either direction, and a safety cut-out switch adapted to be actuated by an obstacle likely to be struck by the front of the truck, a pair of relays of known type having a built-in front contact actuated by the inner end of its plunger core and to which a back contact is added on the outer end of said plunger core.

5 Claims, 3 Drawing Figures



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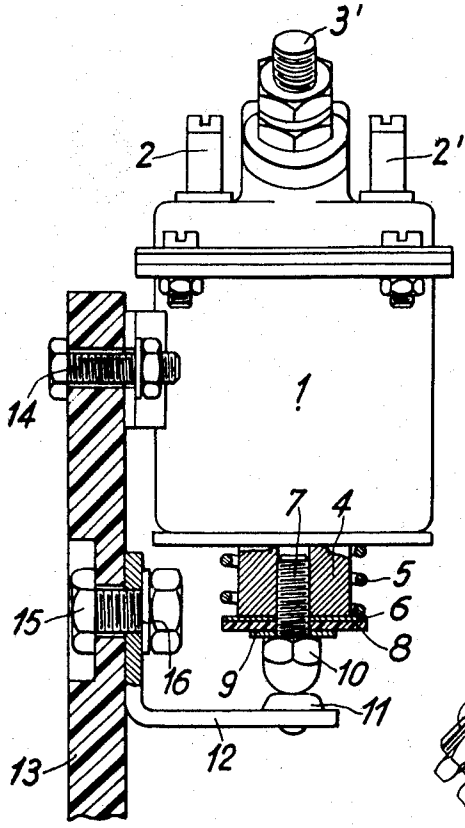

Fig.1.

Fig.2.

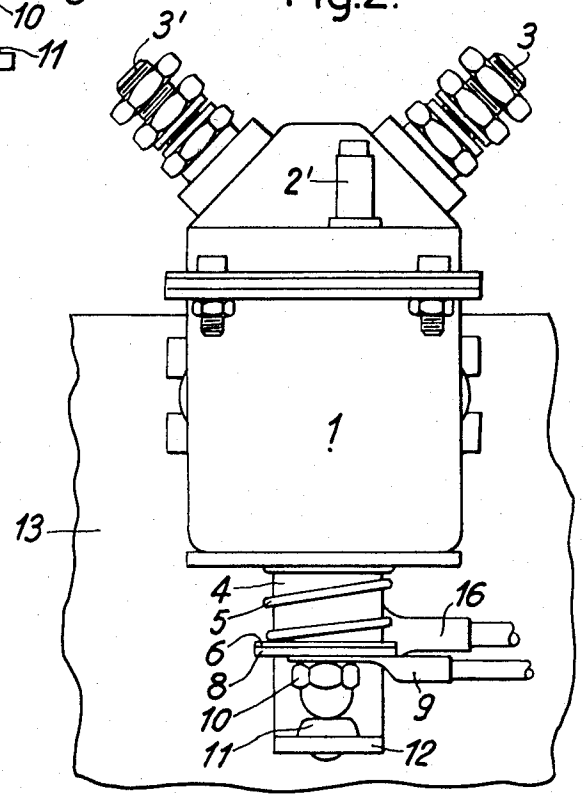

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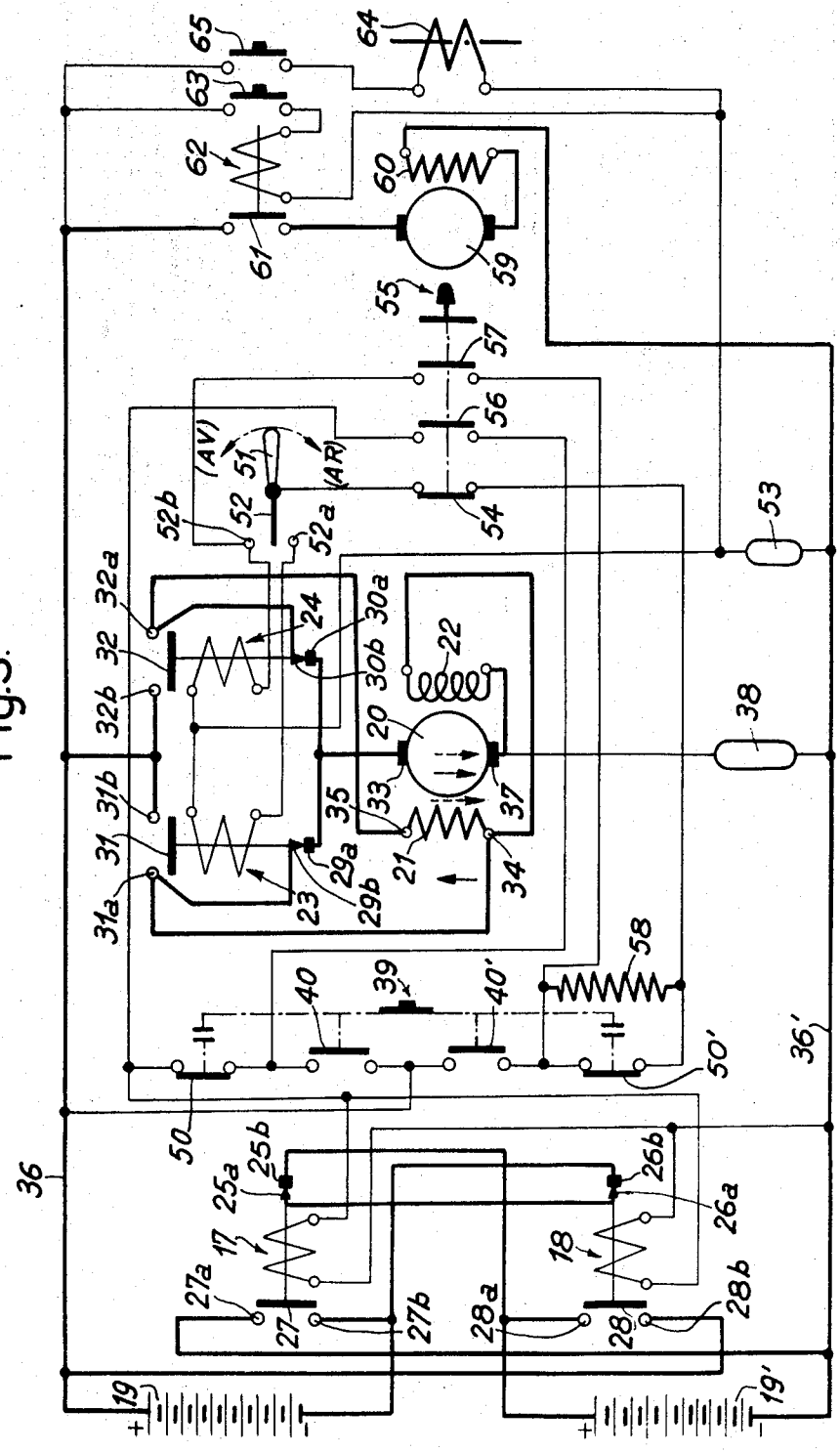
Fig.3.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ELECTRIC CONTROL MOUNTING, NOTABLY FOR MOTORIZED LIFT TRUCK

FIELD OF THE INVENTION.

The present invention relates to electric mountings or circuit means for controlling the movements of a movable mechanical unit, such as a motorized fork lift truck or pallet-handling truck, with a relatively low starting speed.

SUMMARY OF THE INVENTION.

The electric control means or mounting according to the present invention is characterized in that the motor of the vehicle, of the d.c. type, is supplied with current from two similar storage batteries through a coupler adapted to connect said batteries either in parallel for low-speed starting or in series for normal operation at a higher speed; according to an essential feature characterizing this invention the control mounting further comprises a reversing switch for reversing the direction of rotation of the d.c. motor.

This invention is also concerned with a coupler and a reversing switch of the electromagnetic relay type, adapted to be incorporated preferably in the mounting broadly described hereinabove; the coupler or reversing switch according to this invention is characterized in that it consists essentially of a pair of relays of known type each comprising a coil and a plunger core having one end located within said coil and adapted to actuate a front contact, its opposite end projecting from the coil, and that a back contact is provided by disposing a first contact stud at the outer end of said plunger core of each relay and securing to an insulating support of said relay another contact stud in such a position that the first contact stud engages the second contact stud only when the relevant relay is de-energized.

This arrangement of the coupler and reversing switch according to the present invention is particularly advantageous, notably from an economical point of view, in that these switching appliances comprise essentially the combination of relays of a type currently available on the market at a relatively low price, due notably to the fact that they comprise each only one front contact, these relays being adapted to be modified according to the present invention at a relatively moderate cost to incorporate each an additional back contact.

BRIEF DESCRIPTION OF THE DRAWING.

By way of example, a typical and exemplary form of embodiment of the present invention will now be described with reference to the accompanying drawing, in which;

FIGS. **1** and **2** are a front elevational view and a side elevational view, respectively, of an electromagnetic relay adapted to be used in the practical embodiment of this form of embodiment of the invention;

FIG. **3** is a wiring diagram of the control mounting of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT.

The specific form of embodiment of the invention which is described hereinafter with reference to the attached drawing is intended more particularly for controlling the movements of a motorized fork lift truck or pallet handling truck, i.e., a self-propelled vehicle of well known type for transporting and handling loads and materials and adapted to be controlled by an operator standing on the front end of the vehicle notably by means of a two-position push-button switch providing the low-speed starting and normal operation,at a higher speed, of the vehicle, and also by means of a reversing lever providing forward and reverse operation of the vehicle. However, the present invention is applicable to the electric control of the movements of any desired movable mechanical element or machine driven from a d.c. motor.

According to two essential features characterizing this invention, the passage from low starting speed to higher normal speed, on the one hand, and the reversal of the direction of travel, on the other hand, are obtained by means of a coupler and a reversing switch, respectively, and these coupler and reversing switch consist each essentially of a pair of electromagnetic relays of the type illustrated diagrammatically in FIGS. **1** and **2** of the drawing. According to the present invention, each relay of the pair consists of a conventional relay of known type, easily available on the market, and comprising an energizing coil **1**, having end terminals **2** and **2'**, and a plunger core having one end disposed within the coil **1** and adapted to actuate a front contact (not shown) for interconnecting two terminals **3** and **3'**, the other end **4** of said plunger core projecting from the coil **1** and being visible in FIGS. **1** and **2**. In relays of this known type the outer end **4** of the plunger core comprises a return coil spring **5** retained by a metal washer **6** secured to the lower outer end of plunger core **4** by means of a screw, likewise of metal, not shown in FIGS. **1** and **2**. Now, a single-contact relay of this type is relatively inexpensive. Furthermore, it is also possible to add to a relay of this type, according to the present invention, at a moderate cost, an additional back contact necessary for constituting with the two relays thus modified on the one hand the coupler and on the other hand the reversing switch to be incorporated in the electric mounting of this invention. This modification of relays easily available in the trade consists essentially in substituting, for the screw normally retaining the metal washer **6** in position, a screw-threaded rod **7** of insulating material, and slipping on said metal washer **6** another washer **8** but of insulating material and also the end of a first electric conductor, notably a conductor lug terminal **9**; these members **6**, **8** and **9** are then tightened to the outer end **4** of the plunger core by means of a metal nut **10** engaging the screw-threaded rod **7** and constituting the first stud of the back contact to be formed. The other contact stud **11** of this back contact is carried by a metal bracket **12** secured in turn to the supporting plate **13** of suitable insulating material to which the relay coil **1** is secured by means of bolts such as **14**; the bracket **12** is secured to the supporting plate **13** by means of at least one metal bolt such as **15**, the end of another electric conductor, for example a lug terminal **16**, being inserted between the metal bracket **12** and the metal nut screwed on bolt **15**. The position of bracket **12** in relation to coil **1** is so selected that the first stud **10** of the back contact engages the second stud **11** only when said coil is de-energized, i.e., when the plunger core is partially pulled out from the coil by the force of return spring **5**.

The specific form of embodiment of this invention of which the wiring diagram is illustrated in FIG. 3 of the drawing comprises four electromagnetic relays of the type illustrated in FIGS. 1 and 2 and described hereinabove. Two relays 17 and 18 constitute the essential component elements of a coupler adapted to connect a pair of similar storage batteries 19, 19' in parallel or in series for supplying current to the d.c. motor of the truck, the armature winding 20 and field winding 21 of this motor being connected in series; however, in the specific form of embodiment illustrated the coil or winding 22 of an electromagnetic brake is inserted between the armature and field windings of this motor. Another pair of relays of the same type, denoted 23 and 24, are the essential component elements of a reversing switch adapted,when actuated, to reverse the direction of rotation of the d.c. motor 20,21.

It may be pointed out that the coupler comprising according to this invention two relays 17, 18 of the above described type as well as a reversing switch for reversing the direction of rotation of the electric motor, which switch comprises likewise two relays 23,24 also of the same type, are extremely economical in comparison with similar couplers and reversing switches of conventional or hitherto known design as now available in the trade.

Referring now to the wiring diagram of FIG. 3, the reference numerals 25*a*, 25*b* and 26*a*, 26*b* designate the first and second sides of the back contacts of relays 17 and 18, respectively, and the reference numerals 27*a*, 27*b*, 28*a*, 28*b* designate the first and second sides of their front contacts, respectively; furthermore, reference numerals 27 and 28 designate the movable contact studs rigid with the plunger cores of relays 17 and 18, respectively; according to an essential feature characterizing this invention, the first sides 25*a* and 26*a* of the back contacts of both relays 17 and 18 are interconnected and their second sides 25*b* and 26*b* are connected to terminals of opposite polarities of the two batteries, respectively, notably the positive terminal of battery 19' and the negative terminal of battery 19; on the other hand, the two sides 27*a* and 27*b* of the front contact of relay 17 are connected to the negative terminals of both batteries 19' and 19, respectively, and the two sides 28*a* and 28*b* of the front contact of relay 18 are connected to the positive terminals of batteries 19' and 19, respectively. Similarly, the reference numerals 29*a*, 29*b* and 30*a*, 30*b* designate the two sides of the back contacts of relays 23 and 24, respectively, and reference numerals 31*a*, 31*b* and 32*a*, 32*b* designate the first and second sides of the front contacts of these relays 23 and 24, respectively; finally, the reference numerals 31 and 32 designate the movable contact studs of the same front contacts, respectively. According to another feature characterizing this invention, the first sides 29*a* and 30*a* of the back contacts of both relays 23 and 24 are connected in common to the terminal 33 of the armature winding 20 of the d.c. motor; the other side 29*b* or 30*b* of the back contact of each relay 23, 24 is connected to the first side 31*a* or 32*a*, of the front contact of the same relay 23 or 24 and, on the other hand, the first sides 31a and 32a of the front contact of both relays 23 and 24 are connected to the two terminals 34 and 35, respectively, of the field winding 21 of said d.c. motor. Finally, the two lines 36, 36' connected to the positive terminal of battery 19 and to the negative terminal of battery 19', respectively, are connected the former in common to the second sides 31*b*, 32*b* of the front contacts of both relays 23 and 24, and the latter to the other terminal 37 of the d.c. motor armature 20 through a fuse 38.

The coupler consisting essentially of relays 17 and 18 may be actuated by the operator through the medium of a push-button control switch 39 having two contact positions. In a first position this switch 39 closes a pair of contacts 40, 40' without opening another pair of contacts 50, 50', and in its other or second position it opens both contacts 50, 50' without re-opening said contacts 40, 40'.

Under these conditions, in the first contact position of switch 39 the coils of relays 17 and 18 are energized through a circuit (1) comprising elements 36, 40, 50, 17, 18 and 36'.

It is clear that in this case, as a consequence of the closing of the pair of front contacts 27 and 28 of relays 17 and 18, both batteries 19, 19' are connected in parallel to lines 36 and 36'.

In the second contact position of switch 39 said circuit (1) is opened at contact 50 so that the coils of both relays 17 and 18 are de-energized. Therefore, it is clear that, as a consequence of the opening of front contacts 27 and 28 of relays 17 and 18, the pair of batteries 19 and 19' are connected in series to lines 36 and 36'.

On the other hand, the operator may reverse the direction of rotation of the d.c. motor 20, 21 and therefore the direction of travel of the motorized fork lift truck or like vehicle, by simply reversing the position of a control lever 51, so that the conducting arm 52 thereof is moved from its position of engagement with a contact stud 52*a*, connected to one terminal of the coil winding of relay 23, to its position of engagement with the other contact stud 52*b* connected to one terminal of the coil winding of the other relay 24. The opposite ends of the coils of relays 23 and 24 are connected in common to the negative supply line 36' via a fuse 53. The conducting arm 52 of reversing lever 51 is connected on the other hand to one side of the contact 50' of the above-mentioned two-position push-button switch 39, but this connection takes place through a back contact 54 of a safety push-button switch 55 to be described hereinafter. This safety push-button switch 55 is disposed at the front of the fork lift truck or other vehicle equipped with the electric mounting of this invention, so as to be actuated by any obstacle likely to be struck by the vehicle during its forward travel; however, this obstacle may be the operator himself. In addition to the back contact 54 mentioned hereinabove this safety push-button switch 55 comprises a pair of front contacts, i.e., front contact 56 mounted in parallel to contact 50 of said two-position push-button 39, and front contact 57 having one side connected to contact stud 52b of reversing lever 51 and the other side connected to the common point of the movable contacts 40' and 50' of said two-position push-button control switch 39.

Now the mode of operation of the control mounting and circuitry according to the present invention will be described briefly with reference to the circuit diagram of FIG. 3.

To operate the lift truck in the forward direction the operator must firstly set the reversing lever **51** in the AV position and then set the main push button switch **39** in its first position. The closing of circuit (1) as explained in the foregoing causes the pair of batteries **19** and **19'** to be connected in parallel to lines **36** and **36'**. As the back contact **54** of the safety push button switch **55** is closed, the coil of relay **23** is energized through the following circuit:

(2) **36, 40', 50', 54, 52, 52*a*, 23, 53** and **36'**.

The closing of the front contact of relay **23** is attended by the formation of the following circuit:

(3) **36, 31*b*, 31; 31*a*, 34, 21, 35, 32*a*, 30*b*, 30*a*, 33, 20, 37, 38** and **36'**

in which the d.c. motor field winding **21** receives current from its lower terminal **34** to its upper terminal **35**, the same current flowing through the armature **20** from the upper pole **33** to the lower pole **37**; the coil **22** of the electromagnetic brake receives the same current; therefore, this brake is released and the motor **20, 21** is thus caused to drive the vehicle in the forward direction at low speed, since the value of the voltage supplied to the series-connected armature **20** and field **21** corresponds only to that available across the terminals of each battery **19, 19'**. If during this mode of operation, the safety push-button switch **55** is depressed, for example as a consequence of the presence of an obstacle ahead of the vehicle, the opening of contact **54** opens the circuit (2) described hereinabove and therefore de-energizes the relay **23**, while closing contact **57** so as to energize the coil of relay **24** through the following circuit:

(4) **36, 40', 57, 52*b*, 24, 53** and **36'**.

As a consequence of the closing of front contact **32** of relay **24**, the armature **20** and field **21** of the d.c. motor are inserted in the following circuit:

(5) **36, 32*b*, 32, 32*a*, 35, 21, 34, 31*a*, 29*b*, 29*a*, 33, 20, 37, 38** and **36'**, wherein the armature constantly receives current from its upper pole **33** to its lower pole **37**, but in this case the field winding **21** receives current flowing from its upper terminal **35** to its lower terminal **34**. Under these conditions, the motor **20, 21** revolves in the opposite direction with respect to the preceding mode of operation, whereby the vehicle, for example a fork lift truck, is caused to back at the same reduced speed as before.

However, after having started the vehicle in the forward direction at low speed the operator may change to a higher, normal speed by simply setting the control push-button **39** in its second position. Thus, circuit (1) is opened at the level of contact **50**, both relays **17** and **18** are de-energized and as a consequence of the opening of their front contacts and the closing of their back contacts the two batteries **19, 19'** are connected in series to lines **36** and **36'** through the following circuit:

(6) **36, (+19–), 26b, 26a, 25a, 25b, (+19'–), 36'**.

Thus, a voltage having twice the value of the voltage available across the terminals of each battery **19, 19'** is supplied through lines **36** and **36'** to the motor **20, 21**, via the above-described circuit (3); under these conditions, the motor drives the fork lift truck or like vehicle at a considerably higher speed corresponding to the normal operation thereof. However, the voltage supplied to the coil of relay **23** remains substantially unchanged, due to the insertion in circuit (2) of a resistor **58** connected across the terminals of contact **50'** which, in this case, remains open.

If, during this fast operation of the vehicle, the safety switch **55** were opened by an obstacle, on the one hand the switching of its contacts **54** and **57** will produce a permutation in the conditions of relays **23** and **24** and on the other hand the vehicle will be caused to back; in addition, the closing of its contact **56**, notwithstanding the opening of cobtact **50** of push-button **39**, will cause the energization of the coils of both relays **17** and **18**, and therefore the parallel connection of the storage batteries **19** and **19'**; thus, if the vehicle strikes an obstacle during its operation at high forward speed, it is caused immediately and automatically to back at low speed.

Now if the operator himself wants to back the vehicle, it is only necessary for him to move the control lever **51** to its AR position so as to re-energize the coil of relay **24** through the following circuit:

(7) **36, 40', 50', 54, 52, 52*b*, 24, 53** and **36'**.

This backward movement begins at low speed when the main push-button switch **39** is set in its first position, and may if desired continue at normal, higher speed when the driver depresses the same push-button **39** to its other or second position, the two relays **17** and **18** being energized only in the first case through the above-described circuit (1).

During the backward travel of the fork lift truck at low speed its safety switch **55** mounted at the front of the vehicle cannot be actuated by an obstacle; however, the operator himself can actuate this switch either on purpose or inadvertendly; in this case, if in addition the control push-button switch **39** is in its first contact position (slow starting) the circuit (7) energizing the coil of relay **24** is opened at contact **54** but the closing of contact **57** restores the following holding circuit:

(8) **36, 40', 57, 52*b*, 24, 53** and **36'**.

On the other hand, if the push-button switch **39** is set in its second contact position, in addition to the substitution of the auxiliary holding contact (8) for the normal energizing circuit (7) of the coil of relay **24**, the closing of contact **56** of safety switch **55**, in spite of the opening of contact **50** of switch **39**, is attended by the energization of both coils of relays **17** and **18**, and therefore by the reduction in the total voltage fed to d.c. motor **20, 21**; to sum up, actuating the safety switch **55** during the truck operation in reverse will only cause same (in case of operation at the higher, normal speed) to actuate the coupler comprising said relays **17** and **18** so as to reduce the backing speed of the vehicle.

The control mounting for motorized fork lift truck of which the wiring diagram is illustrated in FIG. **3** comprises in addition a motor-pump unit for supplying fluid under pressure to the hoisting cylinder, this unit being driven from a d.c. motor having its field winding **59** and armature winding **60** mounted in series between the lines **36** and **36'** via the front contact **61** of an electromagnetic contact unit having its coil **62** inserted between the lines **36** and **36'** through a control push-button switch **63**. On the other hand, the contraction of the control cylinder may be controlled by means of an electromagnet **64** inserted between the lines **36** and **36'** via the fuse **53** and a control push-button switch **65**.

Of course, the form of embodiment described hereinabove with reference to the accompanying drawing should not be construed as limiting the invention since it is given by way of illustration and since many modifications and variations may be brought thereto without departing from the spirit and scope of the invention, as set forth in the appended claims.

What I claim is:

1. An electric mounting for controlling the energizing circuit of a d.c. motor for driving a movable element comprising a coupler for connecting two poles of said energizing circuit to first and second batteries of substantially identical characteristics, said first and second batteries each including a first terminal of one polarity and a second terminal of another polarity, said first terminal of said first battery being connected to said first pole of said energizing circuit and said second terminal of said second battery being connected to said second pole of said energizing circuit, said coupler including first and second relays each having a set of back contacts and a set of front contacts, the back contacts of said first and second relays on one side thereof being connected to each other, the back contact of said first relay on the other side thereof being connected to the first terminal of said second battery, the back contact of said second relay on the other side thereof being connected to the said second terminal of said first battery, the front contact of said first relay on one side thereof being connected to the second terminal of said second battery, the front contact of said first relay on the other side thereof being connected to the second terminal of said first battery, the front contact of said second relay on one side thereof being connected to the first terminal of said first battery, the front contact of said second relay on the other side thereof being connected to the first terminal of said second battery, and means to simultaneously energize said first and second relays for starting said movable mechanical element at low speed, and to simultaneously de-energize said relays for operating the movable element at a higher, normal speed.

2. An electrical mounting according to claim 1 further comprising an armature and a field winding connected in series to each other, a reversing switch for reversing the direction of rotation of said d.c. motor, said reversing switch including third forward motion and fourth reverse motion relays, each of said third and fourth relays including a set of back contacts and a set of front contacts, the back contacts of said third and fourth relays on one side thereof being connected to one of the terminals of said armature, the back contact of said third relay on the other side thereof being connected to the front contact of said third relay on one side thereof, the back contact of said fourth relay on the other side thereof being connected to the front contact of said fourth relay on one side thereof, the front contact of said third relay on one side thereof also being connected to one side of said field winding and the front contact of said fourth relay on said one side thereof also being connected to the other side of said field winding, the front contact of said third and fourth relays on the other side thereof being connected to said first pole of said energizing circuit, and the second pole of said energizing circuit being connected to the other side of the said armature.

3. The invention according to claim 2 further comprising safety means including a push-button switch mounted to the front of said movable mechanical element, said safety means being adapted, when said push-button switch is actuated, to control the energization means of said first and second relays, and, if said third relay is pre-energized to further de-energize said third relay and energize said fourth relay thereby reversing the direction of said movable element.

4. The invention according to claim 2 wherein at least one of said first, second, third and fourth relays includes a coil and a plunger core having one end disposed within said coil and adapted to actuate the set of front contacts thereof, the back contact set of said relay including a first contact stud disposed on the outer end of said plunger coure of said relay and a second contact stud, and an insulating support for the second contact stud of the said back contact provided outside of said coil and in front of said front contact stud for engaging said second contact stud only when said relay is de-energized.

5. The invention according to claim 4 further comprising a coil return spring for said plunger core, a screw-threaded rod of insulating material connected to said plunger core, a metal washer disposed on the outer end of said rod, a washer of insulating material disposed on said metal washer, a metal clamping nut engaging said screw-threaded rod and constituting the first contact stud of said back contact, wherein one end of a first conductor is inserted between said insulating washer and said nut, a metal bracket and a metal bolt adapted to secure said bracket to said insulating support wherein a second conductor is adapted to be inserted between said bracket and said bolt.

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