SECTION 3

MAGNET CONTROLLER INFORMATION

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GENERAL CONTROLLER INFORMATION

All electromagnet controllers serve the same functions of energizing and de-energizing the magnet. They dissipate the stored inductive energy in the magnet coil, apply a controlled amount of reverse current to de-magnetize the magnet, and finally turn "off" completely the power to the magnet.

Although the basic functions are all common, the major manufacturers of magnet controllers use different circuitry and techniques to perform these functions. Each has its advantages and disadvantages and personal preference and economics usually dictates the selection of a specific product.

COMMON PROBLEMS

The following problems are common to all controllers and can be used as a guide in troubleshooting your magnet controller:

PROBLEM	PROBABLE REMEDY
Controller Does Not Operate	1. No or Low DC Voltage. Check power supply. 2. Defective master switch on push-button station. 3. Burned out or open operating coil. 4. Polairty reversed (L+ must be positive, L- must be negative).
Controller Operates No or Low Magnet Current	1. Main contact tips worn or burned-out. 2. Contact tip spring broken. 3. Contact Shunt Burned or Broken. 4. Lift contactor armature not closing completely.
Controller Operates Load Dribbles From Magnet	1. Controller and Magnet not properly sized. 2. Partly Shorted Magnet. See Section 1. 3. Reverse circuit malfunction check components. 4. Polarity is reversed; CR defective and/or bypassed. 5. Diode DM1 open.
Excessive arcing of Main Contacts (Billowing Arc)	1. Open in discharge circuit. Check components, contacts & wiring. 2. Diode DM1 open. 3. Polarity is reversed; CR defective and/or bypassed.

Excessive arcing of reverse contacts	1. Shorted reverse circuit resistors. 2. Contact tips worn, or contact spring bad.
Reverse contactor does not operate	1. Open reverse contactor coil or reverse circuit component. 2. Diode DM1 open. 3. Defect in push-button or Master Switch, for manual controllers only.
Lift & Drop come in together, Resistors overheat	1. Diode DM1 shorted.

CHECKING DIODES

On newer units employing diodes instead of the auxiliary contact, there is no maintenance required. However, should the operation of the drop cycle be faulty, the diode may be defective. The diode can be checked using a digital multi meter (DMM) with a diode check function. Refer to your meter operation manual on how to use this meter function. The diode can be checked in the following manner.

Make sure all power is off, then:

1. Disconnect the two (2) wires from the diode terminals, isolating the diode from the rest of the circuit.

2. Locate terminals 1, 2 and 3 on the diode. They are impressed into the diode molding.

3. Place the red lead of the DMM on terminal 1 and the black lead on terminal 2. The reading should be low. Reverse the leads and the reading should be high.

4. Place the red lead of the DMM on terminal 3 and the black on terminal 1. The reading should be low. Reverse the leads and the reading should be high.

5. If the readings are good then the diode is ok. If readings show a low reading or a high reading in both directions, then the diode is defective and should be replaced.

CDS CONTROLLER

Trouble Shooting

The most common difficulty experienced with magnet controllers is not primarily caused by the controller, but by a ground in the circuit outside the controller. A ground is a very low resistance reading between one of the lines and the framework of the crane.

Grounds usually occur at one of three places: 1) At the magnet; 2) At the cable reel; 3) At the generator. If a ground occurs at two of the above places then faulty operation of the controller results such as poor load drop of the magnet, delayed opening of the drop contactor, or overheating of the two outside resistors (R1 & R2) in the controller. Continued use of the controller under these conditions can burn up the resistors, or the drop contactor coil. When the grounds are cleared, and the difficulty persists, check the resistor and drop contactor coil.

If a poor load drop is experienced, and no grounds exist, then observe the operation of the controller. When the master lever is placed in the drop position the main contactor should open, and the drop contactor immediately closes and remains closed only long enough to drop the load. This is for 1 to 2 s on small magnets and 3 to 5 s on larger magnets. If the reverse contactor does not close then check the resistors, reverse contactor coil and replace burned out parts. If the reverse contactor stays closed too long then check for a shorted reverse contactor coil.

If the main contactor refuses to close, when the master is in the lift position, then check for broken wires between controller and master switch. Also check for burned out operating coil.

If the magnet is shorted, it will overheat and have a poor load drop with light material dribbling off, or heavy pieces clinging to the magnet. Have the magnet repaired if it is shorted or has a very low ground reading.

OPERATING INSTRUCTIONS

MST, RD-1A, RD-1W & RD-2A CONTROLLERS

The magnet controller is an important part of the system for furnishing DC power to the electromagnet. It provides the means for connecting and disconnecting the magnet to the power supply. The complete function of the control is as follows: 1) to apply full power to the magnet, 2) to safely dissipate the inductive energy of the magnet coil, 3) to apply reverse power to the magnet and 4) to disconnect the magnet from the line.

To activate this controller, a master switch or other control function is required with one control contact which must be maintained closed during the entire lifting mode. This contact must be opened to cause the controller to go through its automatic drop phase and release the magnet load.

The magnet control has three separate circuits to perform the required functions. During the "lift" phase, "L" contactor closes and establishes the lift circuit from L+ to L- through the "L" closed contacts and energizing the magnet. Diode module DM1 or on older units the auxiliary contact of the "L" contactor is open during this time which disconnect the discharge circuit from the magnet.

To make a drop, the master switch control contact is opened which deenergizes the "L" contactor, opening the lift circuit thru the main contacts and simultaneously closing the auxiliary contact "L" (older units). On newer units, a Diode replaces the contact. It has a high resistance to current flow when in the lift state and low resistance to current flow in the discharge and drop state. This establishes the discharge circuit loop around the magnet. Within the discharge loop is a portion of the "D" (drop contactor) coil with terminals 2 - 4. This coil will energize and close the "D" contactor as the magnet current is being dissipated by the resistor in the discharge loop.

Closing of the "D" contacts will establish the reverse circuit which applies reduced voltage of the opposite polarity to the magnet thru the "D" contacts. Within this reverse circuit is another portion of the "D" coil with terminals 1 - 3. The current flowing in this circuit and "D" coil 1 - 3 aids in holding the "D" contactor closed. When the decay of the magnet discharge current reaches a low enough level, current will start to flow in the magnet from the line in the opposite direction. Current also reverses in direction in "D" coil 2 - 4 so that the polarity in both "D" coils are in opposition. As the current in the reverse circuit increases in value, a point will be reached when the fields of the two "D" coils will neutralize each other and the "D" contactor will open taking the magnet, off-the-line.

This will be the point when sufficient reverse current will be flowing in the magnet to neutralize the magnet residual field and drop the load cleanly. The controller and magnet are now ready for another "lift" cycle.

Proper adjustment of the opening and closing of the main and auxiliary contacts (on older units) of the "L" contactor is important as excess contact arcing could result. The main contact gap should be about 20 mm (0.78") when open. The main contacts should be just opening as the auxiliary contact is about to close. On older units, the auxiliary contact gap opening of 1.5 mm (0.06") maximum at this point is acceptable. To adjust the auxiliary contact, loosen the "off-set" pin retaining screw and rotate the operating pin until the above condition is reached. Tighten the screw and check the operation. For the new double contact drop assembly, unloosen the retaining nut locking the auxiliary arm stop screw. Adjust the stop screw to obtain the proper setting and tighten the locking nut.

Besides the difference in current rating of the MST, RD-1A, RD-1W and RD-2A controller, the latter two have a rheostat connected across "D" coil 1 - 3. This permits a fine adjustment of the drop-time and enables the operator to adjust the drop characteristic of the controller to suit the specific magnet.

RD-3A MAGNET CONTROL

MAINTENANCE INSTRUCTIONS

OPERATION:

The magnet controller is an important part of the system for furnishing DC power to the electromagnet. It provides the means for connecting and disconnecting the magnet to the power supply. The complete function of the control is as follows: 1) to apply full power to the magnet; 2) to safely dissipate the inductive energy of the magnet coil; 3) to apply reverse power to the magnet; and 4) to disconnect the magnet from the line.

Full voltage is applied from the power supply to the magnet through contactor "A" which is energized by the contacts of the master switch when the lever is in the "lift" position. On older units, Contactor "A" also has an auxiliary contact which opens when the main contacts close. This auxiliary contact opens the discharge circuit in the controller. On newer units, the controller utilizes a diode for this purpose. The discharge path includes resistor R5 which absorbs the inductive energy of the magnet coil when the lever master is turned to "OFF" position. The circuit prevents excessive arcing at the tips of "A" and "L" contactor. Then opening of "A" contacts applies reduced voltage to the magnet through Resistors R1 and R2 during the initial "OFF" phase of the drop cycle. This reduces the current to the magnet to about 60% of its normal value. Approximately one second (1 s) later, contactor "L" opens and the balance of the line voltage is removed from the magnet. The discharge circuit dissipates the remainder of the magnet current in resistor R5 at this time.

In order to achieve the time delay for the "L" contactor, a timing relay TR-1 is used. The timer automatically "times-out" when the master switch is moved from "lift" to "off". It is set for approximately 1.25 s and can be easily adjusted with a screwdriver for more or less time, to suit the application.

For the manual controller, unless the master switch is moved to the "drop" position, the load will begin to dribble off, and a partial load can be deposited by returning the master switch to the "lift" position. Full holding power will return to the magnet to retain the remaining load. To drop the entire load, the operator must move the lever to the "drop" position and keep it there until the load has dropped clean, at which time he releases the master switch handle and it automatically return to the "OFF" position. The automatic controller will completely drop the load when the master switch is placed in the "OFF" position. Time TR-2 determines the time that the drop contactor stays closed and determines the amount of reverse current to the magnet.

In the "drop" position for the manual controller, or "OFF" position for the automatic controller, of the lever master, contactor "D" is energized which connects reverse voltage to the magnet through resistors R3 and R4, which reduces the line voltage to approximately 15% of its normal value. This is sufficient to neutralize the residual magnetism and provide a quick clean drop. In the manual operation, the operator must release the master switch at the moment all the load begins to fall; otherwise, the reverse voltage will retain a small residue of the load which will drop after the master switch is released. In automatic operation, this time is adjusted on TR-2.

PERFORMANCE CHECK:

Check the voltage and ammeter for proper voltage and current levels. The voltage should be 230 V ± 10%. The current level will depend upon the operating temperature of the magnet; it should be between 70 to 100% of the cold current rating of the magnet. If the current level is below rating, and the line voltage is correct, then check the contact tips of contactor "A"; if they are worn and making poor contact, replace with new tips. If the current is still low, then check the magnet resistance with an ohmmeter. It should be between 100% and 135% of cold rating. If it is above or below these values, the magnet coil is either open, or shorted.

TROUBLE SHOOTING:

The following trouble shooting guide assumes that a DC Voltmeter and Ammeter panel is connected in the system:

ITEM	PROBLEM	SUGGESTED REMEDY
1.	No DC voltage or low DC voltage	Check Power supply for: a. AC input voltage b. Blown fuses c. Push reset button "ON" d. Defective AC contactor e. Defective rectifier diodes f. Defective surge suppressor
2.	No DC Amperes DC Volts O.K.	Check controller as follows: a. Operate master switch to "lift" all devices should energize A,L, and TR 1. 230 V dc should be at M1 and M2 terminals. If not, check the devices and contact tips for wear. Replace as required. b. Check master switch contact tips.

		c. If 230 V dc is a M1 and M2 terminals, check cable reel, magnet lead connections and magnet for open.
3.	High DC Amperes	Check for short or ground at cable reel cable, magnet leads and magnet.
4.	Excessive Arcing of "A" or "L" contacts	Check the following: a. Check R5 for open. b. Check R1 and R2 for open. c. Check per item 3 above. d. Check TR 1 for time delay. e. Check auxiliary contact on "A" for wear (older units) and Diode on newer units for open circuits.
5.	Poor load drop when master is in "DROP" position	Ammeter should indicate 15 A maximum. If no current or excess current flows, check the following: a. Check R3 and R4 for open. b. Check contact tips on "D" for wear. c. Check master switch contact tip. d. Check timer TR 1 & TR 2 contact tips. e. Check "L" auxiliary contact tips. f. Check magnet for short or ground. g. Check for reversed polarity at L+ and L-.
6.	Excessing heating of resistors	Check the following: a. Diode shorted.