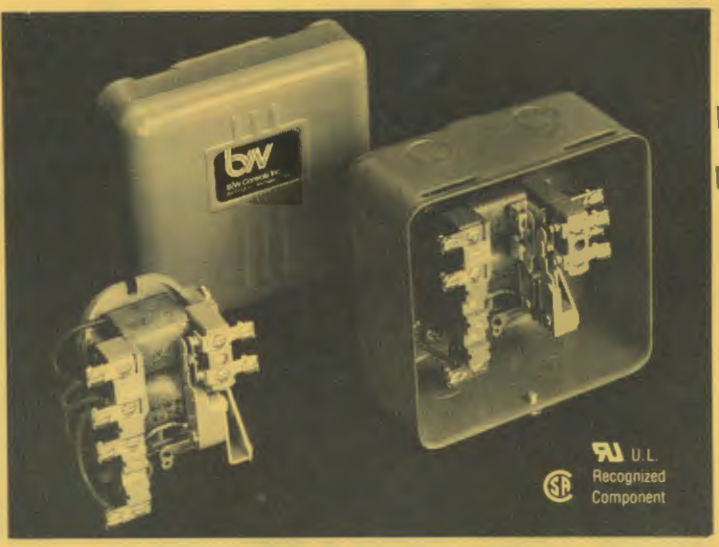
Liquid Level Control Systems



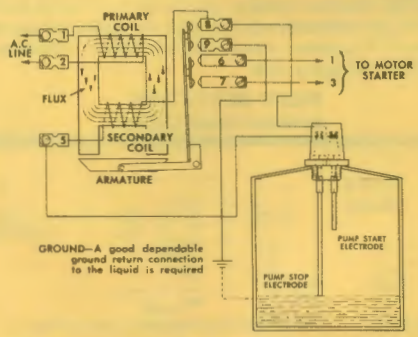


Fig. 1—Secondary coil circuit open; armature down.

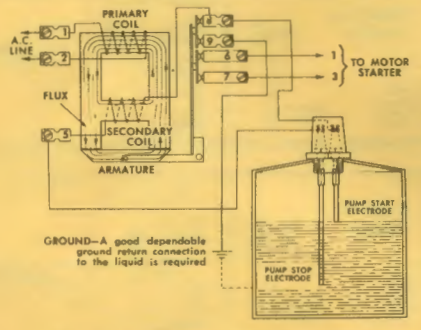


Fig. 2—Secondary coil circuit closed; armature up.

Principle of Operation

A B|W floatless liquid level control system consists of the proper type of relay, a holder to support one or more electrodes or probes in the liquid container, and the corrosion resistant electrodes themselves. Inasmuch as all B|W induction relays are quite similar, differing only in contact arrangement as shown below, the following description of how a Type LH Relay functions on a pump down control application will serve to explain basic design, construction, and operating principles for the entire line.

As shown by the accompanying diagrams, the laminated core of the relay is "B" shaped. The primary coil is assembled to upper bar of the core and the secondary coil for the electrode circuit is placed on the lower bar. An armature located below legs of the core is connected to an insulated arm which carries two movable contacts. When armature is raised, these contacts close or open the motor and electrode circuits — depending upon whether contacts are normally open or normally closed.

When a source of alternating current is connected to the primary coil at termnals 1 and 2, the primary coil sets up a magnetic flux which, following lines of least resistance, circulates through the shortest path. As shown, in Fig. 1, this is through the lower bar of the laminated core on which the secondary coil is mounted. This magnetic flux induces a voltage in the secondary or electrode circuit coil. No current can flow in this coil, however, until the circuit is completed between electrodes. *Thus electrode circuit voltage is generated in relay and has no connection with power line.*

B|W floatless level control systems utilize the liquid as an electrical conductor to complete the secondary circuit between the upper and lower electrodes. Thus, when liquid contacts the upper electrode, the resulting flow of current in this circuit sets up a bucking action in the lower bar of the core. This action tends to divert lines of magnetic force to the core legs and set up an attraction that pulls the armature up into contact with the legs — as shown in Fig. 2. This armature movement closes or opens the electrode and load contacts.

The holding circuit contacts on Type LH Relays connect the secondary circuit to ground when liquid contacts the upper electrode and act as a holding circuit to maintain the relay in its closed position until the liquid falls below the lower electrode. This holding circuit provides control of the load circuit over any desired range in liquid level, depending upon the distance between upper and lower electrodes.

The flow of alternating current through the low energy secondary circuit is very small — and varies with the voltage of the secondary coil. The secondary coil is selected to operate over the resistance of the liquid being controlled. Since there is a wide range of secondary coils from which to choose, it is important that complete information regarding nature of the liquid be furnished when ordering B|W relays.

Contact Arrangement

Contact arrangement data for B|W induction relays are given at right. In addition, a series of manual reset relays equipped with a N.O. or N.C. reset button is also available for use with one electrode for high or low level cutoff. These manual reset relays enable the operator to start a pump manually and have it stop automatically when the liquid leaves or contacts the electrode.

B|W RELAY TYPE	CONTACT ARRANGEMENT		
	Normally Open	Normally Closed	Holding Circuit
LH	1	0	1
2-LH	2	0	1
RH	0	1	1
2-RH	0	2	1
DH	1	1	1

B|W RELAY TYPE	CONTACT ARRANGEMENT		
	Normally Open	Normally Closed	Holding Circuit
L	1	0	0
2-L	2	0	0
R	0	1	0
2-R	0	2	0
D	1	1	0

313 643 8800
TELEX 23 5359

B|W Controls Division
McGraw-Edison Company
1080 N. Crooks Rd.
Clawson, Michigan 48017-1097

April 1983

Installation Instructions

Relay: Install relay in level upright position. Connect wires from AC supply to terminals #1 and #2 on relay. Make sure power is of same rated voltage and frequency as shown for connection to primary coil on relay side plate. Relays draw 9 volt amperes.

Electrodes: Install electrodes in tank or well by suspending them vertically from an electrode holder or some other suspending means. One electrode should be set at desired start level and one at desired stop level. For sewage or surface drainage sumps, make sure electrodes are hung far enough apart so that foreign matter floating on water cannot foul electrodes. Size 18 or larger Type TW or THW wire is recommended for connection to the relay.

CAUTION — Although the electrodes are connected to a low energy secondary coil output which has inherently low current, there may be up to 800 volts between the electrodes or from an electrode to ground. (See Secondary Coil Table.) Thus wiring and electrodes should be installed to protect personnel from accident contact.

Ground: A system ground return circuit is required from the indicated relay terminal to the liquid in order to complete the secondary circuit of relay. *Conduit should not be used.* Instead, connection should be made directly to uninsulated metal tank, or to metal pipe connected to tank below normal low liquid level. In wells, connect ground to pump or metallic water pipe. For concrete, wood, or insulated tanks, use an extra common electrode extending slightly below the longest operating electrode.

In addition, U.L. and N.E.C. safety regulations require physical grounding of relay chassis. Relays supplied in enclosures are grounded to case at factory. Ground open chassis relays with a screw through ground tab to a grounded mounting surface, or install a jumper from the relay ground tab to a suitable external ground.

Secondary Coil: Because the secondary voltage on all B|W relays is an induced voltage generated within the relay itself, the secondary coil should never be connected to any source of power. Voltage of the secondary coil installed on a given relay is determined by conductivity of liquid to be controlled. Current in this secondary or electrode circuit varies according to voltage as shown in able at right.

Load Connections: B|W relays are two-wire control devices having load contacts rated at 1 hp., single-phase, 115 or 230 volts AC o standard duty pilot rating up to 600 volts AC. In operation, load contacts act as a switch to open or close a circuit. Connecting them to an external load does not introduce a source of alternating current into the circuit.

Accordingly, in making connections for direct operation of single-phase loads within rated capacity of relay, power connections must be made as shown in relay wiring diagram.

To operate higher rated single-phase loads or three-phase loads, a magnetic starter must be used. In making connections to motor starter, follow directions given on the starter wiring diagram for connecting two-wire control devices.

Primary Coils

Line Voltage	Frequency (Cycles)	B|W Coil Number	Maximum Amperes (Secondary Shorted)
110-120	50-60	02-089000	.075
208-240	50-60	02-089200	.038
440-480	50-60	02-089300	.019
550-600	50-60	02-089400	.015

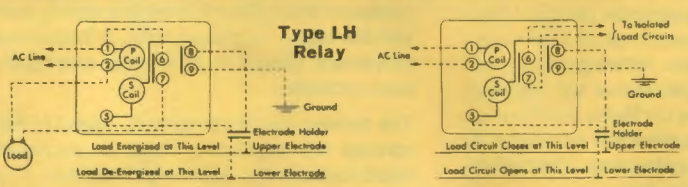
Secondary Coils

Nominal Coil Voltage	B|W Coil Number	Maximum Amperes (Shorted)	Max. Spec. Resistance of Liquid (Ohms cm)
12	02-088700	.44	15
24	02-088800	.22	61
40	02-088900	.117	216
90	02-089000	.053	1,065
110	02-089100	.043	1,620
180	02-089200	.026	4,260
220	02-089500	.022	6,650
360	02-089300	.013	17,000
480	02-089400	.011	26,600
700	02-089600	.007	68,000
800	02-123700	.006	92,600

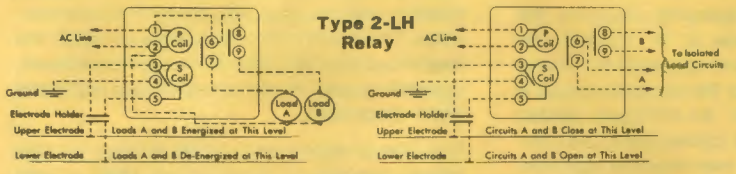
NOTE: Maximum closing resistance in ohms for each coil is approximately equal to specific resistance values shown. Secondary circuit can be shorted indefinitely without damaging coils.

DIRECT OPERATION 1 hp, Single Phase | **PILOT OPERATION Isolated Load Contact**

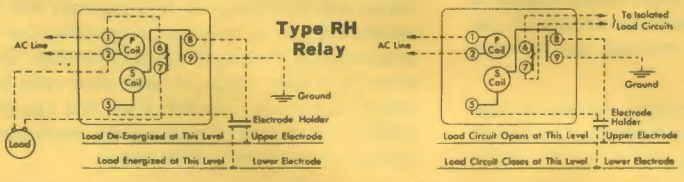
Type LH Relay



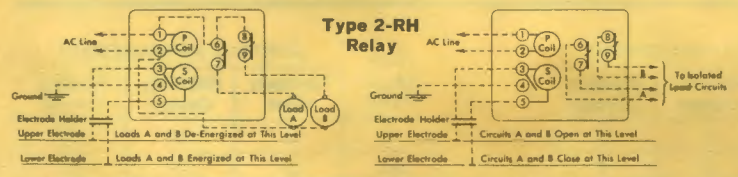
Type 2-LH Relay



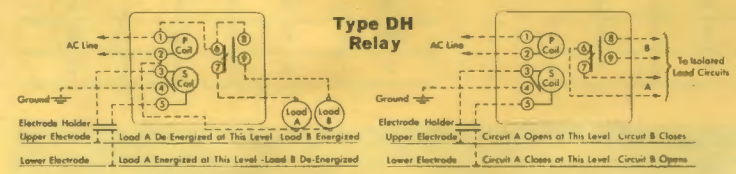
Type RH Relay



Type 2-RH Relay

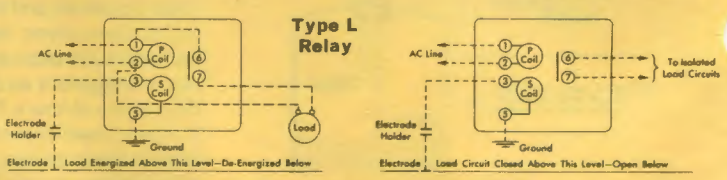


Type DH Relay

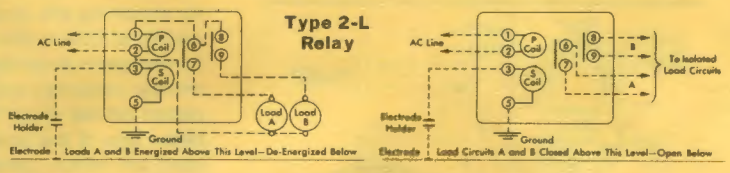


DIRECT OPERATION 1 hp, Single Phase | **PILOT OPERATION Isolated Load Contact**

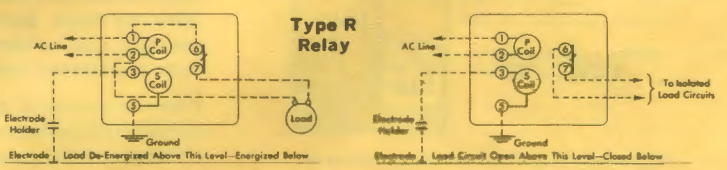
Type L Relay



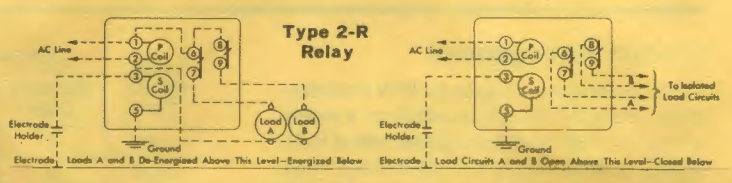
Type 2-L Relay



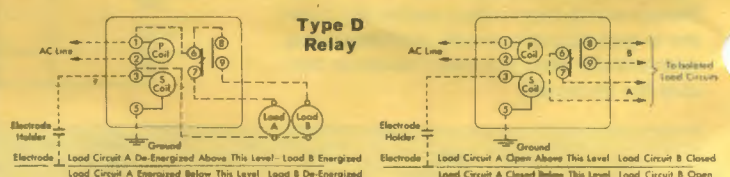
Type R Relay



Type 2-R Relay



Type D Relay



CAUTION: Electrodes are terminals of live electrical circuits and must be installed to prevent accidental contact by personnel. Control power must be disconnected before servicing.

Service Instructions

B|W relays are designed and built to require a minimum of service in the field. Each one is tested and adjusted at the factory to insure positive operation and should not be altered or tampered with prior to installation. If a relay does not operate properly after it has been installed, the following information will be helpful in determining the probable cause.

A RELAY WILL NOT PULL IN

If relay will not pull in when liquid contacts upper electrode, failure to operate is probably caused by one of the following conditions:

1. Power Failure — A power failure to relay can be caused by broken wire, blown fuse, an open switch, loose screw, corroded connection, etc. Check for power failure with voltmeter or test light directly on relay line terminals (No. 1 and 2 on all B|W relays). Also check voltage at motor starter line terminals and overload heaters on motor starter to be sure they have not tripped.

2. Open Coils — Coils used in B|W relays very rarely fail unless struck by lightning or subjected to some severe over-voltage condition. To check coils, disconnect electrode connections from relay terminals, apply line voltage to the primary coil, and touch both ends of secondary coil with an insulated jumper wire. Relay should pull in when the jumper is connected and fall out when jumper is removed. Failure to do so indicates that one of the coils is open. If an open coil is found, contact dealer or the factory for a replacement relay.

3. Poor Ground Connections — B|W induction relays that operate from a single electrode — i.e., Types L, 2L, R, 2R, and D — will not function unless a good dependable ground connection is made to complete the secondary circuit from one end of the secondary coil through the electrode and liquid, and back through ground to the other side of the secondary coil. If such a relay does not operate when liquid contacts the electrode, check ground connection to be sure it complies with Installation Instructions.

4. Broken Wires — A broken wire from relay to either electrode will prevent relay from operating. Broken wires can be checked by shorting the upper and lower electrode leads together at the electrode holder. If relay fails to pull in, one or both of the electrode leads is open. The individual leads can then be checked by running a temporary wire from the relay to holder outside conduit. If relay pulls in, it may be assumed that break is between the holder and the electrodes. This can be checked by shorting between the electrode tips with an insulated jumper.

5. Low Secondary Voltate — If the secondary coil voltage is too low for the resistance or conductivity of the liquid being controlled, the relay will not pull in — or it will buzz and chatter before pulling in. In either case, the relay should be replaced with one which has a higher voltage secondary coil. (See Table.) If in doubt about proper coil selection, furnish factory with details on liquid — or send sample for test.

6. Fouled Electrodes — Accumulation of dirt, grease or other deposits on the upper electrode will insulate it and prevent relay from pulling in. If this occurs, the electrodes should be inspected and cleaned at regular intervals as required to eliminate the difficulty. If unusual quantities of oil, grease, or sludge are encountered, the electrodes can be mounted inside a pipe that is flushed with clean water. A 4" pipe should be used — with the bottom located below the lowest water level, and vent holes provided at top so that the level inside and outside the pipe will be the same. A small flow of water entering the top of the pipe will cause an outward flow of water from the bottom of the pipe and prevent undesirable material from entering. Thus, the electrodes have a clear surface on which to operate and will stay clean.

7. Electrodes Too Short — It is possible for an installation to be completed in which the upper electrode is suspended at a point where the liquid cannot make contact. All installations should, of course, be checked to make sure that proper electrode lengths are provided.

B NOISY RELAY OPERATION

If the relay functions properly but is noisy in operation, it could be caused by the following:

1. Poor Electrode Connections — If wire suspended electrodes are used — and have either been lost or not properly connected — resultant increase in resistance is secondary circuit may cause relay to buzz or chatter in operation. This condition can be corrected by checking to see that proper electrode connections are made. Excessive accumulation of dirt, grease or other deposits on the electrodes can also result in noisy relay operation — in which case periodic cleaning will eliminate the problem.

2. Relay Out of Adjustment — Although B|W relays are tested and properly adjusted prior to shipment, it is possible for parts to become damaged or misaligned during shipment, installation, or after extended service. Improper adjustment of the contacts can cause noisy operation and this should be checked immediately. Proper procedure for adjusting contact compression is described in detail on following page.

3. Low Secondary Voltage — If resistance of the liquid being controlled is at the upper end of the sensitivity range of the relay secondary coil, noisy operation may result. Sensitivity may be increased slightly by interchanging the ground and lower electrode connections at the relay. If this does not correct the condition, the relay should be replaced with one having a higher voltage secondary coil.

C ONE LEVEL OPERATION

If a relay operates at one level only — starting and stopping at one electrode, check following:

1. Electrode Wires — If wires between relay and electrodes are interchanged, relay will not operate over range in level but from upper electrode only. To correct, simply reverse connections — either at relay or at electrodes.

2. Ground Connection — Poor ground connection will prevent holding circuit from functioning and cause relay to operate from the upper electrode only. This can be easily corrected by making sure that ground connections conform with Installation Instructions.

3. Holding Circuit — If the holding circuit is not closing, the relay will operate from the upper electrode only. Since the holding circuit contact carries only a small current, a slight film of grease or dirt can sometimes prevent proper closure. To correct, rub contact surface with a clean paper. Do not use sand paper or emery cloth. If contact compression and opening require adjustment, follow instructions on page 4.

4. Upper Electrode Lead — A ground in lead wire to the upper electrode will cause relay to operate from lower electrode only. This condition can be checked out as described below.

D RELAY WILL NOT DROP OUT

If relay will not drop out when liquid falls below lower electrode, check the following points:

1. Lower Electrode Lead — A ground in the lead wire from relay to lower electrode will prevent relay from dropping out on low liquid level. If distance from holder to relay is relatively short, the best way to check for a ground is to connect a replacement wire from relay to the electrode holder outside the conduit and test the relay for operation. If it drops out properly it is safe to assume that a ground exists in the original lower electrode lead wire.

If relay is located a considerable distance from electrode holder, check for ground as follows: Disconnect power to relay. Remove wires from terminals in electrode holder and allow them to stick up to eliminate possibility of contacting a grounded part. Then turn on power to relay. If relay pulls in, a short is indicated between the electrode leads, from both electrodes to ground, or secondary coil is shorted internally. If relay does not pull in, short secondary coil with piece of insulated wire by bridging between relay terminal connections for upper and lower electrodes. Relay should pull in when this connection is made and drop out when connection is broken. If relay does not drop out, a short to ground is indicated in lower electrode lead. This ground may not be enough to pull in relay, but it can be sufficient to hold relay in once it has been closed in normal operation.

If any of these conditions exist, disconnect power to relay and replace grounded wires.

2. Electrode Holder — Excessive dirt or moisture over insulation at electrode holder or electrodes can cause faulty relay operation. Interior of electrode holder and its underside should be kept clean and dry. Conduit connections should be made so that no condensation can enter holder. Underside of vertically mounted holders should never come in contact with the liquid. Insulated rod electrodes should be used with horizontally mounted holders.

Electrodes should be kept relatively clean and free of dirt or grease. Check them periodically to make sure they do not become fouled with floating debris or insulating deposits.

3. Length of Lead Wires — On installations with excessive distance — over 900 feet — between relay and tank, relay may tend to hold in due to capacitance in electrode lines and fail to drop out when liquid leaves lower electrode. Since there are a number of ways to achieve reliable long distance control, complete information regarding such applications should be submitted to factory for recommendations.

CAUTION

Be sure to disconnect relay control power before servicing electrodes or electrode holders.

Relay Adjustment

All B|W relays are adjusted and tested at the factory prior to shipment to insure proper operation. Accordingly, they should be handled with care during installation in order to avoid changing adjustment or misaligning contacts or other moving parts. If relay does not operate properly after installation, the following should be checked and readjustments made.

Contact Adjustment — The drawing at right shows recommended spring compression in the closed position and proper contact gap in the open position. Too much compression may prevent contacts from opening far enough — while too little compression can cause high resistance at the contact junction and possibly arcing, overheating and excessive contact wear.

When adjusting contacts, do not use tools. Adjust the back load contact first. Hold the armature firmly and, with your fingers, bend the movable contact arm as required. Operate the relay several times by pushing up on the armature — being certain the gap of the movable contact is about the same for each stationary contact. Adjust front contacts in the same manner. The silver alloy contacts seldom require cleaning even though they may develop a black coating.

If relay has holding circuit on left-hand side between terminals 3 and 4 (Types 2-LH, 2-RH, and DH), contact gap should be .020" and is set by loosening lock screw on terminal 4 and adjusting this stationary contact as required.

Changing Relay Contacts

The replacement contact assemblies at right may be installed on all B|W relays as follows:

1. Movable Contacts — First remove screw "B" shown in assembly drawing and lift out movable contact block and contact assembly. Loosen screw "C", remove worn contact assembly, and replace with new movable contact assembly. Reassemble to relay with screws "C" and "B".

2. Back Stationary Contacts — Remove screw "D" and lift off top block. Remove screw "E", replace contact assemblies, and reassemble.

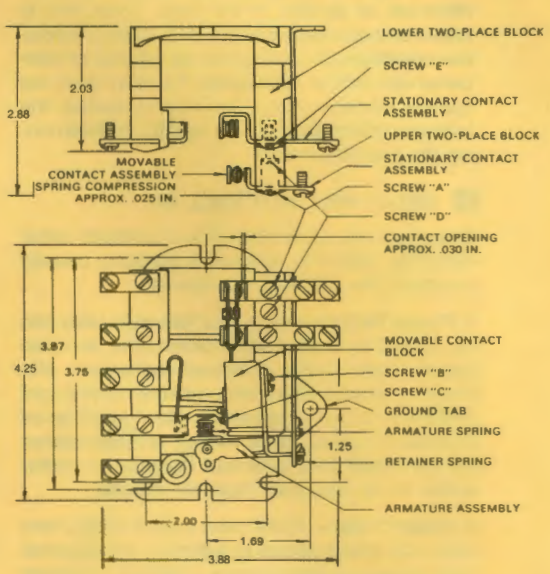
3. Front Stationary Contacts — On B|W Types L and R relays, remove screw "E", replace contact assemblies, and reassemble. On all other relays, remove screw "A" from top of block, replace contact assemblies, and reassemble.

Replacing Relay Coils

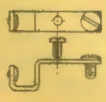
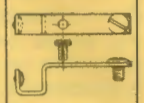
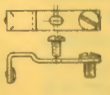
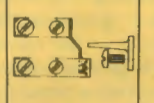
In manufacturing B|W induction relays, coils are assembled to the laminations, and several machining operations and adjustments are made after partial assembly to assure a more rugged construction and quieter operation. For this reason, it is not recommended that individual coils be replaced in the field. If it is necessary to replace a coil, contact your dealer or the factory for a replacement relay.

When ordering replacement units, give serial number of relay being repaired or specify type, line voltage and frequency, and advise nature of liquid to be controlled so the correct primary and secondary coils can be furnished.

Relay Dimensions and Assembly Details



CATALOG SECTION 1100 INDUCTION TYPE CONTROL RELAY

RELAY TYPE	CONTACT KIT PART NO.	LIST PRICES	CONTACT ASSEMBLY KIT COMPONENTS							
								 Bridge and Reed Assembly		
			PART NO. 11-029800	PART NO. 11-029900	PART NO. 11-030000	PART NO. 11-030100	PART NO. 11-030200	PART NO. 11-028800	PART NO. 11-019300	PART NO. 04-270800
1100-L	11-063200	$13.30	2 req'd.						1 req'd.	1 req'd.
1100-2L	11-062700	$26.55	2 req'd.	2 req'd.					2 req'd.	1 req'd.
1100-R	11-063300	$13.30			2 req'd.				1 req'd.	1 req'd.
1100-2R	11-063400	$31.55				2 req'd.	2 req'd.		2 req'd.	1 req'd.
1100-D	11-062800	$26.55	2 req'd.			2 req'd.			2 req'd.	1 req'd.
1100-LH, LM	11-062700	$26.55	2 req'd.	2 req'd.					2 req'd.	1 req'd.
1100-2LH, 2LM	11-063000	$46.25	2 req'd.	2 req'd.				1 req'd.	2 req'd.	1 req'd.
1100-RH, RM	11-062800	$26.55	2 req'd.			2 req'd.			2 req'd.	1 req'd.
1100-2RH, 2RM	11-063100	$51.25				2 req'd.	2 req'd.	1 req'd.	2 req'd.	1 req'd.
1100-DH, DM	11-062900	$46.25	2 req'd.			2 req'd.		1 req'd.	2 req'd.	1 req'd.

Minimum Billing — For shipments totaling less than $25.00 net, a minimum billing of $25.00 net will be made. All prices F.O.B. factory.

MISCELLANEOUS REPLACEMENT PARTS

PART NO.	DESCRIPTION	LIST PRICE
11-082800	5-Place Terminal Block	$6.80
11-081300	Lower 2-Place Terminal Block	$5.10
11-081400	Upper 2-Place Terminal Block	$4.70
11-017100	1-Pole Movable Contact Block	$2.90
11-082900	2-Pole Movable Contact Block	$4.70

DISCOUNT SCHEDULE LL
Prices Subject to Change without Notice

B|W Controls Division
McGraw-Edison Company
1080 N. Crooks Rd.
Clawson, Michigan 48017-1097

Form 364 — CL10M 5/82 — Litho in U.S.A.