A-C MAGNETIC CONTACTORS

TYPE IDN—SIZE 0 AND 1

3 Poles and 4 Poles • NORMALLY OPEN

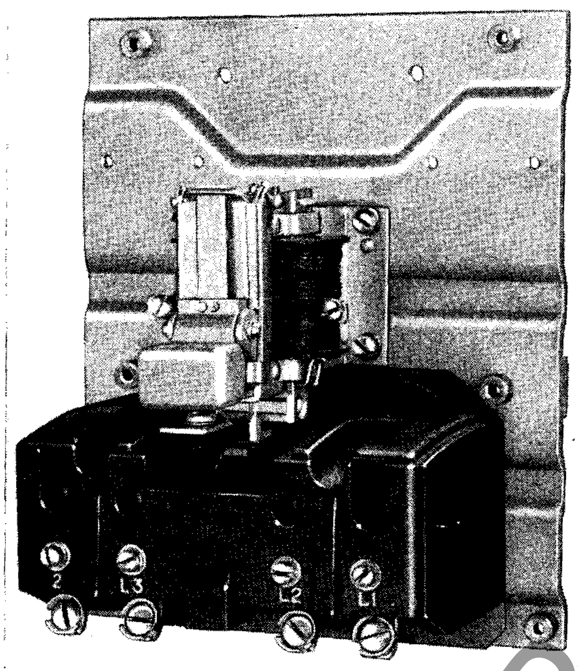


Fig. 1—Type IDN Contactor Mounted on a Large Base Plate

APPLICATION

The Type IDN Contactors are a-c solenoid operated contactors suitable for a-c motor starting or switching service. They have been specifically designed and are recommended for application on Navy Service A controllers per Mil-C-2212B.

RATING

This type of contactor is suitable for full voltage starting of motors and has ampere and maximum hp ratings as tabulated in Fig. 2.

SIZE	8-HOUR OPEN RATING OF CONTACTOR AMPERES	MAXIMUM HORSEPOWER					
		110 V. THREE PHASE	115 V. SINGLE PHASE	220 V. THREE PHASE	230 V. SINGLE PHASE	440 V. THREE PHASE	440 V. SINGLE PHASE
0	20	2	1	3	2	5	3
1	30	3	2	7½	3	10	5

Fig. 2—Rating Table

The operating coils are suitable for continuous duty at the rated voltage. A coil and magnet will operate a contactor satisfactorily from 80% to 110% of the rated voltage at rated frequency.

The contact parts and coil are insulated from the base and have sufficient creepage and arcing distances for 500 volt enclosed applications.

CONSTRUCTION

A Type IDN Contactor mounted on a large base plate is shown sectionally by Figs. 5 and 6. It consists essentially of an arc box and stationary contact assembly, a moving cross-bar and contact assembly, an operating magnet and coil, an inertia latching mechanism, and a steel mounting or base plate. The arc box is made from an inorganic material which will not carbonize from arcing or shatter when subjected to a high impact shock. All parts are protected against corrosion. The moving and stationary contact buttons are fine silver; the interlock moving contact is stainless steel with silver contact buttons.

The 3 Pole Contactor has 3 main pole contacts. The normally open interlock contact which may be used in a coil holding circuit is the pole at the extreme left-hand side of the arc box. The moving contact (16) of the interlock is made of lighter material than that used in the main moving contact (14) and should not be used in any circuit except a control circuit.

The 4 Pole Contactor has 4 main poles and all moving contacts are the same. It is similar to the contactor shown by Fig. 5 except the interlock assembly is replaced by a main pole contact.

These contactors are for front connection only. The steel mounting bases are suitable for mounting on either steel or insulating supports. Figs. 1-5-6 show the contactor mounted on a large size base plate which has sufficient space to accommodate and mount two overload relays and a terminal block. The contactor is also available mounted on a small size base plate. The small base plate is just large enough to mount the contactor and provide three mounting holes.

OPERATION

1. NORMAL—When an a-c voltage that is within the operating limits is applied to the coil (4), the armature (10) and moving contact assembly are lifted vertically upward until the armature seals itself against the upper surface of the magnet (7). The moving contacts (14 and 16) bridge the stationary contacts (21) and complete the circuit for each pole. The contact saddle (15) which is attached to the insulating cross-bar (19) moves up 9/64 inch for the main and 17/64 inch for the interlock contact from the point where the respective contacts touch the stationary contacts. This extra movement provides overtravel and permits the contact spring (17) to exert and maintain sufficient contact pressure between the moving and stationary contacts for the current that is to be carried. Figs. 7 and 8 show the relative position of the moving contact and armature for both open and closed contactor operation.

2. UNDER SHOCK—The inertia latching device consists of a vertical latch lever (8) pivoted about a bearing at the top of the magnet (7), a latch weight (9) pivoted about a bearing at the front of the magnet (7), and a latch slider (11) which function only during the period that the base or mounting plate (3) is subjected to a shock or impact force. The latch weight (9) is an unbalanced weight system with respect to its bearing pin and is normally spring biased to the position shown in either Fig. 7 or 8. A shock from any direction applied to the base plate (3) will tend to rotate the latch weight (9). Rotation of this weight in either direction will push the vertical latch lever (8) towards the magnet (7). Any movement of this lever (8) will in turn push the slider (11) into a slot in the armature (10). As shown by Figs. 9 and 10, the engagement of the slider (11) with the slot in the armature (10) will either hold the armature in the open or closed position, depending upon its position prior to the shock. When the shock has subsided, the latch parts will return to their normal position and the contactor is then free to operate normally.

INSTALLATION—MAINTENANCE—REPLACEMENT OF PARTS

1. GENERAL—General instructions and suggestions for installation and maintenance can be found in Instruction Leaflet 6000-1. A periodic inspection should be made to insure that all screws and bolts are tight. For proper operation of this contactor on shock, it is very important that the six mounting bolts through the base holes (1) on Figs. 5 and 6 and the four screws (2) which mount the magnet (7) to the base plate (3) be as tight as possible.

When the contactor is mounted on a small base plate, it has holes for three mounting bolts; all of the mounting bolts should be tightened firmly.

Any loose wires or parts that might interfere with the operation of the latch mechanism should be fastened down. There should be no obstructions within 1 inch of the front of the latch mechanism.

To facilitate repair and replacement of parts, it is suggested that the contactor be removed from the enclosure.

2. MOVING CONTACT ASSEMBLY—The cross-bar (19) which carries the moving contact assemblies may, for inspection and repair, be removed from the armature by taking out the two mounting screws (18). The moving contacts (14 or 16) may be removed from the saddle (15) by depressing them until the contact spring (17) is solid and then turning them 90°.

CAUTION—WHEN THE MOVING CROSS-BAR AND CONTACT ASSEMBLY IS REPLACED, THE INTERLOCK CONTACT (16) MUST BE ON THE LEFT-HAND SIDE AS SHOWN BY FIG. 5.

3. STATIONARY CONTACTS—After the moving contact and cross-bar assembly has been removed, the stationary contacts (21) may be removed by taking out the mounting screws (22).

4. MAGNET ASSEMBLY—After the cross-bar assembly has been removed, the complete magnet assembly which consists of the magnet (7), coil (4), armature (10), and inertia latch mechanism (8, 9, 11) can be removed by disconnecting the coil leads and removing the four mounting screws (2). After the mounting screws (2) have been removed, the magnet assembly should be pulled slightly forward to disengage it from the dowel pins in the base; an upward movement will then remove it from the arc box. The armature (10) can now be slid out of the magnet assembly.

CAUTION—WHEN REPLACING THE ARMATURE (10), THE NOTCHES FOR LATCH SLIDER (11) MUST BE TOWARD THE FRONT OF THE MAGNET AS SHOWN BY FIGS. 6 TO 10.

The latch mechanism is ineffective on shock if the armature is not re-assembled in this manner. The armature (10) should be kept clean and should move freely in the guides (6). There should be a total clearance of .010 inch to .035 inch between the armature and guides in both directions. The clearance in one direction is shown by Fig. 7.

5. OPERATING COIL—After the armature (10) has been removed, the coil (4) may be removed by (a) loosening the single screw at the top of the magnet and removing the spring clip which holds the armature guides (6), (b) removing a spring snap ring on the bearing pin about which the latch weight (9) rotates, (c) sliding out the weight bearing pin and removing the latch weight (9) from the magnet, (d) pulling the armature guides (6) out of the magnet, and (e) sliding the coil sideways out of the magnet frame.

CAUTION—IF THE LATCH SLIDER (11) IS REMOVED, IT SHOULD ALWAYS BE REPLACED WITH THE BEVELED EDGE UPWARD AS SHOWN BY FIG. 8.

6. CONTACT GAP—OVERTRAVEL—PRESSURE—The contact operation may be observed by looking through the inspection holes (13) in the front of the arc box. The operator should make certain that the power is off and should move the armature and cross-bar by hand.

The total travel of the armature (10) and cross-bar (19) from the fully open position to the sealed position should be approximately 35/64 inch. This travel may be checked by scribing a mark on the back of the arc box at the open and closed positions of the armature. The distance between the scribed lines may then be measured.

The main contact gap, overtravel, and pressure are shown on Figs. 5, 7 and 8. The gap may be measured by marking the arc box at the armature open position and at the position where the moving contacts touch the stationary contacts. The contact touch position may be observed through the inspection hole in the arc box. The overtravel may be measured similarly by marking the contact touch and fully closed armature position. All main contacts (14) should touch the stationary contacts (21) at approximately the same time. The contact pressures may be measured by using a spring scale and a light string looped over each end of the moving contact (14).

The interlock contact should have approximately 3/64 inch overtravel when the armature is latched in the closed position as shown by Fig. 10. To check this overtravel dimension, the arc box should be marked at the touch position and at the latched position. The armature may be placed in the latched position by raising the armature to the sealed position, rotating the latch weight (9) downward and holding it in that position, and then releasing the armature. The latch slider (11) will then engage the armature as shown on Fig. 10. This overtravel is important as the interlock must usually provide a circuit to the coil so that the armature may be pulled back to the sealed position after the contactor has been subjected to a shock.

The normal interlock overtravel and contact pressures are shown on Fig. 5.

7. CONTACT MAINTENANCE—Both the stationary (21) and moving (14) main contacts should be replaced when the overtravel decreases to 1/32 inch. If either the stationary or moving silver contact buttons wear or burn down to 1/32 inch from the brass or stainless steel contact support, the contact should immediately be replaced. Brass and stainless steel are extremely poor contact materials and may cause overheating or contact support welding. In general, burned and blackened silver contacts do not require replacement or dressing as the discolored surface is usually still a good conductor. The moving contacts (14) should operate freely up and down in the contact saddle (15). Any sticking of these parts may prevent the armature from sealing, may cause contact overheating, and will eventually prevent the moving contact from properly bridging the stationary contacts.

If excessive contact burning and pitting takes place, the overtravel and pressures should be checked as previously described.

8. INERTIA LATCH—For proper operation, it is very important that all parts of the latching device move freely; lubrication is undesirable and should not be necessary. However, if the finish does become damaged, corrosion may be prevented by applying a very light film of oil and wiping dry. Under no circumstances should the latch parts be painted. When the latch mechanism is in the normal position as shown by Figs. 7 and 8, the armature should slide up and down freely in the guides. There should be a clearance of from 0 to 1/64 inch maximum between the end of the latch slider (11) and the armature (10) when the armature is pushed tight against the front edges of the armature guides (6). The four semi-circular cams on the latch-weight (9) should all be in contact with the vertical latch lever (8). If the armature does not slide freely and the other latch parts are not aligned as described, the entire magnet and latch assembly should be replaced by a new one.

9. NOISY MAGNET OPERATION—A-c magnets normally produce a low magnetic hum. If the contactor becomes excessively noisy, an immediate examination may prevent serious damage. The armature should first be checked for proper sealing. Any obstruction between the upper end of the armature and the sealing surface of the magnet or dirt in the armature guides may prevent the armature from properly sealing; this condition would cause the magnet to chatter and may in time overheat the operating coil. The coil voltage should also be checked to see if it is within the limits of the rated value. If these operations do not correct the trouble, the complete magnet assembly should be taken off the base and the operating coil removed. The machined sealing surface at the top of the magnet should be cleaned with a solvent to remove any dirt or sludge that may have collected. The shading coil (5) which is a single copper loop embedded in the sealing surface of the magnet should be carefully inspected for breaks or interference with the proper sealing of the armature. If the shading coil is damaged, the complete magnet should be replaced. Before reassembling the magnet and armature, the sealing surface of the magnet should be coated with a light film of oil and then wiped dry. This treatment will help to prevent rust. The armature (10) is manufactured so that the iron laminations can slide longitudinally; this helps to seat the armature against the magnet. If the armature rivets are so tight that the punchings cannot be moved over each other, the armature should be replaced. Sometimes a light tap on the top of the magnet when the coil is energized will help to seat the armature and reduce the noise.

WEIGHT OF CONTACTOR AND SPARE PARTS

DESCRIPTION	NO. PER SET	WEIGHT	
Complete Contactor—Figs. 5-6			
On Large Base Plate—Without Coil	..	5 lbs.—2½ oz.	
On Large Base Plate—With Coil	..	5 lbs.—8 oz.	
On Small Base Plate—Without Coil	..	4 lbs.—6½ oz.	
On Small Base Plate—With Coil	..	4 lbs.—12 oz.	
Spare Parts—Figs. 5-6			
Type IDN-030 & 130			
Coil (4)	1	5½ oz.	10⅛ oz.
Stationary Contact (21)	8	3½ oz.	
Main Moving Contact (14)	3	1 oz.	
Auxiliary Moving Contact (16)	1	⅛ oz.	
Contact Spring (17)	4	.....	
Type IDN-040 & 140			
Coil (4)	1	5½ oz.	10⅜ oz.
Stationary Contact (21)	8	3½ oz.	
Main Moving Contact (14)	4	1⅜ oz.	
Contact Spring (17)	4	.....	

Fig. 3—Weight Table

CIRCUIT DIAGRAM SYMBOL

FRONT VIEW

3 Pole	4 Pole

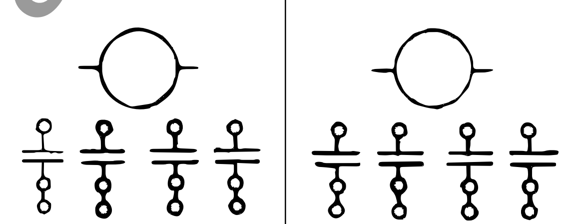
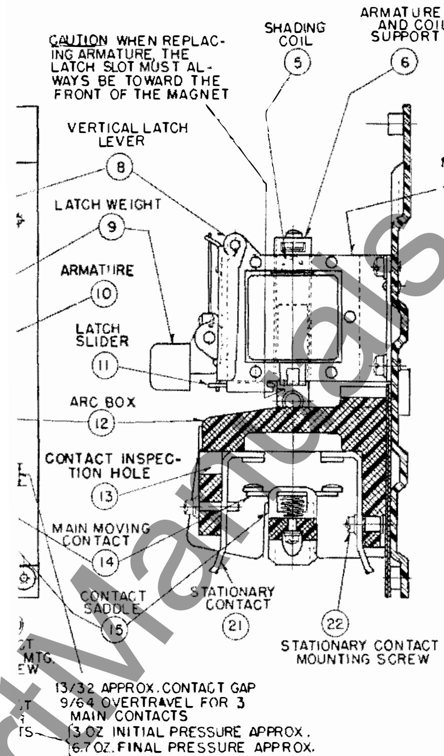


Fig. 4—Wiring Diagram Symbol



ACTOR

FIG.6 SIDE VIEW

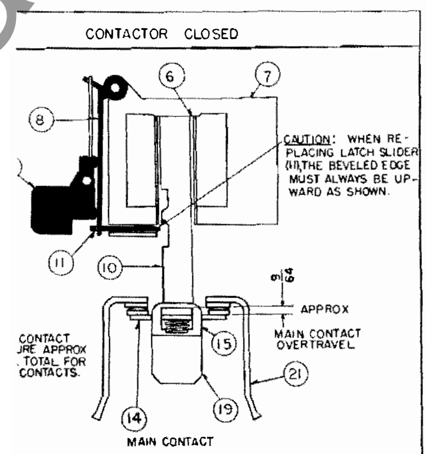


FIG.8

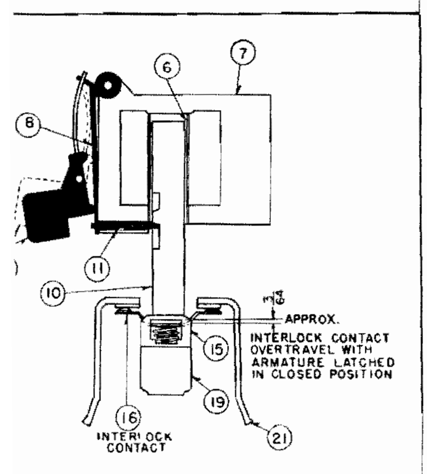


FIG 10

NAVY SERVICE A

A-C OR D-C MASTER SWITCHES

TYPE SMP

PEDESTAL-MOUNTED • WATER-TIGHT ENCLOSURE

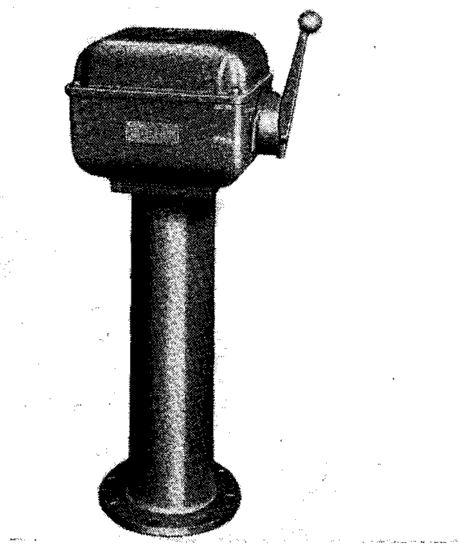


Fig. 1—Type SMP Pedestal-mounted Master Switch in Water-tight Enclosure (Cast Bronze)

APPLICATION

The pedestal-mounted Type SMP Master Switches are for deck application and are intended for use with magnetic controllers for winches, windlasses, capstans and other similar motor driven auxiliaries aboard ship. These master switches have been specifically designed for Navy Service A applications.

RATING

The switch unit ratings are in accordance with the information given in Fig. 2.

CONTACT						
DESCRIPTION	AMPERES CONTINUOUS CAPACITY	D-C RATING AMPERES INTERRUPTING CAPACITY FOR RESISTIVE LOAD		A-C RATING AMPERES INTERRUPTING CAPACITY FOR RESISTIVE LOAD		
		115 V.	230 V.	110 V.	220 V.	440 V.
Normally Open or Closed	25	50	25	50	25	10

Fig. 2—Switch Unit Rating Table

The enclosure heater is rated at 35 watts.

CONSTRUCTION

The pedestal Type SMP Master Switch shown in Fig. 1 consists of a cast bronze case and cover mounted on a relatively heavy section of steel pipe. The mounting flange at the bottom of the pipe pedestal is open to permit the control leads to be brought up through the deck and pedestal to the terminal boards in the enclosure. A gasket should be used between the pipe flange and the deck to prevent the entrance of water or moisture. The enclosure is split well below the centerline of the contact assemblies so that when the cover is removed, all parts are accessible. The cover is held on the case by four bronze bolts, one in each corner, and a neoprene gasket between case and cover. All parts are accessible when the cover is removed. The operating handle can be placed on either the right-hand or left-hand side of the enclosure. The handle is guided in such a manner that a small side motion is required when moving the handle from the forward to the reverse direction, or from the reverse to the forward direction. On the "Off" point the handle is usually in a vertical position. If it is desired, the handle assembly can be turned so that in the "Off" position the handle is in a horizontal position with respect to the enclosure. A greater angular movement of the handle is required between the "Off" position and the first point in either direction than between any other points. This provides some protection against accidental moving of the handle from the "Off" position. On the right-hand side of the enclosure a small auxiliary handle operates a switch unit known as the "Safe Switch" which must be moved from the "Off" to "On" position before any movement of the operating handle will be effective in operating the controller. This protects the apparatus and personnel against danger if the operating handle is moved inadvertently.

A resistor unit mounted inside the enclosure functions as a heater to prevent the condensation of moisture. The heater maintains the temperature inside the enclosure at a temperature level at which moisture cannot form. All metal parts are either made of corrosion-resisting material or are suitably protected against corrosion.

WESTINGHOUSE ELECTRIC CORPORATION
BUFFALO PLANT • MOTOR AND CONTROL DIVISION • BUFFALO 5, N. Y.
October, 1959
Printed in U.S.A.

NAVY SERVICE A

A-C OR D-C LIMIT SWITCH

TYPES NDH & NDHE

WATERPROOF or EXPLOSIONPROOF ENCLOSURES • DIRECT ACTING

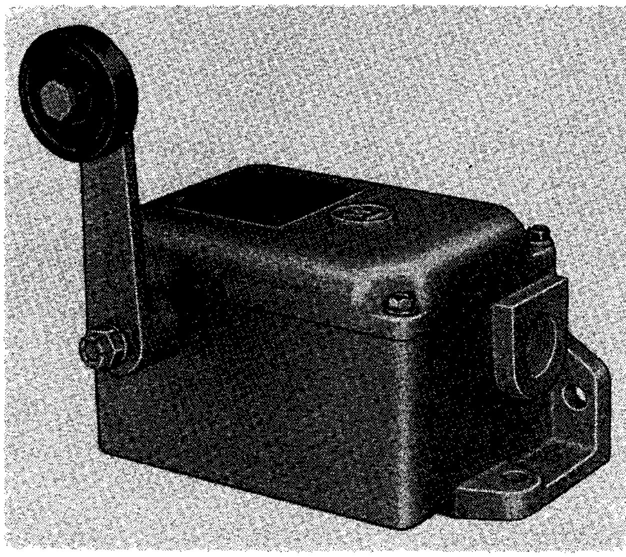


Fig. 1—Type NDH Limit Switch in Waterproof Enclosure

GENERAL DESCRIPTION

The NDH and NDHE Limit Switches are lever-actuated contact mechanisms suitable for a-c or d-c service.

The Type NDH Limit Switch Fig. 1, is supplied in a waterproof aluminum enclosure. It consists essentially of a cam operated contact unit, and an external operating arm or lever with attached roller.

The Type NDHE Limit Switch Fig. 2, is furnished in a bronze explosionproof enclosure. All internal parts except the shaft are identical to and are interchangeable with those of the Type NDH Limit Switch.

Two contacts are supplied in each switch. These may be arranged as both normally open, both normally closed or one normally open and one normally closed.

The operating lever may be arranged on either side of the enclosure. Its position is adjustable through 360° by 24 steps 15° apart.

These switches may be deck mounted or bulkhead mounted.

INSTALLATION AND MAINTENANCE

The Limit Switches are shipped with both contacts set for normally-open operation.

If it is desired to convert either contact to normally-closed operation, the following procedure should be observed:

TYPE NDH—Loosen the 4 cover screws. (These screws are captive in the cover so they cannot be dropped or misplaced). Remove the screw on the appropriate cam. Rotate the cam 180° and replace the screw securely.

TYPE NDHE—The same procedure as above should be followed except remove completely the 6 bronze bolts holding the cover to the case. (These bolts are not captive so care should be taken to stow the cover and bolts in a safe place while working on the internal mechanism.)

It is important that all the cover screws or bolts be replaced on both switches to assure satisfactory performance. It is particularly hazardous to operate the NDHE in an explosive atmosphere with the cover bolts loose or missing.

If it is required to locate the operating lever on the opposite side of the case, proceed as follows: First remove the cover. Then remove the two cam screws and the single screw on top of the pawl carrying the torsion spring. The shaft may now be

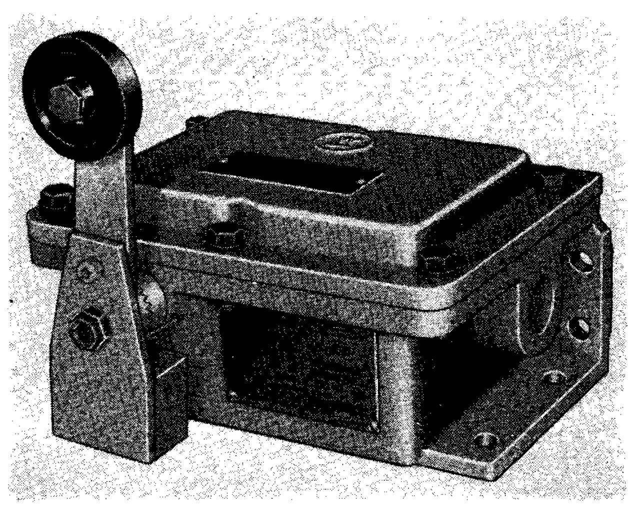


Fig. 2—Type NDHE Limit Switch in Explosionproof Enclosure

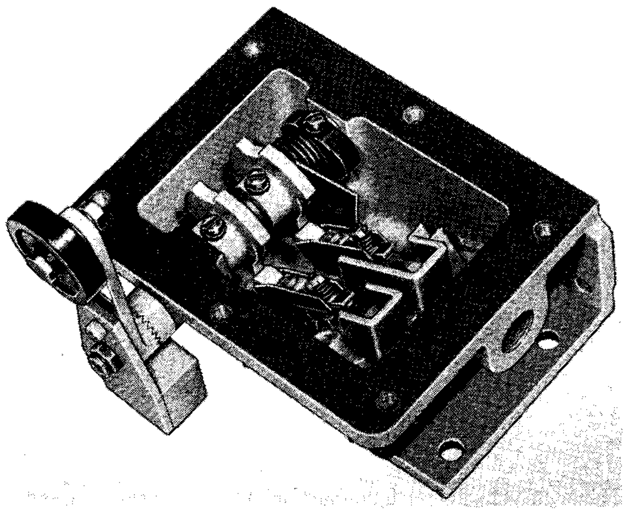


Fig. 3—NDHE Limit Switch with Cover Removed Showing Internal Mechanism

pulled from the enclosure and inserted from the opposite side. All cams, pawls and barriers should be replaced in their original positions.

To locate the lever in the desired position, loosen the lock nut until the mating teeth are disengaged. Rotate the lever to the desired position and tighten the nut securely.

When aligning the switch lever and roller with the operating dog or ramp, maximum life of the switch will be obtained if the dog or ramp is shaped so that a camming action rather than a direct thrust or impact is obtained.

Always locate the switches on a sound flat surface and tighten all mounting bolts securely. Use two 3/8-16 mounting bolts for the type NDH and four 3/8-16 mounting bolts on the type NDHE Limit Switch.

After a period of operation it is advisable to apply a few drops of machine oil to the shaft bearings.

A slight discoloration of the contact faces is not harmful and no filing or dressing of these is necessary.

The contacts should be replaced however, before the silver contact faces become fully burned away.

OPERATION

SHOCK—The occurrance of a severe shock may produce a momentary separation of normally closed contacts. It will not, however, cause the contacts to close from the open position even momentarily.

LEVER TRAVEL—A 6° movement of the operating lever in either direction from a neutral position will open a normally closed contact and a 15-½° movement in either direction from a neutral position will close a normally open contact. The operating lever will deflect a total of 45° in either direction from neutral before being mechanically stopped. **Caution: Do not operate with lever hitting the mechanical stop.**

A force of 5 to 6 lbs., at the end of a 4 inch lever is required to operate these switches.

WEIGHT OF LIMIT SWITCH AND SPARE PARTS

DESCRIPTION	WEIGHT	STYLE NUMBER
NDH Limit Switch Complete (Waterproof)	6.875#	569D419G01
NDHE Limit Switch Complete (Explosionproof)	26#	560D496G01

SPARE PARTS DESCRIPTION	NO. PER SWITCH	WEIGHT	STYLE NUMBER
Moving Contact Assembly	2	.25#	298B199G03
Spring	1	.055#	32D2014H01
Stationary Contact	4	.08#	32D2009G01
Retaining Ring	2	.01#	298B199H01

NAVY SERVICE A
A-C OR D-C LIMIT SWITCH
TYPES NDT AND NDTE

WATERPROOF OR EXPLOSION PROOF ENCLOSURES—SNAP ACTION

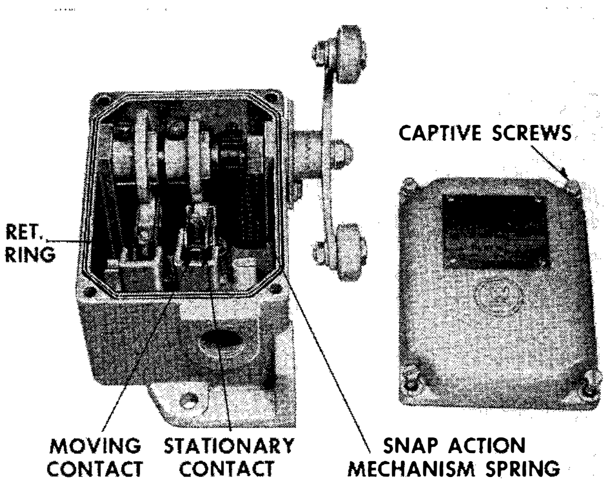


FIG. 1. Type NDT Limit Switch with Cover Removed Showing Internal Mechanism

RATING

VOLTS	MAX. CONT. AMPS. A-C OR D-C	RUPTURING CAPACITY IN AMPERES		
		MAX. A-C	D-C RESISTIVE LOAD	D-C INDUCTIVE LOAD
250	25	25	2	1
600	25	15	1	0.4

GENERAL DESCRIPTION

The NDT and NDTE limit switches are lever operated snap-action contact mechanisms suitable for a-c or d-c service.

The type NDT limit switch Fig. 1 is supplied in a waterproof aluminum enclosure. It consists essentially of a cam-actuated contact unit mechanically arranged to provide snap-action and an external operating arm or lever with attached rollers.

The type NDTE limit switch Fig. 2 is furnished in a bronze explosion-proof enclosure. All levers and internal parts except the shafts are identical to and are interchangeable with those of the type NDT limit switch. Two contacts are supplied in each switch. These may be arranged as both normally open, both normally closed or one normally open and one normally closed.

The operating lever is assembled on one side of the enclosure only and cannot be relocated on the opposite side. Its position is adjustable through 360° by 24 steps 15° apart.

These switches may be deck mounted or bulkhead mounted.

OPERATION

A force of 3 to 4 lbs., at the end of a 4-inch lever is required to operate these switches.

Motion of the operating lever is transmitted to the switching elements by means of an over-center mechanism which produces a snap-action of the contacts. The lever remains in the thrown position until returned during the reverse portion of the operating cycle.

Linear operating speed should not exceed 300 ft/min.

Shock. the occurance of a severe shock may produce a momentary separation of normally closed contacts. It will not, however, cause the contacts to close from the open position even momentarily.

INSTALLATION AND MAINTENANCE

The contacts may be converted readily from normally open to normally closed operation or vice

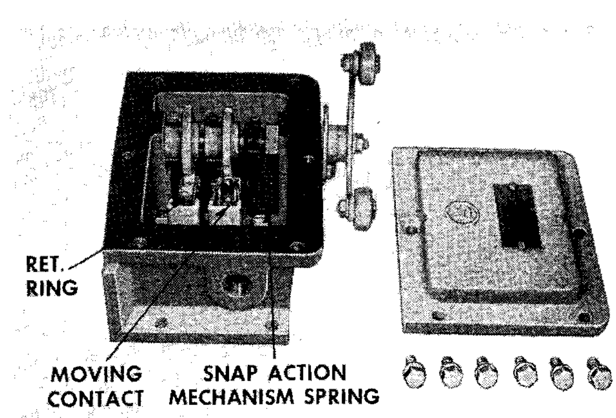


FIG. 2. NDTE Limit Switch in Explosion Proof Enclosure

versa. To perform such an operation, proceed as follows:

Type NDT. Loosen the 4 cover screws. (These screws are captive in the cover so they cannot be dropped or misplaced). Remove the screw on the appropriate cam. Rotate the cam 180° and replace the screw securely.

Type NDTE. The same procedure as above should be followed except remove completely the 6 bronze bolts holding the cover to the case. (These bolts are not captive so care should be taken to stow the cover and bolts in a safe place while working on the internal mechanism.)

It is important that all the cover bolts or screws be replaced on both switches to insure satisfactory performance. It is particularly hazardous to operate the NDTE limit switch in an explosive atmosphere with the cover bolts loose or missing.

Always locate the switches on a solid flat surface and tighten all mounting bolts securely. Use two 3/8-16 mounting bolts for the type NDT and four 3/8-16 mounting bolts for the type NDTE Limit Switch.

Approximately once a month it is advisable to apply a few drops of machine oil to the shaft bearings and snap action mechanism.

Slight discoloration of the contact faces is not harmful and no filing or dressing is necessary. The contacts should be replaced however, before the silver faces become fully burned away.

To relocate the operating lever in another position, loosen the locknut until the mating teeth are disengaged. Rotate the lever to the desired position and tighten the nut securely.

WEIGHT OF LIMIT SWITCH AND SPARE PARTS

DESCRIPTION	APPROXIMATE WEIGHT LBS.
NDT Limit Switch Complete (waterproof)	7
NDTE Limit Switch Complete (Explosion Proof)	26

SPARE PARTS DESCRIPTION	NO. PER SWITCH	APPROXIMATE WEIGHT LBS.
Moving Contact Assembly	2	.25
Snap Action Mechanism Spring	1	.04
Stationary Contact	4	.08
Retaining Ring	2	

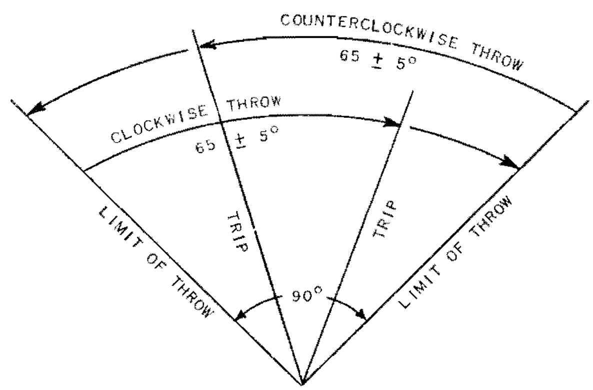


FIG. 3. Angular Travels of Operating Lever

NAVY SERVICE A
D-C MAGNETIC CONTACTORS
TYPE IM—SIZES 1, 2, 3 AND 4

FRAMES 120, 220 and 320 (2 Poles) and 410 (1 Pole) • NORMALLY OPEN

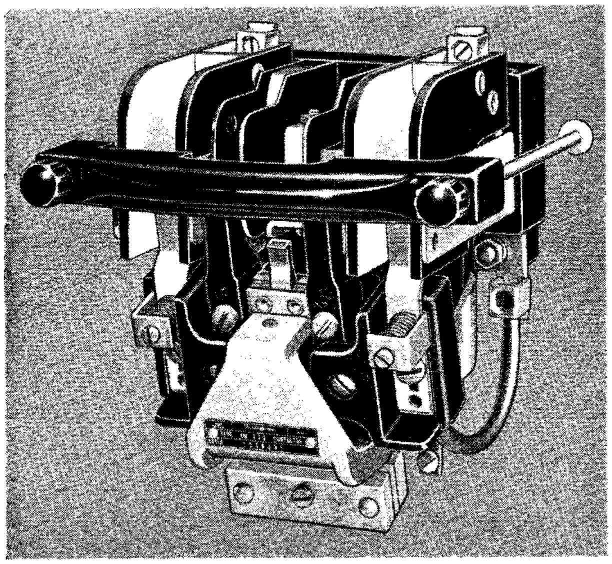


Fig. 1—Type IM-220 Contactor with One Normally Open and Two Normally Closed Auxiliary Contacts

APPLICATION

The Type IM Contactor is a d-c magnet operated contactor for d-c service. It has been specifically designed and is recommended for application on Navy Service A controllers.

RATING

This contactor is suitable for full or reduced voltage starting of d-c motors and has main contact ampere and maximum hp ratings as tabulated in Fig. 2.

MAIN CONTACTS				
SIZE	8-HOUR OPEN RATING IN AMPERES	MAXIMUM HP		
		115 VOLTS	230 VOLTS	250 VOLTS†
1	25	3	5	5
2	50	5	10	10
3	100	10	25	25
4	150	20	40	40

†Submarine duty

Fig. 2—Main Contact Rating Table

The auxiliary contacts are rated as indicated in Fig. 3.

The operating coil is suitable for continuous duty at its rated voltage. The coil and magnet will operate the contactor satisfactorily from 80% to 110% of the rated voltage.

AUXILIARY CONTACTS						
PER FIG.	FIG. 6 MOUNTING LOCATION	DESCRIPTION	D-C RATING			
			AMPERES CONTINUOUS CARRYING CAPACITY	AMPERES INTERRUPTING CAPACITY FOR RESISTIVE LOAD		
				115 VOLTS	230 VOLTS	250† VOLTS
7	A	Normally Closed	10	10	5	2
8	B	Normally Open	2	1	.5	.25
9	C	Normally Closed	10	10	5	2

†Submarine duty

Fig. 3—Auxiliary Contact Rating Table

Special coils and series resistors are available for contactors applied to submarine service which will provide satisfactory operation over a range of 64% to 139% of the rated voltage.

The contact parts and coil are insulated from the frame and have sufficient creeping and arcing distances for 500 volt enclosed applications.

CONSTRUCTION

The Type IM Contactor is shown in full and sectional views by Fig. 6. This contactor consists essentially of an arc box and stationary contact assembly, an armature and moving contact assembly, an operating magnet and frame, and an inertia latching mechanism. The arc box is made from an inorganic material which will not carbonize or burn from arcing or shatter when subjected to a high impact shock. All parts are either made of corrosion-resisting material or are suitably protected against corrosion. The main stationary and moving contact tips are silver alloy.

The contactor main contacts and auxiliary contacts are for rear connection. Connectors are provided on the Sizes 1 and 2 contactors for making front connections also to the main contacts. A phenolic arc box brace is provided to hold the arc boxes in place and provide additional bracing for the stationary contact assembly against shock.

This contactor is usually mounted on a Micarta or insulating panel. Contactor assemblies are available which are suitable for mounting on ¾ to 2½ inch thick panels.

For simplicity, the main contact springs, contacts, and operating coils are the same for all sizes.

The blow-out coils are specifically designed for each size of contactor and the flexible shunts and studs have ample current carrying capacity for each current rating.

The main contact arrangement is indicated in the type numbers. The first number following the type letters—IM—indicates the contactor size (Size 1 = 25 amperes, Size 2 = 50 amperes, Size 3 = 100 amperes, and Size 4 = 150 amperes); the second number indicates the number of normally open main contacts; and the third number indicates the number of normally closed main contacts.

Contactor Sizes 1, 2, and 3 have two main and insulated contact poles. The Size 4 contactor is for single pole applications and is the same as the two-pole 100 ampere contactor (Type IM-320) except the two main poles are connected in parallel.

Fig. 7 shows a cross-section view of a normally closed auxiliary contact assembly which is generally used to insert the operating coil holding section or a coil holding resistor into the circuit when the contactor armature is fully closed. This contact assembly mounts in position "A" on the contactor shown in Fig. 6.

Fig. 8 shows a sectional view of the normally open auxiliary contact assembly which is usually used in the holding circuit of a low-voltage-protection control scheme. When the contactor is closed, the contact separation during shock of this auxiliary contact assembly is of such a short duration that the coil will not be de-energized. This contact assembly can be mounted in position "B" shown on Fig. 6.

A normally closed auxiliary contact assembly which can be mounted in position "C" indicated on Fig. 6 is shown by Fig. 9. This contact may be used to de-energize an inductive timing relay coil or to perform some other control function. This contact assembly and that illustrated by Fig. 7 may bounce open during a shock that occurs when the contactor armature is in the open position. The application of these auxiliary contacts is usually made so that this contact opening is of no consequence.

OPERATION

1. **NORMAL**—When a d-c voltage that is within the operating limits is applied to the coil (22), the armature (37) is attracted toward and seals against the core pole face (34). The moving contacts (46) complete a circuit through the flexible shunt (42) to the stationary contact studs (18) and connectors (9). If the contactor is carrying current, the magnetic blow-out coil (13) produces a magnetic force which stretches out the arc when the contacts separate. The blow-out coil is wound and assembled in such a manner that the arc is always moved in an upward direction regardless of the stationary contact polarity.

The main moving contacts (46) touch the stationary contacts (10) before the armature (37) is completely sealed. This extra armature movement provides overtravel and permits the contact spring (45) to exert and maintain sufficient contact pressure between the moving and stationary contacts for the current to be carried.

A typical low-voltage-protection circuit is illustrated by Fig. 10. When the momentary contact device, such as a pushbutton, is operated, the normally open auxiliary contact "M_A" closes and maintains the circuit to the coil when the momentary contact device is opened or released. In order to reduce the size of the operating magnet to a minimum, an intermittently rated pick-up coil winding is employed to close the armature. However, once the armature is closed, a normally closed auxiliary contact "M_B" which is operated by an operating arm on the armature opens to insert the coil holding winding into the circuit. When full voltage is applied to the pick-up winding "S-T", the resultant magnetic force (or ampere-turns) produced may be three to four times the magnetic force produced by the energization of the complete winding "S-F" which is used as the holding winding. The magnetic force required to hold the armature in the closed position is only one-third to one-fourth that required to close the armature.

When the contactor must operate over a large voltage range, such as is encountered in submarine controller applications, a circuit illustrated by Fig. 11 is often employed. The operation of this circuit is similar to that for Fig. 10 except that the entire coil winding space may be used for the pick-up winding and that the coil current is reduced by an external resistor during the time that the armature is closed.

If the supply voltage fails when the contactor armature is in the closed position, the contactor will open and will not reclose on the restoration of voltage when it is connected for a low-voltage-protection scheme until the operator recloses the momentary control contact device.

A low-voltage-release circuit is shown by Fig. 12. For this type of circuit which is controlled by a maintained control contact, the contactor will reclose after a voltage failure on the restoration of power. Fig. 13 shows a low-voltage-release circuit with a coil holding resistor.

Figs. 14 and 15 show the relative position of the armature for both the open and closed contactor positions.

2. UNDER SHOCK—The inertia latching device consists of a latch (39) pivoted on a bearing pin riveted into the latch casting (25), a latch weight and oscillating spring assembly (40), a latch return spring (36), and a latch bar (38). These parts function only during the period that the contactor mounting panel or support is subjected to a shock or impact force.

The latch weight assembly (40) is an unbalanced weight system with respect to its bearing pin and is normally biased to the position shown in Figs. 14 and 15. A shock from any direction applied to the mounting panel (17) will rotate the latch weight (40). Rotation of this weight in either direction will push the latch (39) down to engage the latching bar (38). As shown by Figs. 16 and 17, the engagement of the latch (39) and latch bar (38) will either hold the armature in the open or closed position, depending upon its position prior to the shock. When the shock has subsided, the latch parts will return to their normal position and permit the contactor to operate in a normal manner.

When the armature is latched during shock from a previously closed position, for most low-voltage-protection circuit applications, the normally open auxiliary holding circuit contact per Fig. 8 is still in the closed position so that the coil circuit will not be de-energized and so that the armature will be reclosed when the shock dies out. The closed auxiliary contact position during shock is illustrated by the dotted lines for contact parts (65, 66, and 67) on Fig. 17.

INSTALLATION—MAINTENANCE—REPLACEMENT OF PARTS

1. GENERAL—General instructions and suggestions for installation and maintenance are given in Instruction Leaflet 6000-1. A periodic inspection should be made to insure that all screws, bolts, and nuts of this contactor are tight. For proper operation of this contactor on shock, it is very important that the frame mounting bolt (28) and frame stud nut (26) which fasten the contactor to the panel (17) be as tight as possible.

Any loose wires or parts that might interfere with the operation of the latch mechanism should be securely fastened down. There should not be any obstructions within 1 inch of the front of the latching mechanism.

2. MAIN MOVING CONTACT ASSEMBLY—The moving contact (46) should move freely in its phenolic bearing support (43) and contact spring guide (3). The moving contact (46) may be removed from its operating support (43) by removing the contact screw (44) which holds the flexible shunt connection clip to the contact. The upper end of the moving contact (46) should be pushed toward the stationary contact (10) to disengage its lower end from the phenolic bearing support (43). Next, the contact should be pulled in an upward direction to disengage both the contact spring (45) and contact from the spring support (3). The complete moving contact assembly can be removed from the armature by removing the phenolic arm mounting screw (5).

3. MAIN STATIONARY CONTACTS—The main stationary contact (10) may be removed very easily after the complete moving contact assembly (4) has been removed from the armature. As the stationary contact tip support (11) is slotted, it is necessary only to loosen the stationary contact support screw (47). After the screw (47) has been loosened, the contact can be removed by pulling in a forward and upward direction. When replacing the stationary contact, the dowel on the back of the stationary contact support should be located in the dowel pin hole in the arcing horn (12). The dowel pin prevents the contact from being twisted out of position when the screw is being tightened.

4. ARC BOX BRACE AND ARC BOX—If it becomes necessary to remove the arc box assembly (6) for inspection or repair, the arc box brace (49) should first be removed by taking off the insulated nuts (48) which hold the brace through steel studs to the panel. The complete arc box assembly (6) can be taken off after the arc box bolts (8) have been removed by pulling it in a forward direction. When replacing the arc box, the round head of the arc box bolt (8) must always be on the inside as shown. If the arc box bolt (8) nut is assembled on the inside, the auxiliary contact operating arms may catch and prevent the armature from operating properly.

The arc box brace (49) supports the contactor and prevents breakage and distortion of parts during shock. For this reason, the insulated nuts (48) must always be as tight as possible.

5. ARMATURE AND MOVING CONTACT ASSEMBLY—The complete moving contact (4) and armature (32) assembly can be taken off of the contactor by removing the two armature stop casting (1) mounting bolts (30). After the bolts (30) have been removed, the stop casting (1) should be disengaged from the frame dowel pins (31) which hold the casting in the proper location with respect to the frame by pushing the casting in a downward direction.

The armature kickout spring (2) can be removed without disassembling the armature or contact parts. However, the removal of one moving contact assembly (4) greatly facilitates the removal of this spring.

6. OPERATING COIL—After the armature assembly (32) has been removed, the coil (22) may be taken off by (a) unscrewing the core pole face (34) mounting bolt (35), (b) disconnecting any coil leads which are connected to the coil terminals, and (c) pulling the coil in a forward direction parallel to the axis of the magnet core (27).

When replacing the wires connected to the coil terminals, care should be exercised to make certain that the wires are connected to the proper terminals. Three-terminal coils have all terminals labelled. ("S" = start of coil winding; "T" = tap on coil winding; and "F" = finish of coil winding.)

7. AUXILIARY CONTACTS

a. Normally Closed Auxiliary Contact—Fig. 7—For inspection and repair of this contact assembly, the complete contact assembly should be removed from the contactor. The arc box brace (49) and contact operating arm (51) should be removed first. The phenolic operating arm (51) can be removed by taking out its mounting screw (50). The contactor mounting panel should be removed from its enclosure to make the contact mounting studs (59) accessible. The complete contact assembly mounts by the two studs (59) which also serve for making the electrical connections. After all mounting stud nuts (61) have been removed from the studs, the complete assembly can be removed by pulling it in a forward direction and away from the frame (29).

The insulation plate which provides arcing and creeping insulation from the latch mechanism to the auxiliary contacts is held by two drive screws and can be easily pried off the phenolic base (60) with a thin-bladed screwdriver or knife. The moving contact (55) should always move freely and not stick in its saddle (54) or on its guide stud (52). The studs (59) must be removed in order to replace the stationary contacts (56). The moving contact guide stud (52) must be removed in order to replace either the moving contact (55) or the contact spring (57). The contact pressure, gap, and overtravel should be as indicated on Fig. 7. The insulation plate must always be replaced in exactly the same manner in which it was originally assembled.

b. Normally Open Auxiliary Contact – Fig. 8—The complete contact assembly can be removed and disassembled in a manner similar to that described for the normally closed contact illustrated by Fig. 7. The operating spring (68) can be removed by unscrewing the phenolic operating plunger (65) retaining screw which screws into the front end of the guide stud (64). The plunger (65) should always move freely and without friction on its guide stud (64). The stationary contacts (67) may be removed by taking out the mounting studs (70). The stationary contact (67) supporting bracket (72) must always be re-assembled as shown on Fig. 8. This supporting bracket (72) stiffens the stationary contact (67) and prevents it from bouncing open excessively during shock. The stud (64) should be removed to replace the moving contact (66). The contact gap, overtravel, and pressure should be as shown on Fig. 8.

c. Normally Closed Auxiliary Contact — Fig. 9—The complete moving contact assembly (81) can be removed by taking out the mounting bolt (74). The moving contact (76) and contact spring (78) can be replaced after taking out the guiding and mounting bolt (77). The moving contact (76) should move freely in its guide (82) and on its guide bolt (77). The stationary contacts (79) can be removed after the mounting screw nuts (80) have been removed from the rear of the panel. Fig. 9 gives information on the proper contact gap, overtravel, and pressure.

8. INERTIA LATCH—For proper operation, it is very important that all parts of the latching mechanism move freely. All vital and rotating parts are fabricated from either bronze, copper alloy, or stainless steel material which will not corrode nor require lubrication. Lubrication is undesirable as it helps to collect dust and dirt. Under no circumstances should the latch parts be painted. The latching mechanism should be adjusted with the adjusting screw (41) so that it has a .020 inch clearance between the latch (39) and the armature latching bar (38) as indicated by Fig. 14. If the latching mechanism does not operate freely, the complete unit should be replaced with a new one.

9. CONTACT GAP — OVERTRAVEL — PRESSURE—The contact gap, overtravel, and pressure for the main and auxiliary contacts are shown on Figs. 6 to 9. The contact gap is the distance that the moving contact is separated from the stationary contact when it is in the open position. The overtravel is the additional distance that the moving contact would travel if it were not stopped by the stationary contact. The overtravel is usually given in inches at a given reference point or at a place where it is convenient to measure. The contact pressures can be measured with a spring scale and a light string by one of the methods illustrated in Instruction Leaflet 6000-1.

10. CONTACT MAINTENANCE—Both the stationary and moving contacts should be replaced on the main and auxiliary contact assemblies when the overtravel decreases to 1/32 inch. If either the stationary or moving silver alloy contact tips or silver contact buttons wear or burn down to 1/32 inch from the copper, steel, or bronze contact support, the contact should be immediately replaced. The contact supports usually do not operate very satisfactorily as contacts and may cause overheating or welding of the contact supports. In general, burned and blackened silver or silver alloy contacts do not require replacement or dressing as the discolored surface is usually still a good conductor.

Moving contacts should always move freely in their guides or supports. Any friction between parts may cause overheating, and may eventually prevent the moving contacts from properly seating on the stationary contacts.

If excessive contact burning and pitting takes place, the overtravel and pressures should be checked.

11. MAIN CONTACT AND ARMATURE BEARINGS—The armature and main contacts have knife-edge bearings. This type of bearing is not usually affected by dirt or dust and should not be lubricated. Lubrication is very undesirable as it collects dirt and dust and usually does more damage than good.

12. FAILURE TO OPERATE—Failure of the contactor armature to close may be caused by the coil circuit being opened, power failure or low voltage, or mechanical interference. Failure of the contactor armature to open can result from the coil circuit being energized, mechanical interference, or a broken armature return spring.

Sluggish operation or failure of the contactor armature to fully seal may be caused by poor contact between the moving and stationary contacts of the normally closed auxiliary contact shown by Fig. 7 which usually controls the switching from the pick-up to the holding winding of a three-terminal coil or which shorts out the coil current limiting resistor as illustrated by Figs. 10 to 13.

WEIGHT OF CONTACTOR AND SPARE PARTS

DESCRIPTION	NO. PER SET	WEIGHT	
Complete Contactor—Fig. 6			
Without Coil	..	8 lbs.	
With Coil	..	9 lbs.- 4 oz.	
Spare Parts—Fig. 6			
Coil (22)	1	1 lb.-4 oz.	1 lb. 8¼ oz.
Main Moving Contact (46)	2	2½ oz.	
Main Stationary Contact (10-11)	2	1 oz.	
Main Contact Spring (45)	2	½ oz.	
Armature Kickout Spring (2)	1	¼ oz.	
Normally Closed Auxiliary Contact—Fig. 7			
Stationary Contact (56)	2	⅝ oz.	1 oz.
Moving Contact (55)	1	⅜ oz.	
Contact Spring (57)	1	.....	
Normally Open Auxiliary Contact—Fig. 8			
Stationary Contact (67)	2	⅛ oz.	¼ oz.
Moving Contact (66)	1	⅛ oz.	
Plunger Return Spring (68)	1	.....	
Normally Closed Auxiliary Contact—Fig. 9			
Stationary Contact (79)	2	1 oz.	1½ oz.
Moving Contact (76)	1	½ oz.	
Contact Spring (78)	1	....	

Fig. 4—Weight Table

CIRCUIT DIAGRAM SYMBOL

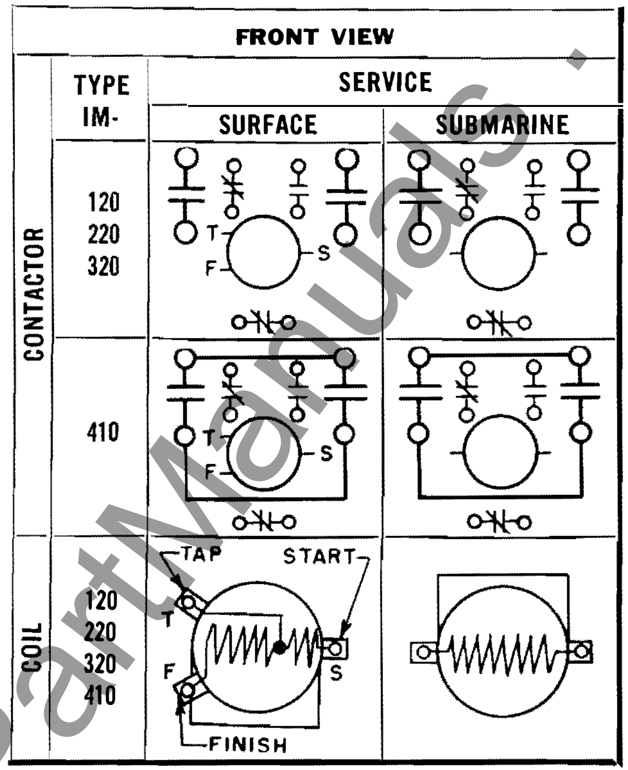
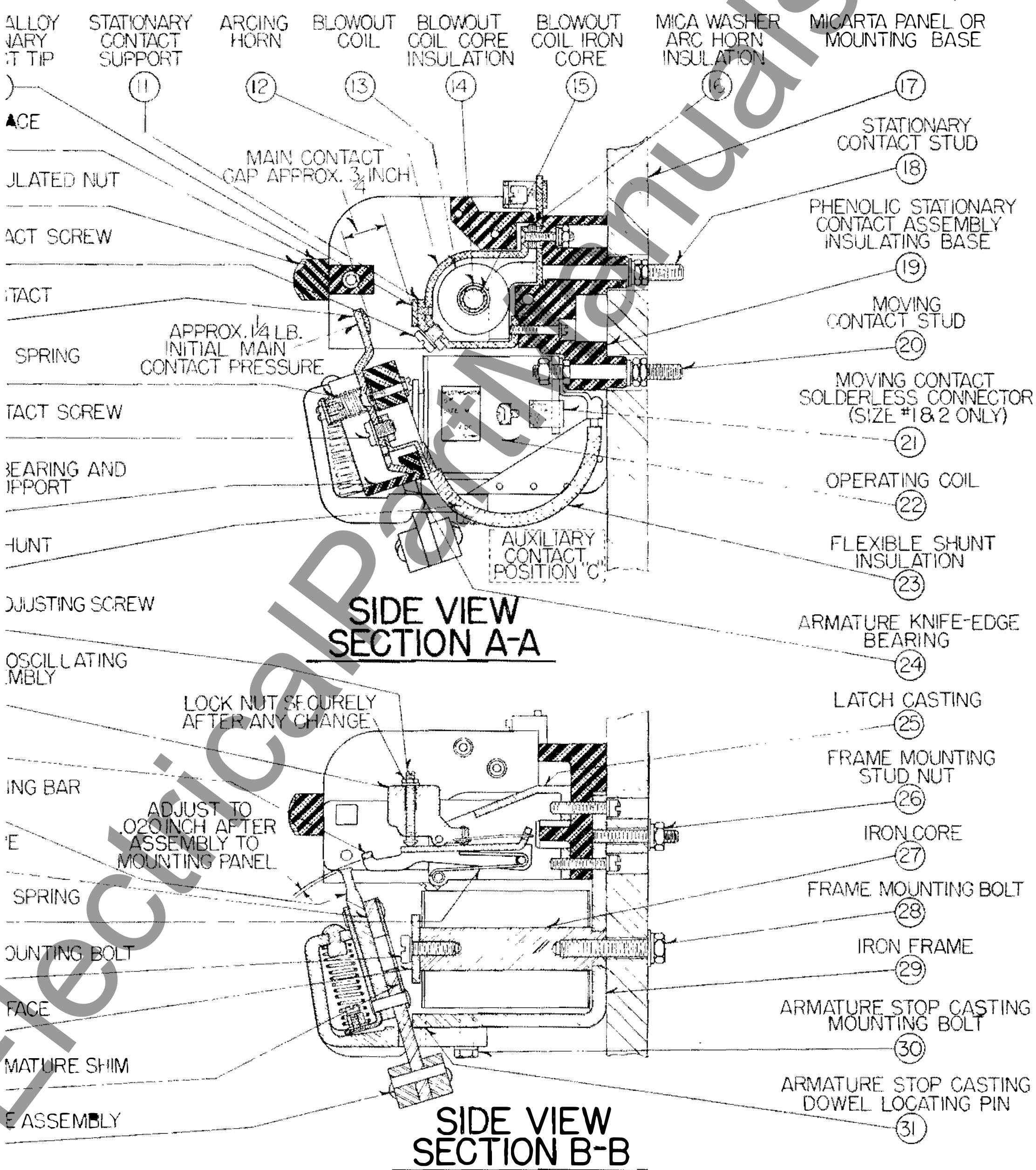


Fig. 5—Wiring Diagram Symbol



VIEW OF TYPE IM CONTACTOR

RY CONTACTS

FIG. 8

(FOR POSITION "B" ON FIG. 6)

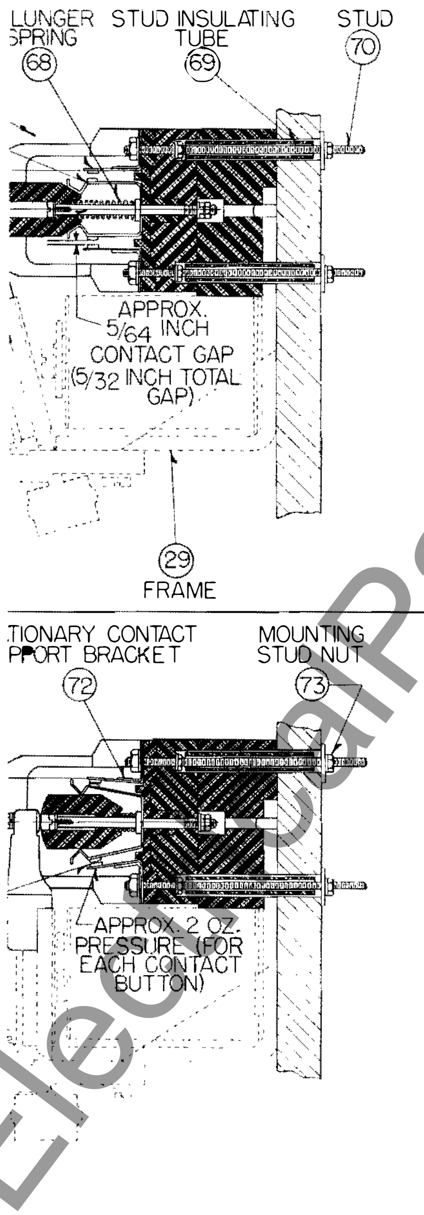
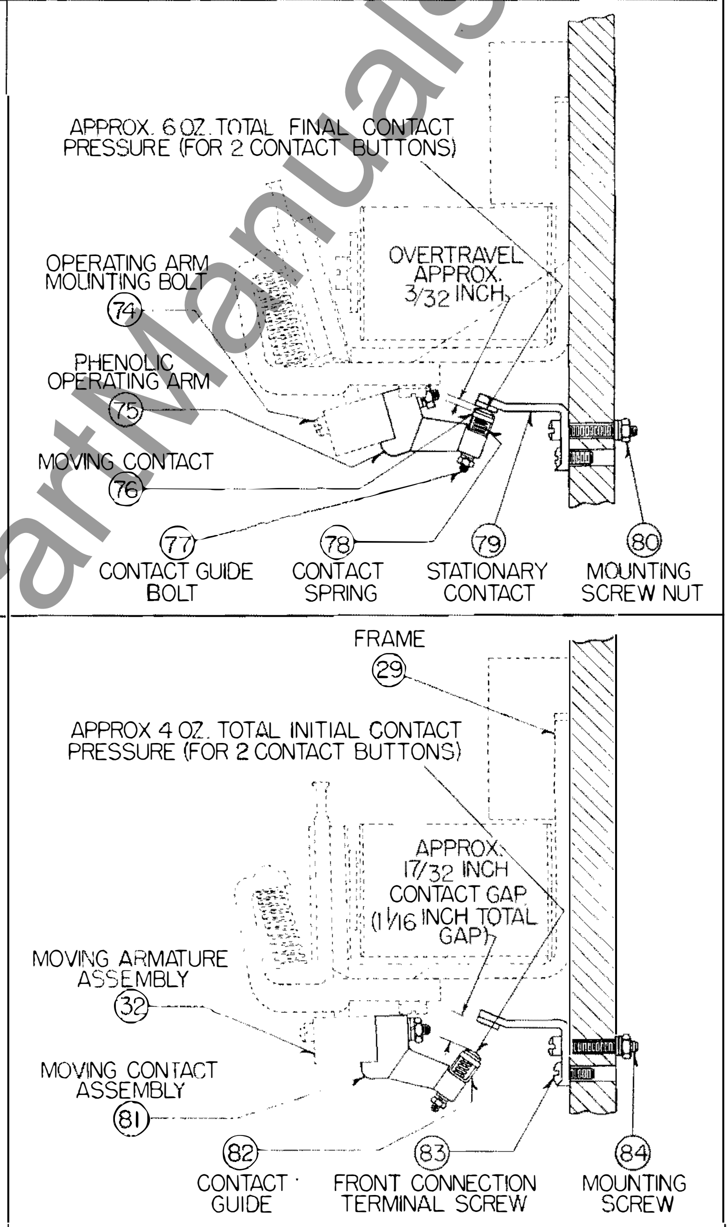


FIG. 9

NORMALLY CLOSED (FOR POSITION "C" ON FIG. 6)



TACTOR COIL CIRCUITS

LICATION FOR

	SUBMARINE

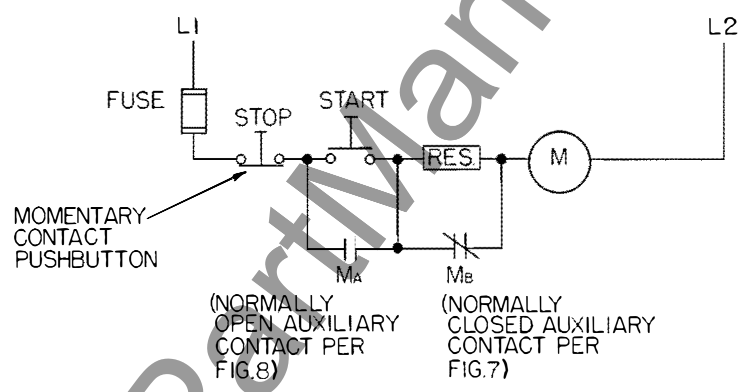


FIG.11

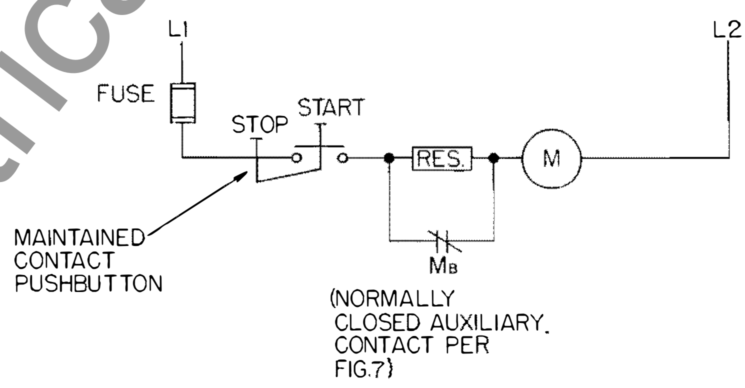


FIG.13

LATCH OPERATION

FULLY
SED

RE FULLY

CONTACTOR CLOSED

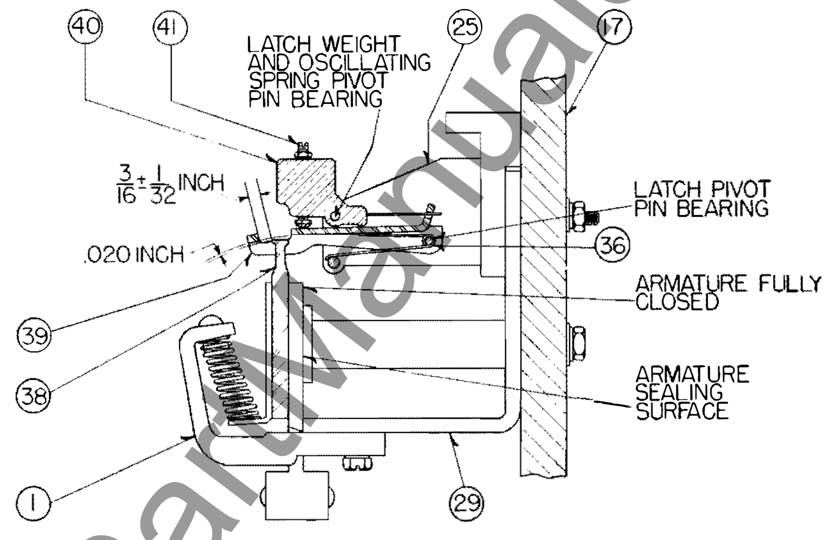


FIG.15

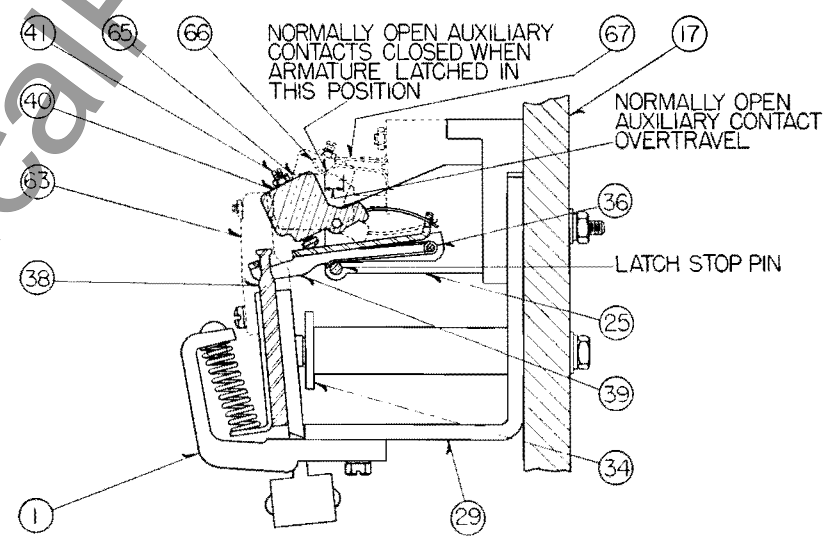


FIG.17