



Principle of Operation

A B/W floatless liquid level control system consists of a relay of the proper type, a holder designed 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, the following description of how an LH Relay functions on a pump down control application will serve to explain the design, construction, and operating principles for the entire line.

As shown in diagrams below, the laminated core of the relay is  shaped. The primary coil is assembled to the upper bar of the core,

and the secondary coil for the electrode is placed on the lower bar. An armature located below the legs of the  core is connected to an insulated arm carrying two movable contacts. When the armature is raised, these contacts close or open the motor and electrode circuits, depending upon whether the contacts are normally open or closed.

When a source of alternating current is connected to the primary coil at terminals 1 and 2, the primary coil sets up a magnetic flux which — following the lines of least resistance — circulates through the shortest path. As shown in Figure 1, this is through the lower bar of the laminated core on which the secondary coil is mounted. This magnetic

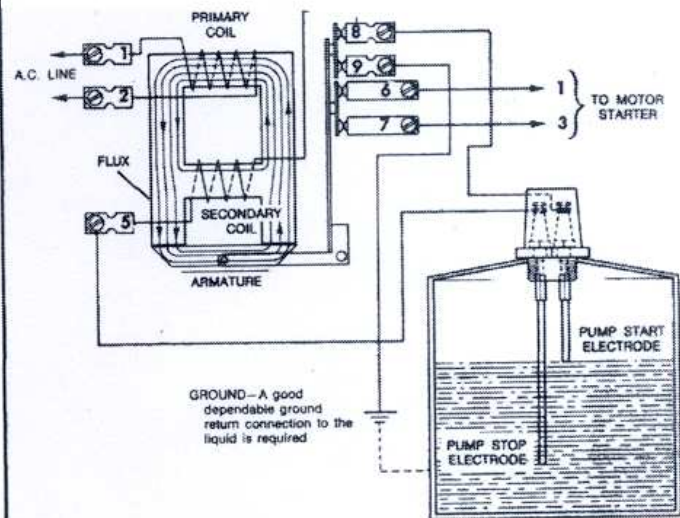
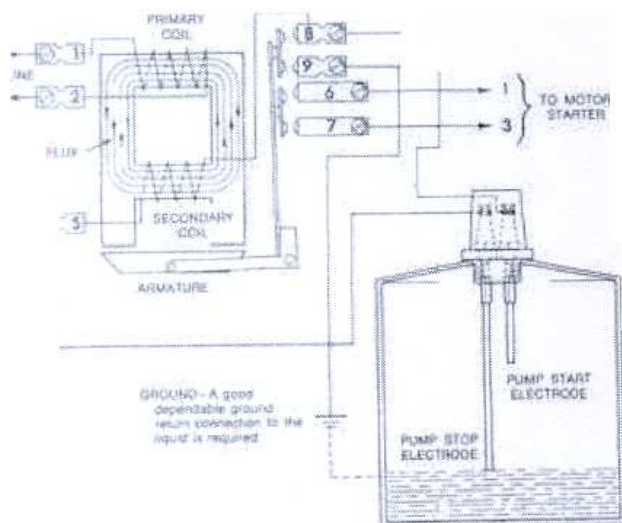
flux induces a voltage in the secondary or electrode circuit coil. No current can flow in this coil, however, until the circuit is completed between the electrodes. Thus, *the electrode circuit voltage being generated within the relay has no connection with the power line.*

B/W control systems utilize the liquid as an electrical conductor to complete the secondary circuit between the upper and lower electrodes. Thus, when the 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 into contact with the legs, as shown in Figure 2. This armature movement closes or opens the electrode and load contacts.

The top contacts on 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 through the bottom contacts of the relay over any desired range in the liquid level, depending on the distance between the upper and lower electrodes.

The flow of 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. Accordingly, since there is a wide range of secondary coils from which to choose, it is important that complete information regarding the nature of the liquid be furnished when ordering B/W induction relays.

Type LH Relay used for Pump Down Control



General Specifications

B|W induction relays are manufactured to the highest standard of quality commercially attainable. They are listed by the Canadian Standards Association (File No. LR 6377-4) and Underwriters' Laboratories, Inc. in Recognized Component Index (File No. MH 8616).

All B|W induction relays are furnished as standard to operate on 115, 230, 460 or 575 volts at 25, 50 or 60 Hertz. Other voltages and frequencies are also available to meet special application requirements. All contacts are double break and are made of durable silver alloy. All coils are precision wound. All insulation blocks are made of a thermosetting plastic that has high arc resistance, dielectric strength and dimensional stability.

Available as open chassis units or furnished factory mounted in a choice of standard or special enclosures,* these relays must be connected to a constant source of alternating current. When properly installed, they will draw a maximum of 9 volt-amperes regardless of the line or electrode circuit voltage.

Contact Ratings

Load contacts of B|W induction relays are rated at 1 hp., single phase; 115 or 230 volts ac. or standard duty pilot rating up to 600 volts ac.

Direct current ratings are: 1 ampere at 250 volts; 2 amperes at 125 volts; 10 amperes at 48 volts; or 20 amperes at 24 volts dc.

*See relay enclosure details on page 14.

Ordering Information

All B|W induction relays are supplied with a primary coil designed to operate on a given line voltage and frequency—plus a secondary coil selected to operate over the resistance of the liquid to be controlled.** In view of these options and variables, the following information *must be furnished* for each relay ordered.

1. Line voltage and frequency.
2. Type of induction relay desired.
3. Type of relay enclosure desired.*
4. Intended application of the relay.
5. Nature, temperature and pressure of the liquid to be controlled.

**See B|W Coil Selection Data on Page 9.

Induction Relays

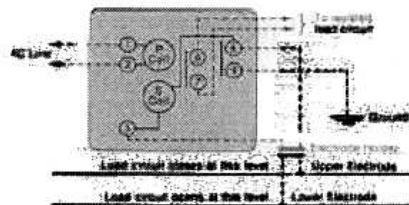
Wiring Diagram and Operation

Typical Applications

Type LH Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
	0	

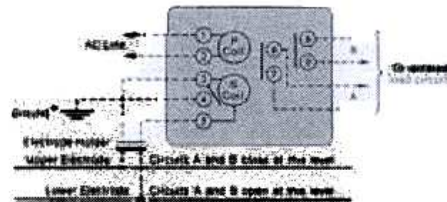


Pump Down Control for sewage and sump pumps, condensate return systems, etc. Low Level Cutoff for submersible pumps. Normally closed Solenoid Valve Control for discharging liquids from tanks, etc.

Type 2-LH Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
2	0	1

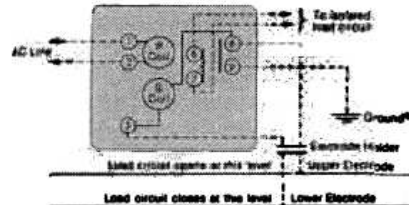


Same as Type LH Relay above except that additional Normally Open contact is provided to permit simultaneous operation of second pump. Extra contact can also be used for signal purposes if desired.

Type RH Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
0		

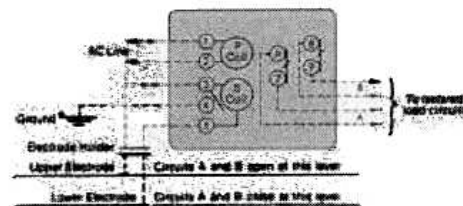


Pump Up Control for supply pumps on elevated tanks and towers, carbonators, etc. High Level Cutoff for pumps and valves. Normally closed Solenoid Valve Control for plating tank and boiler make-up, etc.

Type 2-RH Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
0	2	

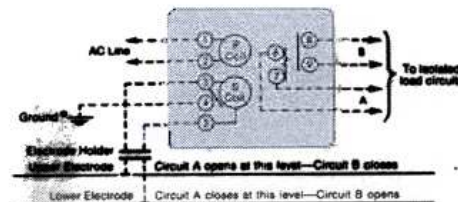


Same as Type RH Relay above except that additional Normally Closed contact is provided to permit simultaneous operation of second pump. Extra contact can also be used for signal purposes if desired.

Type DH Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit



Pump Up or Pump Down Control for same applications listed above for B|W Type LH and Type RH Relays. It is also suitable for use in controlling hydropneumatic tanks and motorized valve installations.

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.

* A good dependable ground return connection to the liquid is required.

B/W Induction Relays

Induction Relays

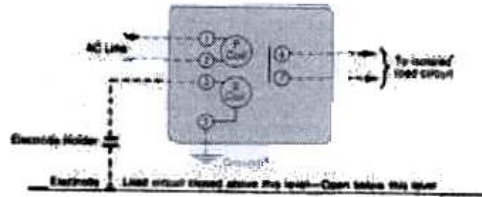
Wiring Diagram and Operation

Typical Applications

Type L Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
	0	

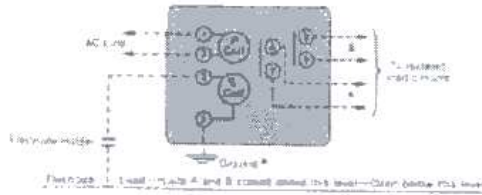


High Level Signal Control. Low Level Cutoff when wired in series with Stop button in 3-wire pushbutton stations. Remote, long distance and low voltage manual control applications, etc.

Type 2-L Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
2	0	

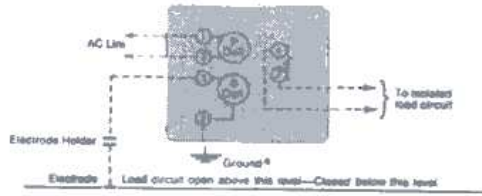


Same as Type L Relay above except that an additional Normally Open contact is provided to permit simultaneous operation of different types of secondary signal devices in remote locations.

Type R Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
0	1	0

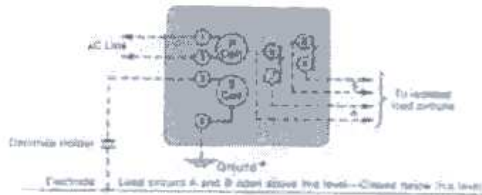


Low Level Signal Control. High Level Cutoff when wired in series with Stop button in 3-wire pushbutton stations. Remote, long distance and low voltage manual control applications, etc.

Type 2-R Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
	2	

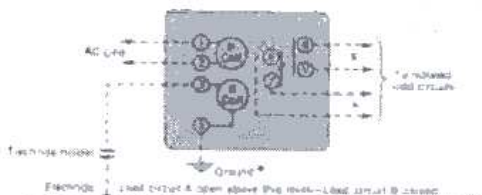


Same as Type R Relay above except that an additional Normally Closed contact is provided to permit simultaneous operation of different types of secondary signal devices in remote locations.

Type D Relay

Contact Arrangement

Normally Open	Normally Closed	Holding Circuit
1	1	

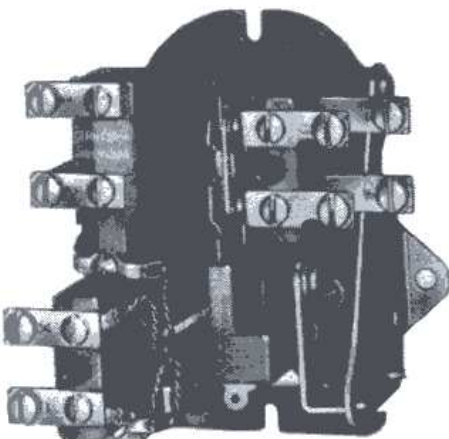


High or Low Level Signal Control. High or Low Level Cutoff when wired in series with Stop button in 3-wire pushbutton stations. Can also be used to interlock various types of signal devices.

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.

* A good dependable ground return connection to the liquid is required.

Type "Z" Rectified Relays for Operation from Contacts



B/W induction relays can be supplied with Zener diodes added in the secondary circuit to provide full wave rectified dc outputs for operation from contact type sensors rather than level sensing electrodes. These diodes limit the voltage surge, normally experienced when the secondary circuit is opened, to about 50% above the rated secondary voltage.

Typical applications for these relays include: Detecting metal parts in a press — voltage surge limitation prevents marring polished surfaces and reduces shock hazards. Simultaneous multiple machine control — permits series or parallel connection of relays without regard for phasing of primary coil voltages.

Contact Ratings—Load contacts are rated 1 hp. at 115 or 230 volts ac. Auxiliary contacts are rated 1 ampere at 115 or 230 volts ac.

Contact Arrangements

RELAY TYPE	LOAD CONTACTS		AUXILIARY CONTACTS
	N.O.	N.C.	N.O.
LZ	1	-	-
2-LZ	-	0	0
	2	0	1
2-RZ-NO	0	2	0
	0	2	1
DZ	1	1	0
	1	1	1

Secondary Circuit Limitations

VOLTAGE	MAX. RESISTANCE (N=No. of Relays)		
	Parallel Connected		
18 v. dc.	15 ohms x N	15 ohms ÷ N	
36 v. dc.	60 ohms x N	60 ohms ÷ N	
40 v. dc.	68 v. dc.	210 ohms x N	210 ohms ÷ N



Manual Reset Relays for use with one electrode

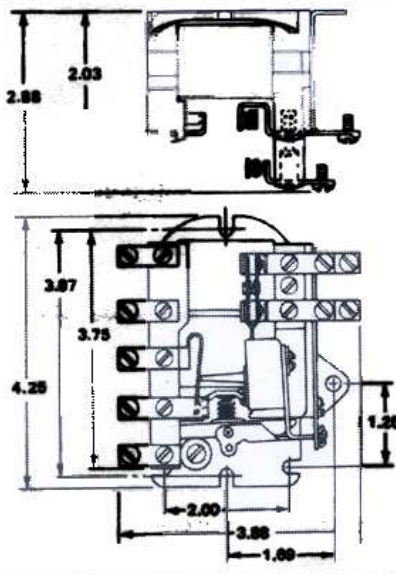
B/W Manual Reset Relays are basic induction relays equipped with a N.O. or N.C. reset button which permits an operator to re-establish the electrode circuit. They are normally used with one electrode for high or low level cutoff operation. Once a pump has been stopped by the liquid leaving or contacting the electrode, it cannot be started again until the relay has been manually reset by means of the pushbutton. Available as single pole or double pole — normally open or normally closed — and as single pole, double throw relays. When ordering, please specify operation desired.

RELAY TYPE	CONTACT ARRANGEMENT			RESET BUTTON	OPERATION AND APPLICATION
	Normally Open	Normally Closed	Holding Circuit		
LM		0	1	N.O.	Low level cutoff with manual reset.
2-LM	2	0	1	N.O.	Same as Type LM with additional contact.
RM	0	1	1	N.C.	High level cutoff with manual reset.
2-RM	0	2	1	N.C.	Same as Type RM with additional contact.
DM-1	1	1	1	N.C.	High level cutoff and/or signal, manual reset.
DM-2	1	1	1	N.O.	Low level cutoff and/or signal, manual reset.

Induction Relay Chassis Dimensions

Shipping weight
2 pounds

See page 14 for
relay enclosure
specifications.



Induction Relay Coil Selection Data

Since B/W level control systems use the liquid as an electrical conductor to complete the relay's secondary circuit — and since the resistance of liquids varies, it is necessary that each induction relay be equipped with a secondary coil that will operate over the resistance of the liquid it controls. The following tables list the operating characteristics of various coils available. All values are based on line voltage of 115, 230, 460 or 575 volts at 60 Hertz.

Primary Coils

LINE VOLTAGE	FREQUENCY (Hertz)	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. SPECIFIC RESISTANCE OF LIQUID (ohms/cm)	MIN. SPECIFIC CONDUCTIVITY OF LIQUID (micromhos/cm)
12	02-088700	.44	15	67,000
24	02-088800	.22	61	16,000
40	02-088900	.117	216	4,630
90	02-089000	.053	1,065	940
	02-089100	.043	1,620	
	02-089200	.026	4,260	
	02-089500	.022	6,650	
	02-089300	.013	17,000	
	02-089400	.011	26,600	
	02-089600	.007	68,000	
	02-123700	.006	92,600	

NOTE: The maximum closing resistance in ohms over which each coil will operate is approximately equal to the specific resistance values shown above. All B/W relays may be energized indefinitely with the secondary circuit shorted without damaging the coils.

Recommended Secondary Coils for various types of liquids

COIL NUMBER	TYPICAL LIQUIDS
02-088700	Metallic circuits.
02-088800	Metallic circuits.
40 02-088900	Acid or caustic solutions; Milk; Brine and salt solutions; Plating solutions; Buttermilk; Soups.
90 02-089000	Weak acid or caustic solutions; Beer; Baby foods; Fruit juices.
220 02-089500	Sewage; Most water—except very soft; Pottery slip; Water soluble oil solutions; Starch solutions.
360 02-089300	Very soft water; Sugar syrup.
02-089400	Steam condensate; Strong alcohol solutions.
02-089600	Demineralized or distilled water.*
02-123700	Demineralized or distilled water.*

*Exceptionally pure water produced for some industrial applications requires use of B/W Type 52-1201 Solid-State Relay. (See page 10.)