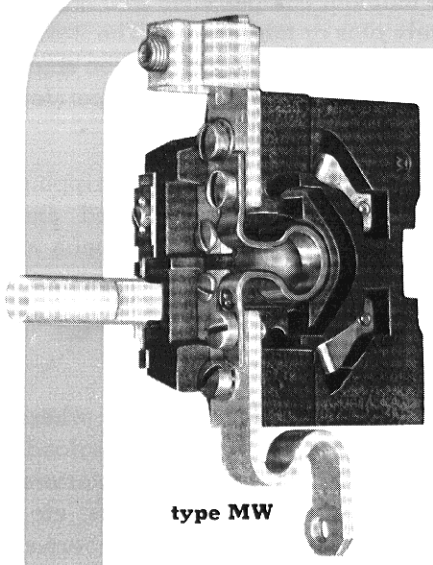
motor control components

overload relays

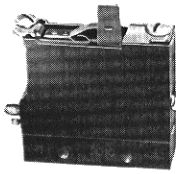
for motor overload protection a-c or d-c

descriptive bulletin **16-300** page 1

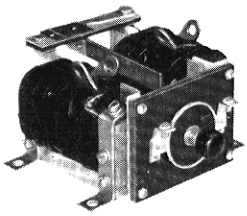
thermal



type MW

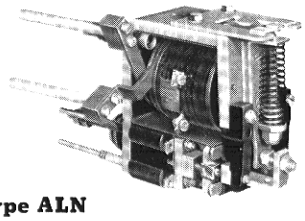


type R



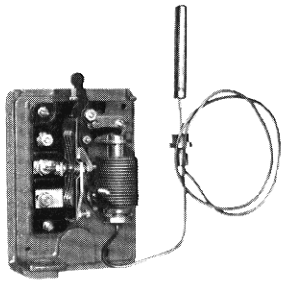
type MG

magnetic



type ALN

thermostatic



type HQ

thermal	magnetic	thermal-magnetic	thermostatic
type MW type MG types R and B	type ALN type UTN	type TI-2	type HQ

application

Overload relays are protective devices designed to guard motors against overloads in excess of 125% motor full load current. They are set to trip out and shut off motors at sustained 110% to 125% of normal motor full load.

There are two main types of overload relays. **Thermal** relays operate on the temperature produced by the load current passing through resistance, and have characteristics closely paralleling those of the motor. **Magnetic** relays are series coil types which provide inverse time limit characteristic entirely independent of motor heating.

The two other types of overload relays are: **thermal-magnetic**, which combines the features of thermal and magnetic, acting as an inverse time delay thermal relay on light sustained overloads and an instaneous trip magnetic relay on severe overloads or grounds; and **thermostatic** which protects transformers, bearings, resistors, etc., from overheating by the action of a volatile liquid which expands a bellows and opens a toggle switch when overheating occurs.

Most overload relays can be mounted on panels or in sheet steel enclosures.

January, 1958
new information
mailed to: E/192, 200/DB; D61-1C, S; C21-5Y

selection

Thermal overload relays are widely used to provide overload protection for motors because of their inverse time characteristics which, in general, follow the heating curves of the motors. Different motor full load current ratings are obtained by interchangeable heaters which are connected in the motor circuit and carry full load current. (See heater selection tables in price list 16-320.)

These relays are self-protecting on currents up to approximately 10 times full load motor currents. However, for protection against short circuit, the National Electric Code requires that heaters be protected by fuses or a time limit circuit breaker rated at not more than 4 times rated motor current or by an instantaneous trip circuit breaker.

Thermal overload relays are calibrated and applied on the basis of 40° C ambient and standard open motor ratings are determined on the same basis.

The minimum tripping currents vary with change in ambient temperature at approximately the same rate as the change in motor ability. Heaters selected for protection in a 40° C ambient will, therefore, provide motor protection at any other ambient temperature.

When the relay is enclosed, particularly if enclosed with other heat generating apparatus the effective ambient temperature of the relay is greater than that outside of the enclosure. It is, therefore, necessary to compensate by derating the heaters. Normally, one size larger heater is required for 15° C rise within the enclosure.

Motors having heavy inertia loads sometimes have starting currents so great that some overload relays will trip before full speed is attained. For most applications such as this the type MW relay is adequate. Special adaptations are available for increasing tripping time when desirable but discretion should be observed because delaying the tripping time unnecessarily may result in failure to give the motor adequate protection.

Thermal relays type MW can be used for a majority of applications. When properly applied, they give satisfactory performance under practically all conditions.

Type MG thermal relays are used for a-c, 60 cycle overload protection at higher ratings than those of the MW. MGs are ambient compensated and adjustable to approximately plus or minus 15%. The 2-pole MG also affords extra single phasing protection since the tripping time is shorter if either pole is operated alone.

R and B thermal relays are very quick-tripping relays for protection of hermetically sealed and standard a-c or d-c motors of lower ratings such as air conditioning and heating.

The tripping time may be increased by the use of saturating inductive shunts. (See page 6.)

Magnetic overload relays should be used where practically instantaneous trip on abnormal overloads is required. They may be used with d-c starters, wound-rotor motors, reduced voltage starters, etc., and are used where the time required for a thermal relay to reset would be a handicap. The ALN is available to cover a wide range of application and current ranges, while the UTN is designed for mounting on bus bars only.

The thermal-magnetic type TI-2 is especially designed to prevent motor overloads on heavy-duty d-c applications such as steel mills.

HQ thermostatic relays provide the specialized function of protecting transformers, bearings, resistors and cables from overheating.

overload relays

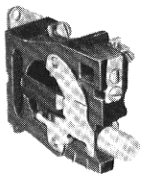
for motor overload protection a-c or d-c

selector guide

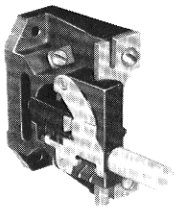
	type of relay	application	heater rating amps	full load motor current rating • amps	coil rating	max volts	no. poles	type of reset	page
thermal	**MW-11** **MW-21** **MW-31** **MW-41** **MW-51** **MW-52** **MW-53**	general purpose, current sensitive relay for overload protection of a-c or d-c motors	.59 to 45.0 3.26 to 81.5 18.6 to 127 18.6 to 181 95 to 354 95 to 354 95 to 354	.48–40.0 .45–72.5 14.9–110 14.9–160 76–308 76–308 76–308	....	600 a-c or d-c	1 1 1 1 1 2 3	hand, auto or no stop	**4,5,6**
	MG	ambient compensated inductive thermal overload relays protective of 60 cycle a-c motors with heavy currents	.53 to 580	.425–505	.530 to 580	600 a-c	2	hand	**7**
	R **B**	current sensitive relay for quick trip overload protection of hermetic and standard a-c or d-c motors, especially air conditioning types, etc.	11.4 to 54.5 5.68 to 46.0	9.2 to 47.4 4.55 to 40.0	....	600 load 230 control a-c or d-c	1	hand or auto	**8**
magnetic	**ALN**	d-c instant trip relay for overload protection in low voltage release control	.....	13 to 500	26 to 2100	600 d-c	1 or 2	auto	**9**
	UTN	d-c instant trip relay for overload protection, bus bar installation	.....	800 to 24,000	.....	600 d-c	1	auto	**10**
thermal-magnetic	**TI-2**	overload protection on d-c heavy duty applications, such steel mills	4.6 to 2525	3.6–2250	.....	250 d-c to 600 d-c	1	hand or auto	**11**
thermostatic	**HQ**	temperature sensitive control for protection of bearings, grids, transformer windings, etc.	contact ratings: a-c: 6 amps max.; d-c: 1.2 amps at 115V to .14 amps at 550V			600 a-c or d-c	.....	hand or auto	**12**

thermal overload relays

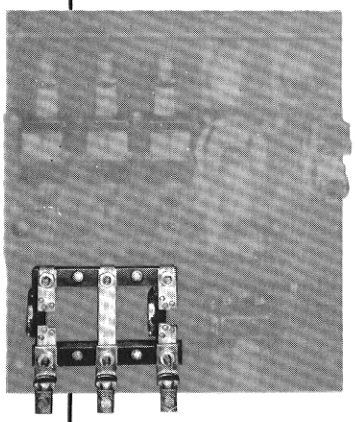
type MW

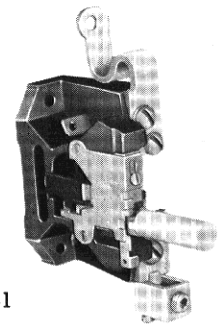


MW-11

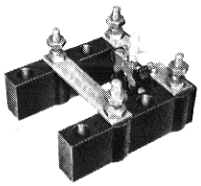


MW-21

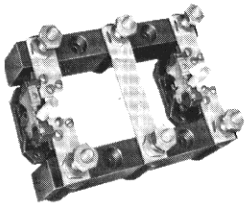




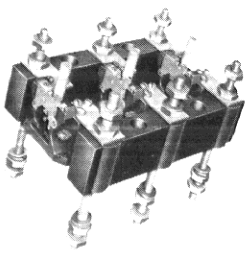
MW-31 & 41



MW-51



MW-52



MW-53

application

Like all overload relays, MW relays detect and protect motors from overloading by automatically disconnecting the power. Allowing motor starting currents to flow during the starting period, they will trip when subjected to smaller but sustained overloads. MWs provide protection against abnormal load conditions to current values exceeding locked rotor current. They feature a bi-metallic disc which insures the same accuracy and uniformity obtained in precision thermostats.

MW relays are designed for mounting on either steel or insulated panels. They are also the overload relays used in Westinghouse Life-Line® starters, size 0 through 5. The first digit in their type number refers to the starter size and the second to the number of poles. Thus, an MW-41 is a single pole relay used in a size 4 starter.

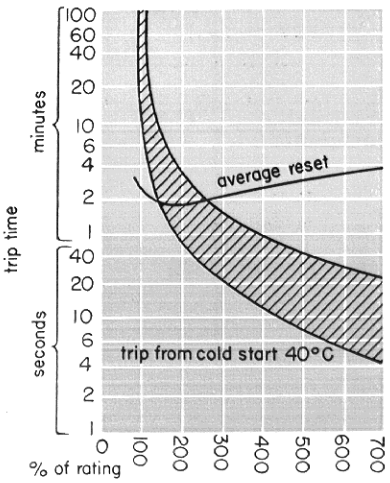
description

MW-11 to MW-51 are single pole, the MW-51 consisting of the basic thermal element of the MW-41 mounted between two rigid insulating blocks to support large cables. An MW-52 is two pole with two thermal elements mounted on a single pair of insulating blocks. Similarly, a three-pole MW-53 consists of three thermal elements on a single pair of blocks.

ratings

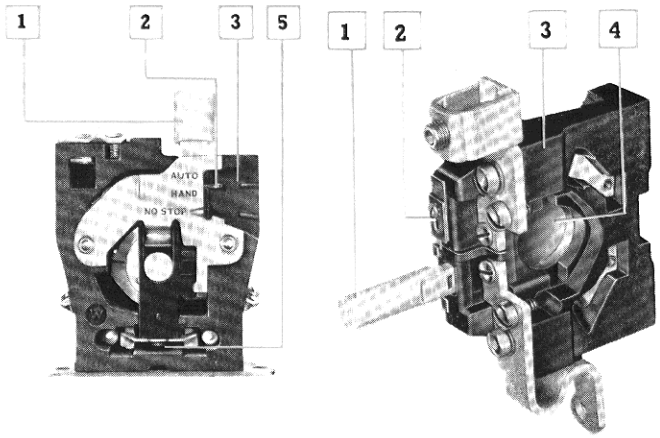
MW relays are used on circuits of not more than 600 volts and have contacts which will carry and break a-c currents of the contactor coil up to 2 amperes. They will also handle 50VAs at a maximum of 1 ampere in a d-c circuit. With heaters properly selected from the heater application tables in price list 16-320 they may be used on circuits listed in the following table.

The time required for the relay to trip depends upon the size of the overload, the greater the overload the shorter being the time to trip. This is indicated in the time characteristic curve of a relay operating in a 40° C. (104° F.) ambient temperature. The curve applies in general when the relay is operated in any ambient temperature as long as the currents are expressed in percentages of the minimum tripping current at that ambient temperature. The minimum tripping current changes with the ambient temperature in approximately the same ratio as the change in load capacity of the motor.



relay type	approx. current range amperes (motor full load)	no. of heaters
MW-11	0.49 to 40	1
MW-21	3.0-71	1
MW-31	24-110	1
MW-41	24-160	1
MW-51	76-308	1
MW-52	76-308	2
MW-53	76-308	3

construction features



1 Friction-free nylon reset button is smooth acting and non-breakable.

2 Adjustment lever on MWs-11 and 21 and marked slide on MWs-31, 41, 51, 52 and 53 which set the push-rods controlling reset action. Adjustment lever or marked slide may be set for one of three push-rod actions: "auto," "hand" and "no stop."

automatic: Overload contact opens and closes automatically . . . a feature not available on many relays . . . reset button can be used as a stop button.

hand: Overload contact opens automatically . . . requires resetting by operator . . . can also be used as a stop button.

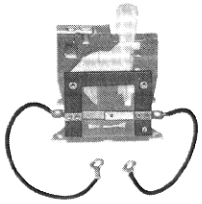
no stop: Overload contact opens automatically . . . requires resetting by operator . . . cannot be used as a stop button.

3 Relay body molded of high grade, non-carbonizing cold molded material.

4 Free type, snap-action bi-metallic disc with the precise action and accurate calibration of a fine thermostat. (See explanation under heading "operation.")

5 Double break silver plated contacts.

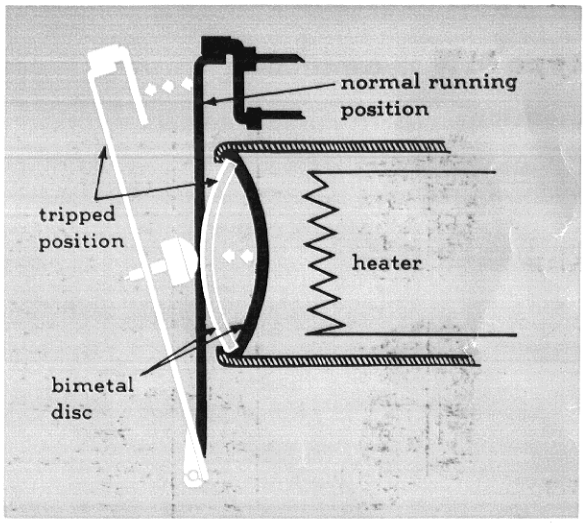
6 Available with auxiliary normally open contacts (bell alarm).



enclosures

Type MW relays are available in NEMA type I enclosures. Other standard NEMA type can be supplied on special order.

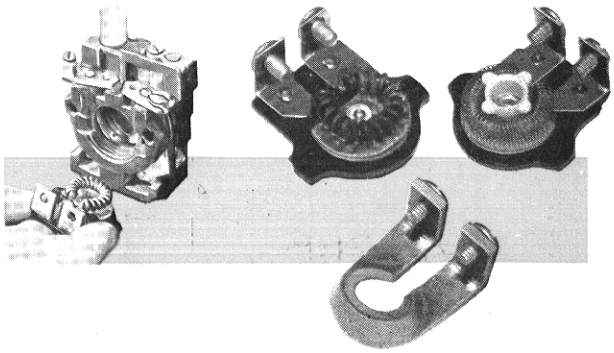
operation



Overload protection is accomplished by a free, bi-metallic, snap-action disc. This is a reliable precision device, not damaged by attempted reset at any time during its cooling period.

The bi-metallic disc consists of two dissimilar metals laminated together and pressed into a concave disc. When heated to a predetermined temperature by the heater element adjacent to the disc, the more rapid expansion of one metal increases disc tension until it suddenly snaps to its convex position, opening the contacts and stopping the motor. When the disc cools, it snaps back to its original position. These discs retain their precise action and accurate calibration indefinitely.

heater selection



The same basic type heaters are used in all MW relays. They are front removable and are easily changed by taking out only two screws. Each one is identified by a code marking stamped on one terminal near the mounting hole.

Complete heater application tables are printed in price list 16-320. They indicate the range of full load motor current to which a given heater may be applied. This range is so selected that the current to produce ultimate tripping of the relay will be approximately 115% to 125% of the rated motor current.

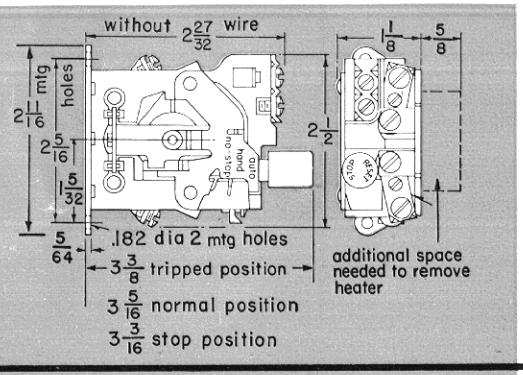
for outline dimensions see page 6

thermal overload relays

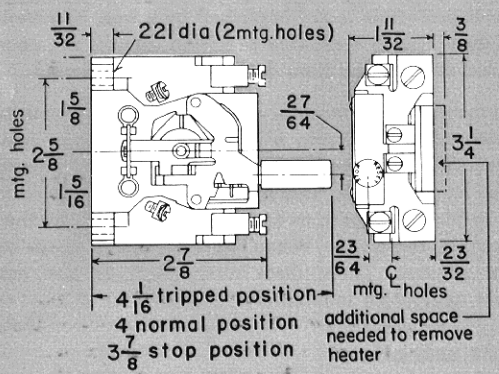
type MW continued

dimensions

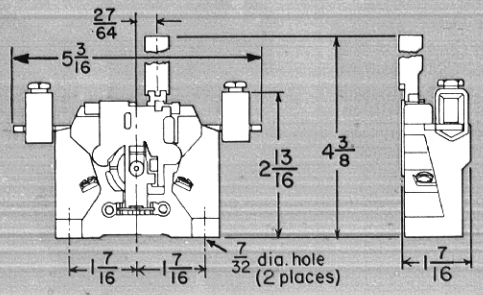
MW-11



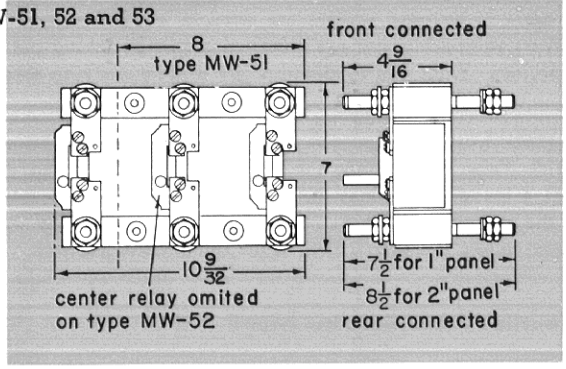
MW-21



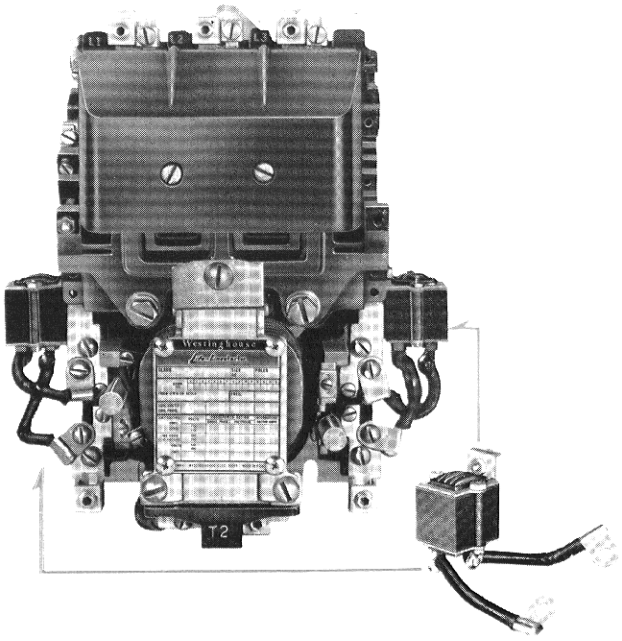
MW-31 and 41



MW-51, 52 and 53



saturating reactive shunts

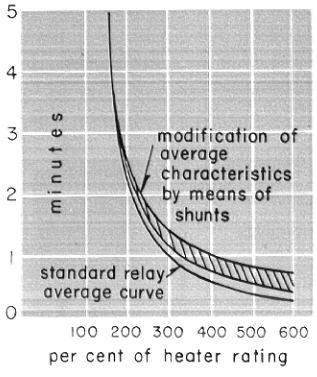


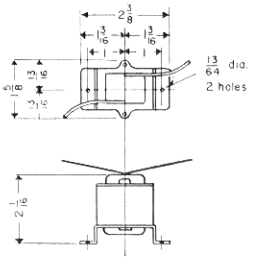
description

Saturating shunts are small iron core reactors which can be connected in parallel with MW relay heaters to increase the tripping time of the relay and to protect the heaters from high overload currents.

application and dimensions

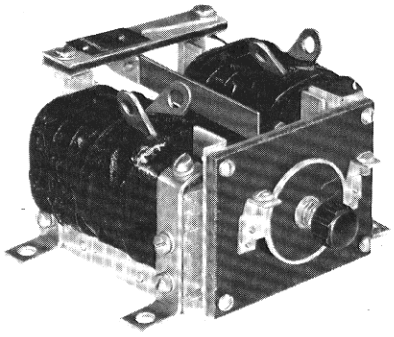
At normal heater rating the potential drop across the heater is below the saturation voltage of the reactor so that only a very small current is diverted. At higher currents the reactor saturates and a large percentage of the current is shunted.





As seen in the curve above these shunts increase the tripping time of MW relays considerably. The shaded portion shows the variation that may be obtained with different heater-shunt combinations. This is due to variations in saturation and differences in heater characteristics. However, the curves shown cover the entire field of shunts and heaters and individual combinations will give much more consistent results and a much narrower range.

type MG



application

Type MG relays provide overload protection for a-c 60 cycle motors by automatically disconnecting the power when subjected to sustained overloads.

They are inductive type thermal overload relays, ambient compensated and adjustable approximately plus or minus 15%. The contacts are normally closed, hand reset and will carry and break up to six amperes maximum.

description

These relays consist essentially of two transformers mounted on a frame. Secondary coils are permanently connected to pass current through heavy hairpin shaped bi-metals which act to trip the contacts. Primary coils are changeable and are available in ratings from 85 to 580 amperes.

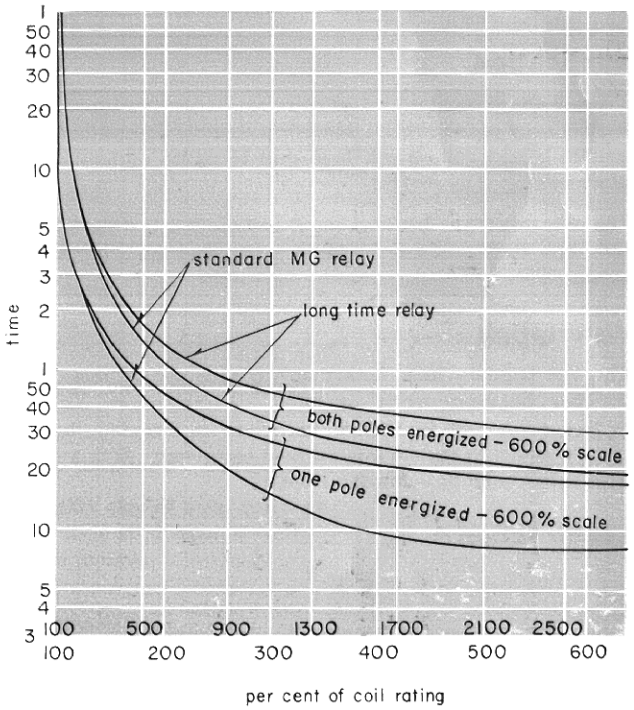
The plus or minus 15% ambient temperature adjustment is set by moving a pointer, located on the side of the relay, to the correct marking either 115%, 100% or 85%. One hundred percent is set for an ambient of 40° C.

Coil insulation is class B and the coils will withstand extremely high overcurrents.

A special long time relay, using cores giving higher saturation, is used for starting high inertia loads.

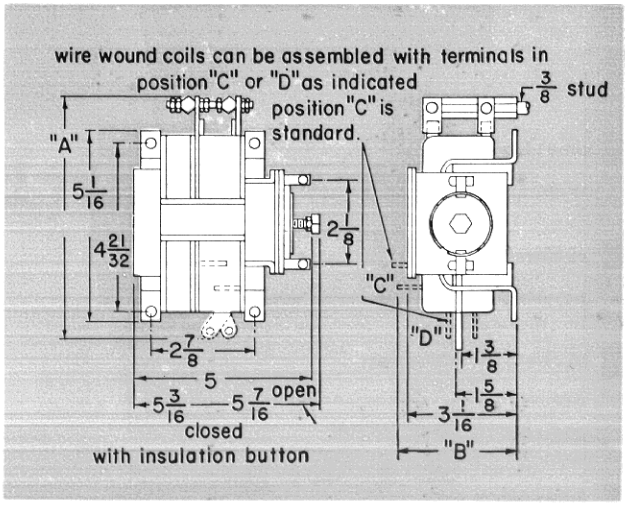
ratings

Insulation, when mounted on an insulating panel, is for 600 volts maximum. Coils will stand currents up to 25 times rating for the time required for the relay to trip. Contacts will carry and break 6 amperes a-c or 50 VAs at standard voltage d-c.



Characteristics for both the standard and long time relay are shown in the curve above. As shown by the lower curves, they afford increased protection if only one pole carries current, as occurs on single phasing. Reset time is less than 45 seconds.

dimensions



thermal overload relays

types R & B for air conditioning starters

application

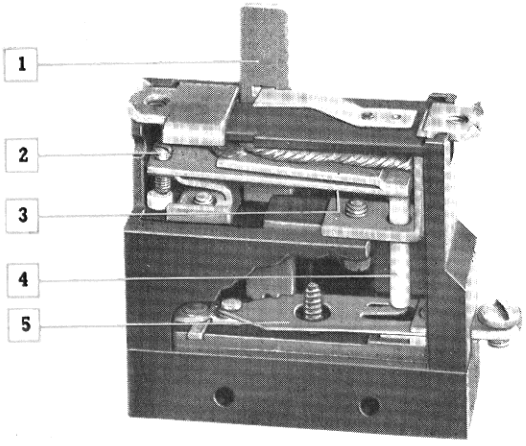
Types R and B overload relays were specifically designed to give hermetically sealed motors positive protection against dangerous overloads and consequent high cost of motor burnout and replacement.

The only difference between the R and the B is that the R trips in less than 10 seconds at 300% of rating and the B at 400% of rating.

description

The fast tripping time (less than 10 seconds) of these relays matches hermetic motor operating characteristics. They are factory calibrated to reduce variations in tripping time and factory sealed to protect against field tampering. Both are available either hand or automatic reset.

construction



1 reset lever:

is strong glass melamine held in channel of Moldarta® case.

2 calibration screw:

adjusts flexing of bi-metallic strip.

3 bi-metallic element:

deflects under continued overload currents to actuate the snap action cut-off switch.

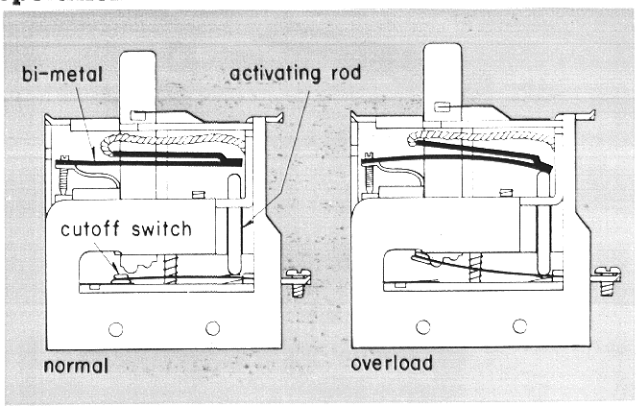
4 activating rod:

of high density ceramic transmits bi-metal motion to cut-off switch.

5 beryllium copper cut-off switch:

has over-center, positive snap action.

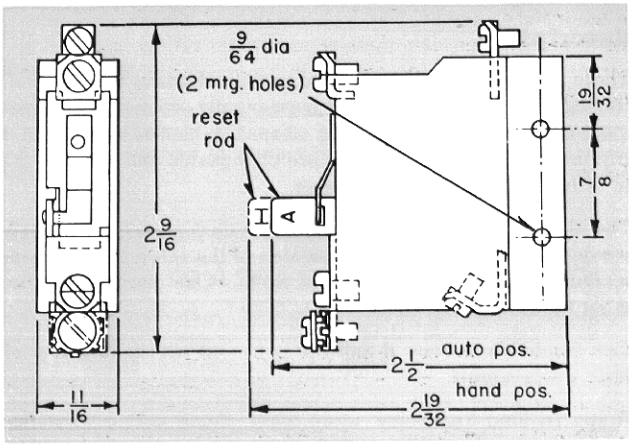
operation



When starter is carrying motor full load current, the sketch shows the position of the bi-metal, the activating rod and the snap-action cut-off switch.

When a dangerous overload occurs, the bi-metal strip heats, flexes downward and pushes the rod against the cut-off switch. This, in turn, causes the switch to snap open, drops the starter out, and stops the motor. The cut-off switch cannot be held closed under any conditions.

dimensions



ratings①

600 volt maximum on load with maximum of 250 volts on control circuit

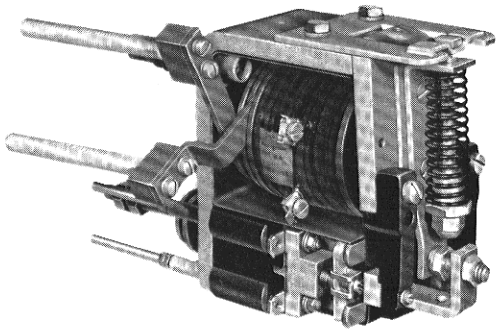
type	general application open, 40° C ambient		mounted on starter open, 40° C ambient		mounted on starter enclosed, 40° C ambient	
	current rating (amps)	full load motor current (amps)	current rating (amps)	full load motor current (amps)	current rating (amps)	full load motor current (amps)
R	11.4 to 54.5	9.2 to 47.4	11.3 to 31.5	9.1 to 32.6	10.6 to 36.2	8.5 to 31.4
B②	5.68 to 46.0	4.55 to 40.0	5.55 to 37.5	4.44 to 30.0	5.05 to 37.0	4.04 to 30.0

① For complete lists of open, general application ratings and characteristic trip curves, see price list 16-320, page 8.

② Open relay for general application is not U. L. listed.

magnetic

type ALN



application

The type ALN is a d-c, instantaneous trip overload relay for use in low-voltage release control circuits. It is operated by a series coil and the armature will pickup in a range of 700 ampere-turns minimum to 2100 maximum.

The shunt wound lockout coil is usually connected in series with the normally open contact and is energized only when the relay is in the tripped position. The lockout coil will hold the armature in the closed position until the line voltage decreases to a low value (approx. 20% of rated voltage) or a reset switch is operated to de-energize the coil.

description

The frame has a .005″ thick non-magnetic spacer permanently assembled under the frame core-face. The normally closed main contact serves only as the armature stop on this relay. The auxiliary contacts have silver buttons and double break gaps per pole.

An adjustable kickout spring provides a means for varying the pickup and dropout characteristics. The pickup can be varied by adjusting the stationary main contact and by changing the kickout spring force. The dropout ampere-turn value is affected only by a change in the kickout spring force. The relay is operated by means of a strap-wound series coil. A shunt-wound lockout coil is assembled on the same coil spool as the series coil and holds the armature in the closed position and the normally closed control contact open when the relay trips on an overload current.

ratings

Insulation is for 600 volts from the coil or electrically energized auxiliary contact parts to the frame. The main contact which acts as the armature stop is mechanically and electrically connected to the frame. The contacts will carry 5 amperes continuously and will interrupt an inductive coil load of 150 volt-amperes (.65 amperes at 230 volts) maximum when the main and normally closed contact which serves as the armature stop is set for ¼ inch or longer gap. Series coils are available for a maximum continuous motor full-load current of approximately 500 amperes. The series coils are usually provided with a cross-section area that will give a current density of 2000 amperes per square inch at full load motor current. The shunt lockout coils are rated for continuous duty.

characteristics

weight

with coil	8 lbs.
without coil	5 lbs.
panel thickness	¾″ min to 2½″ max

main contact

gap	9/32″
force	1 to 5 lbs.

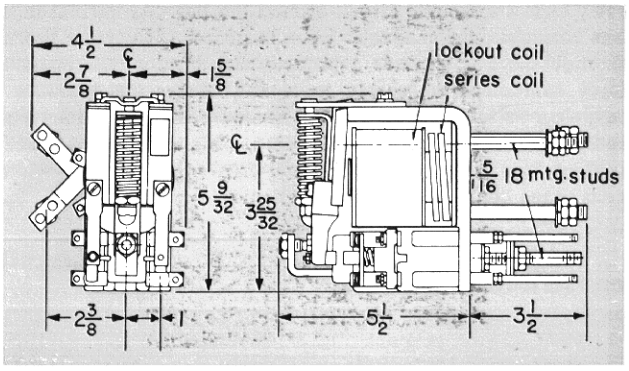
normally open aux. contact

gap (total for 2 gaps in series)	9/16″
overtravel	5/64″ to ⅛″
force (total for 2 buttons)	6 oz.

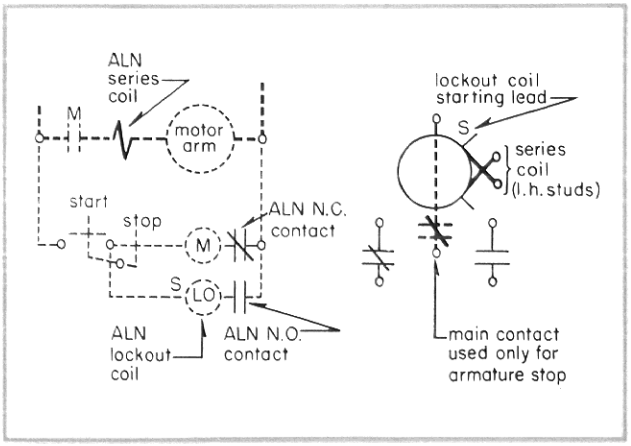
normally closed aux. contact

gap (total for 2 gaps in series)	⅜″
force (total for 2 buttons)	8 oz.

dimensions

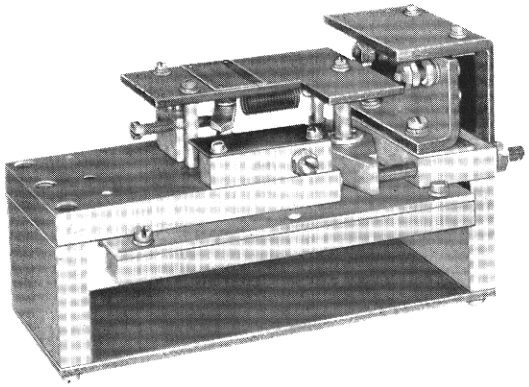


typical wiring diagram and rear view diagram symbol



magnetic overload relays

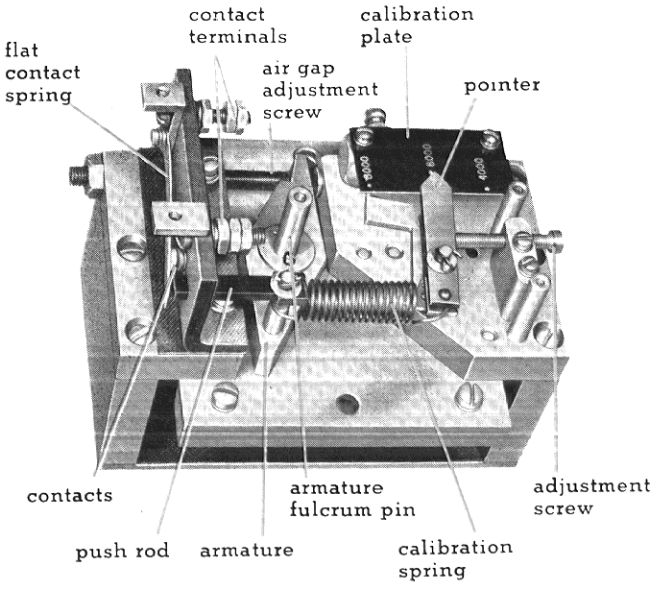
type UTN



application

This bus mounted d-c relay is designed to immediately interrupt current to the contactor tripping mechanism in case of a motor overload. The back plate, two spacers and two pole pieces of the relay form a magnetic circuit around the bus. As current in the bus increases, the magnetic force increases. If current flowing through the bus exceeds a predetermined value, the magnetic force overcomes the spring force and causes the armature to rotate on its fulcrum. When the armature trips, a contact push rod presses against a flat steel spring, which carries the moving contact. This opens the contacts and breaks the circuit to holding coils of the contactor tripping mechanism.

construction



description

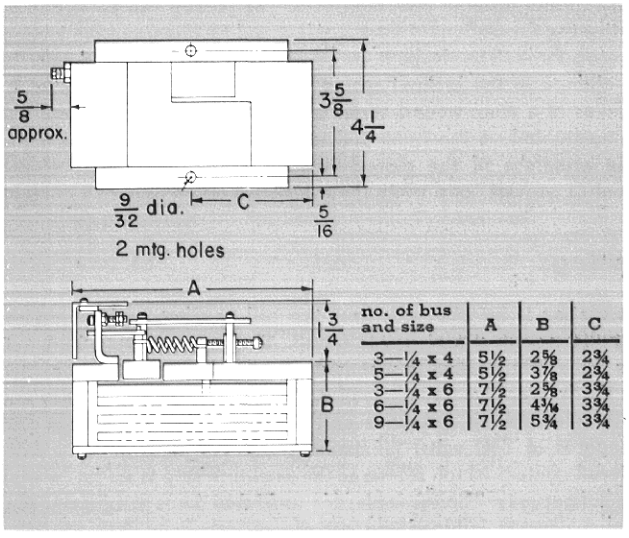
A steel yoke forms a magnetic circuit around the bus. This yoke is composed of a backplate, two spacers, and two pole pieces which support a diamond-shaped steel armature, on a stainless steel fulcrum pin. The hole in the armature for the pin is equipped with a copper alloy bushing. A steel coil calibrating spring attaches one end of the armature to a steel pointer which is mounted on top of the large pole piece by means of a fulcrum pin. The other end of the pointer projects over a calibration plate. The pointer's position is determined by a calibrating screw which provides for adjustment of the tripping current. Since one end of the calibrating spring is attached to the pointer, the pointer's position determines the tension of the spring. Markings engraved on the calibration plate show the tripping current value for different settings. A locking screw is provided to secure the calibrating screw.

An air gap adjustment screw and an armature stop screw are installed in holes drilled and tapped in the smaller pole piece. Attached to this pole piece is a contact mounting bracket which is fabricated of insulating material. Silver contacts are mounted on this bracket. The moving contact is mounted on a flat steel spring attached loosely to the armature by a pin. The free end projects through a guide hole in the contact mounting bracket to the moving contact spring. The contacts, armature, and spring are protected by removable insulating covers shaped to permit reading of the calibration plate.

ratings

The moving contacts are rated at 5 amperes continuous and 75 volt amperes on inductive circuit. Insulation is suitable for 600V between bus and control circuit, but the frame of the relay is at same potential as the bus.

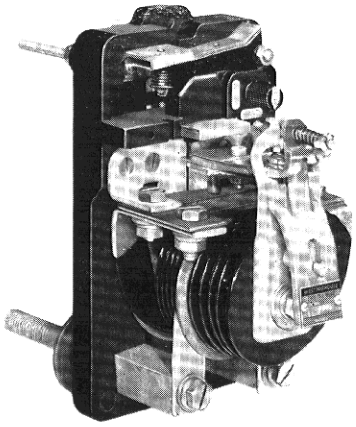
dimensions



no. of bus and size	A	B	C
3—¼ x 4	5½	2⅝	2¾
5—¼ x 4	5½	3⅞	2¾
3—¼ x 6	7½	2⅝	3¾
6—¼ x 6	7½	4¼	3¾
9—¼ x 6	7½	5¾	3¾

thermal-magnetic relay

type TI-2



application

The type TI-2 relay is a single pole, panel-mounted d-c overload relay. The spring-closed contact opens with thermal inverse time delay characteristics on moderate sustained overloads. In addition, this relay provides the exclusive feature of instantaneous trip on severe overloads or grounds.

It was specifically designed for steel mill control and similar heavy duty applications where abnormal overloads are frequently encountered and where dependability is imperative.

construction

The TI-2 is entirely self-contained on its own molded base and is designed for easy mounting on control panels.

It operates according to a combination of magnetic and thermal principles. A series coil carries the motor current which also flows through a heater strip of "Invar" (a nickel-iron alloy). The magnet armature is held in its lower position by the magnetic attraction of the strip of Invar. Under tripping conditions the lockout effect of this alloy strip is neutralized or overpowered. The armature is then drawn to its upper position by the magnetic effect of the magnet frame and so lifts a push rod which opens the contact.

The inverse time delay is caused by the physical properties of Invar which loses its magnetic permeability at a temperature of about 200° C. On moderate sustained overloads the heat generated in the heater gradually raises its temperature to this demagnetization point and its lockout effect is neutralized, allowing the relay to trip.

For overloads which exceed the instantaneous trip setting of the relay, a vertical auxiliary armature, attracted toward the coil strikes the horizontal armature, raising it from the heater strip sufficiently to break the lockout and allow the relay to trip.

The contact is copper to a special graphalloy. A holdout latch and reset pushbutton built into the base permit either hand or automatic reset. A quarter turn of the reset button sets the relay for either type of operation.

This relay can also be set to latch out after operating by providing it with an auxiliary shunt connected magnet for electrical reset by a remote pushbutton.

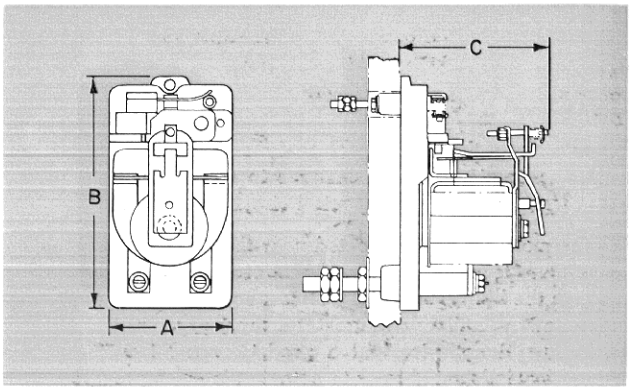
The TI-2 has two adjustments. The rating can be varied by about 12% with high current heaters and 20% with low ones by turning an ajdustment plate attached to the horizontal armature from "low to high." A nut adjustment which varies spring tension on the auxiliary armature changes the percent overload at which instantaneous trip occurs. This adjustment is set at the factory to trip at 3 or 4 times full load motor current and can be adjusted from 200 to 600% of rating.

ratings

Heater and coil designs are available for d-c motor current ratings from 10 to 2250 amperes up to 600 volts. The contacts will open d-c contactor coil circuits carrying ½ ampere at 250 volts or ¼ ampere at 600 volts and will carry 5 amperes continuously.

Type TI-2 relays are applied according to the rule that the minimum tripping current for the relay is approximately 120% of the continuous motor rating or of the nominal current rating of the motor when it is applied on intermittent loads above its continuous rating. Time delay curves for a typical application according to this rule are shown in the graph above.

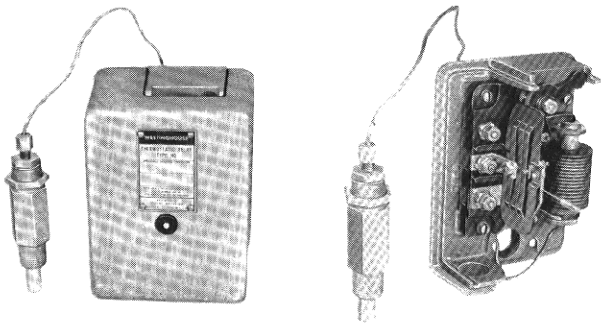
dimensions



type	A	B
hand reset	4 ¾	4
electric reset	5 ¼	4 ⅝
electric latchout	5 ¼	4 7/32

thermostatic relays

type HQ



application

The HQ relay is designed for use in protecting bearings, resistors, cables, transformers, etc., from over-heating. As a bearing thermostat, for protecting the bearings of rotating machinery, it obviates the necessity of constant manual supervision and is of particular value in automatic substations where there is no attending operator.

It may be used to protect mill motors and other industrial machinery, also transformers in isolated locations.

As a grid thermostat the HQ relay is used to protect the series grid resistors of automatic substations from damage by overload, due to sustained short circuits on the system.

construction

Operating parts are mounted on a cast iron base enclosed in a fabricated sheet steel enclosure. Fastened by a thumbnut, the cover is quickly removable for easy inspection. The operating parts consist of an expanding bellows and a spring toggle switch. A thermostatic bulb is connected to the bellows by a flexible tube.

operation

Action of the thermostat is largely mechanical. Temperature variations create pressure changes in the expandable bellows which makes or breaks the control circuit contactor.

The thermostatic bulb is located near the point where excessive temperature is likely to occur. As the temperature of the material in which the bulb is embedded rises a liquid enclosed in the bulb and bellows volatilizes and creates a vapor pressure that expands the bellows lengthwise. At a predetermined temperature the bellows expands sufficiently to actuate the spring toggle switch, which operates the relay contacts.

Grid, cable and transformer types automatically reset when temperature returns to normal. However, the bearing type requires manual resetting, thus forcing attention to the bearing.

Contacts are quick make, quick break and are suitable for use in any relay, control or signal circuit.

design features

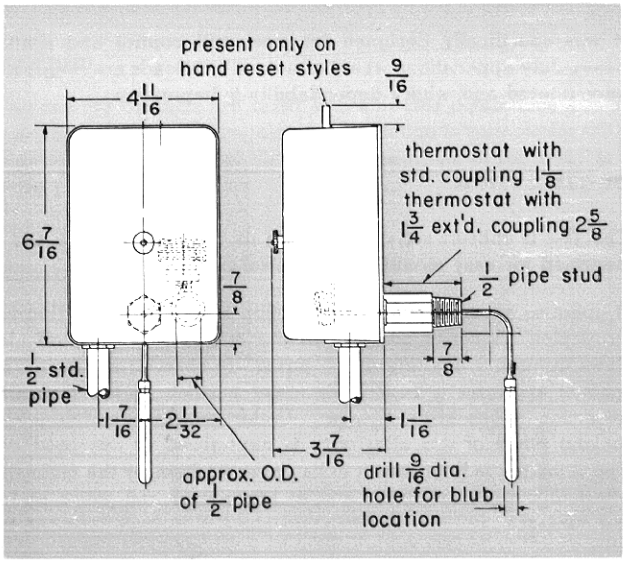
- Make and break contact actuated by temperature.
- No pins, levers, or connected moving parts, to cause friction.
- The toggle or snap switch action of the switch is obtained by the flexing of metal strips, giving a quick and frictionless action.
- Automatic reset on grid, cable, or transformer types.
- A hand reset is supplied with bearing type HQ relays thus enforcing attention to bearing.

ratings

6.0	amps	110 to 600 volts a-c
1.2	amps	115 volts d-c
.5	amps	230 volts d-c
.14	amps	550 volts d-c

insulation for 600 volts, a-c or d-c

dimensions



Contact Westinghouse for suggested methods of mounting HQ relays on specific equipment.

further information

prices: price list 16-320
d-c relays: descriptive bulletin 16-301
a-c relays: descriptive bulletin 16-302
other relays: see your nearest Westinghouse representative

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