D-C MAGNETIC CONTACTOR

TYPE NSM—SIZE 5

FRAME 204 (300 Amps.) • SINGLE POLE • NORMALLY OPEN

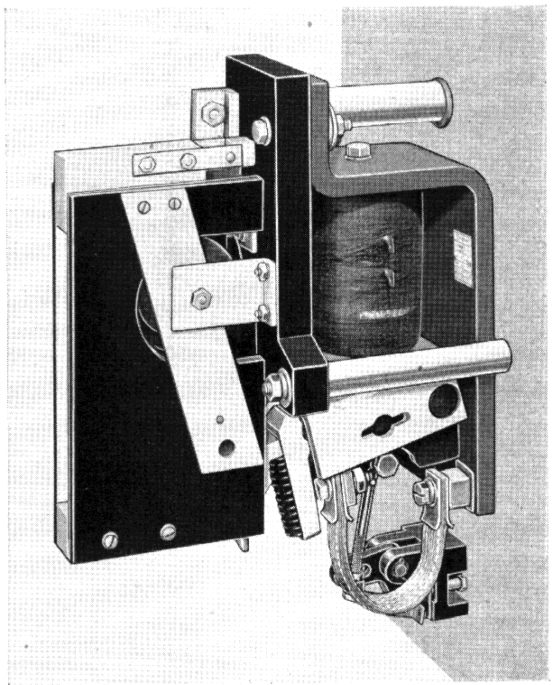

Fig. 1—Type 204 NSM Contactor with Blow-out and a Normally Closed Auxiliary Contact

APPLICATION

The Type 204 NSM Contactor is a d-c magnet operated single pole contactor for d-c service. It has been specifically designed for application on Navy Service A controllers.

RATING

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

MAIN CONTACT						
SIZE	8-HOUR OPEN RATING IN AMPERES	1-HOUR OPEN RATING IN AMPERES	INTERRUPTING CAPACITY IN AMPERES AT 500 VOLTS	MAXIMUM HP		
				115 VOLTS	230 VOLTS	250 VOLTS*
5	300	400	3000	40	75	75

*Submarine duty

Fig. 2—Main Contact Rating Table

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

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

AUXILIARY CONTACTS					
PER FIG.	DESCRIPTION	D-C RATING			
		AMPERES CONTINUOUS CARRYING CAPACITY	AMPERES INTERRUPTING CAPACITY FOR RESISTIVE LOAD†		
			115 VOLTS	230 VOLTS	250 VOLTS*
10	Normally Closed	10	10	5	2
11	Normally Open	10	10	5	2

*Submarine duty
†For a minimum contact gap of 1/4 inch

Fig. 3—Auxiliary Contact Rating Table

The operating coils are intermittently rated. For continuous duty, a resistance should be inserted in the coil circuit when the armature is closed. With this type of circuit with a series resistor, the magnet and coil will operate the contactor satisfactorily from 80% to 110% of the rated voltage.

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

CONSTRUCTION

The Type 204 NSM Contactor is shown in full and sectional views by Fig. 7. This contactor consists essentially of an arc box, a stationary contact and blow-out coil assembly, an armature and moving contact assembly, an operating coil, and an iron frame. The arc box assembly is composed of a 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 contacts are made from hard drawn copper.

This contactor is made in single pole assemblies only. A contactor assembly is also available without a blow-out coil and is similar to the contactor shown by Fig. 7 except for the omission of the blow-out coil assembly (47-48-49-50) and the arc box assembly (10).

The main and auxiliary contacts are for rear connection. This contactor is usually mounted on a Micarta or insulating panel. The main moving contact is electrically and mechanically connected to the armature and frame. The frame mounting bolts are suitable for 1 inch thick mounting panels.

Fig. 10 shows a normally closed auxiliary contact assembly in the closed and open positions. This contact assembly is generally used to insert a resistor in series with the coil when the contactor armature is in the closed position.

A normally open contact assembly is shown by Fig. 11 in the open and closed positions.

The auxiliary contact assembly and operating lever parts are exactly the same for either the normally closed or open contact assemblies. As illustrated by Figs. 10 and 11, the mounting position of the phenolic base (64) will determine whether the contact will be normally open or closed.

OPERATION

1. NORMAL—When a d-c voltage that is within the operating limits is applied to the coil (20), the armature assembly (2) will be attracted toward and will seal against the core pole face (26). The main moving contact (43) will then be in electrical contact with the stationary contact (44) and will complete a circuit from the moving contact stud (31) to the stationary contact stud (19). If the contactor is carrying current, the blow-out coil (50) produces a magnetic force between the field plates (51) 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.

As illustrated by Figs. 8 and 9, the main moving contact (43) touches the stationary contact (44) before the armature assembly (2) is completely sealed. This extra armature movement provides overtravel and permits the contact spring (39) to exert and maintain sufficient contact pressure between the moving and stationary contacts even if they should become burned or worn.

In order to reduce the size of the operating coil and magnet to a minimum, an intermittently rated coil is employed. When the armature is fully closed, a normally closed auxiliary contact assembly as illustrated by Fig. 10 is usually used to insert resistance in series with the coil. A definite time delay relay could also be used to insert the resistor into the circuit. A typical circuit for operation with a normally closed interlock is shown by Fig. 4.

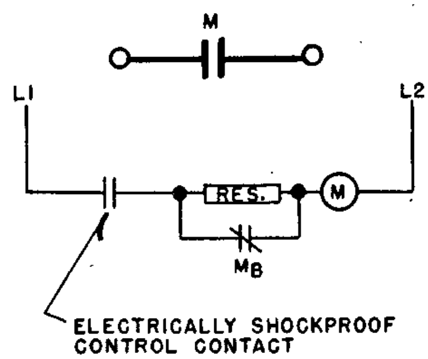

Fig. 4—Typical Control Circuit (Dwg. 13-D-6404)

The magnetic force required to hold the armature in the closed position is only a small percentage of that required to close or pick up the armature. This type of control circuit permits operation over a large voltage range similar to that encountered in submarine controller applications.

A non-magnetic shim (25) assembled between the core (24) and the core pole face (26) insures that the armature will be released and not held by residual magnetism when the coil is de-energized. When the operating coil (20) is de-energized, the contact spring (39) produces a force on the armature that will provide a quick contact opening action. In addition to the contact spring, the weight of the armature assembly also assists in opening the main contacts.

2. UNDER SHOCK—All parts of this contactor have been made to withstand mechanical damage from high impact shock. The main and auxiliary contacts may open or close momentarily when the mounting structure is subjected to a high impact shock. However, this is usually of no consequence as the contactor is always applied for use with other fully shockproof apparatus and in a circuit in such a manner that momentary opening or closing of the contacts does not cause any false operation or affect the operation of the associated control elements.

The coil circuit is usually controlled by a control contact which is electrically shockproof, as shown by Fig. 4. As the contactor main contacts may close under shock from an open position, the contactor is sometimes connected in series with a motor operated cam switch whose line contacts are held open mechanically when the control is in the de-energized position. With this arrangement and circuit, the load will not be energized even though the contactor main contacts should close momentarily.

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, bolts and nuts of this contactor are tight. All joints between current carrying parts should be kept as clean and tight as possible.

Any loose wires or parts that might interfere with the movement of the armature or auxiliary contact mechanism should be securely fastened down.

2. ARC BOX ASSEMBLY—If it becomes necessary to inspect or replace the main contacts (43-44), this operation can be greatly facilitated if the arc box assembly is removed first. The arc box assembly (10) can be removed by taking out the mounting bolt (6) and pulling out and upward on the lower front edge of the box as shown on the side view of Fig. 7. After the box has been rotated approximately 45° in the clock-wise direction, the arc box hinge pin (13) can be disengaged from the hinge bracket (12). The box will then be completely disengaged from the contactor.

CAUTION—THE ARC BOX MUST ALWAYS BE IN PLACE AND IN THE POSITION SHOWN BY FIG. 7 DURING ANY OPERATION THAT REQUIRES THE INTERRUPTION OF CURRENT. THIS BOX CONFINES THE ARC DURING THE INTERRUPTION—AND THE MAGNETIC FIELD PRODUCED BETWEEN THE FIELD PLATES (51) BY THE BLOW-OUT COIL (50) STRETCHES OUT THE ARC AND MOVES IT FROM THE CONTACTS TO THE ARC HORNS.

3. MAIN MOVING CONTACT—After the arc box has been removed, the main moving contact (43) may be removed by taking out the mounting bolt (42). The mounting bolts (42-46) have both a hexagon and socket head. A special splined socket wrench is usually supplied with each controller or group of controllers to facilitate the removal of the contact mounting bolts. The surface between the contact (43) and the contact support (40) should be clean. The arc horn (41) should always be replaced as shown on Fig. 7 as it helps to prevent the arc from burning the contact mounting bolt head and contact spring.

4. MAIN STATIONARY CONTACT—The main stationary contact (44) may be taken off by removing the mounting bolt (46).

5. ARMATURE AND MOVING CONTACT ASSEMBLY—The complete moving contact (40-43) and armature (2) assembly can be taken off of the contactor by loosening the locking bar screws (22) and lifting the armature bearing pin locking bar in an upward direction. The locking bar (23) locks and rigidly holds the armature bearing pin (3) in place. The bearing pin (3) can now be removed from the contactor bearing bracket by pushing it in a sidewise direction; the complete moving armature assembly (2) can now be removed as a unit. If the contactor has an auxiliary contact assembly, the operating lever (53) should be taken off by removing the bearing mounting bolt (52) as shown on Fig. 10.

CAUTION—WHEN THE ARMATURE ASSEMBLY IS RE-ASSEMBLED ON THE CONTACTOR, THE SLOT IN THE ARMATURE BEARING PIN (3) MUST ALWAYS BE ON THE LEFT-HAND END AND TURNED SO THAT IT WILL BE IN ALIGNMENT WITH THE WEDGE SHAPED END OF THE LOCKING BAR (23). After the locking bar (23) and bearing pin (3) are lined up, a light tap on the top of the locking bar will insure that the bearing pin is in the proper location and securely locked in place. The locking bar screws (22) should then be firmly tightened.

6. ARMATURE ASSEMBLY AND BEARING BRACKET—The complete moving armature (2) and bearing bracket assembly can be removed by taking out the bracket mounting bolts (30). When the armature and bracket are removed in this manner, the bearing pin locking bar screws (22) should be loosened before the bracket is re-assembled. This procedure will help to provide better alignment of the parts.

The flexible shunt (36) can be taken off by removing the mounting bolts (37). The shunt should always hang in a smooth curve and should never be twisted or bent out of alignment. The life of the shunt will be very long if it is draped in a shape similar to that illustrated by Figs. 7, 8 and 9.

If the screws which hold the moving contact spring support and bearing bracket (38) to the "U"-shaped steel armature should become loose, they should be securely retightened and restaked. Before the bearing bracket mounting bolts (30) are tightened, the position of the bracket should be adjusted so that when the armature (2) is in the closed position, it will lie perfectly flat against the core pole face (26).

7. OPERATING COIL—The operating coil (20) is mounted and held to the iron frame (28) by a bolt (15) which threads into the core (24). After the armature assembly (2) has been taken off the contactor as described in paragraph No. 5, the coil can be removed from the contactor by disconnecting the coil leads and removing the mounting bolt (15). After the mounting bolt (15) has been taken out, the coil should be rotated around a base supporting tube (27). It can then be taken out from either side of the frame. The coil mounting bolt (15) should always be as tight as possible to provide a good magnetic joint between the core and the frame.

The coil can also be removed by taking off the armature and bearing bracket assembly as described in paragraph No. 6. With this procedure, the coil can be lowered and taken out at the bottom of the stationary contact and blow-out coil base assembly. This method should be used only if there is insufficient space to permit removal of the coil at the side of the contactor frame.

The coil (20) is wound directly on the iron core (24) as that provides a maximum of heat dissipation. The core is always supplied as an integral part of the coil. Any attempt to drive the core out of the coil assembly will damage the insulation and will, in all likelihood, cause a dielectric breakdown.

8. STATIONARY CONTACT AND BLOW-OUT COIL BASE ASSEMBLY—The phenolic contact base (14) can be removed from the contactor by removing the nuts on the supporting studs (4), taking out the mounting base bolt (9), and removing the stationary contact stud (19). The blow-out coil and stationary contact assembly is held to the base (14) by the connection bolt (8) and mounting bolts (11). All current carrying parts should be held together as tightly as possible.

9. AUXILIARY CONTACT ASSEMBLY

a. Normally Closed Auxiliary Contact Assembly—Fig. 10—All contact parts of this auxiliary contact assembly are accessible from the front of the contactor panel. The stationary contacts (59) can be removed from the phenolic base (64) by taking out the mounting screws (60). The moving contact (69) can be removed from phenolic operating lever (61) by taking out the cotter pin (66) and removing the moving contact guide and spring retainer pin (65). The contact gap and overtravel can be adjusted by changing the location of the bearing pin (58) with respect to the operating lever (53).

b. Normally Open Auxiliary Contact Assembly—Fig. 11—The normally open contact assembly employs exactly the same parts as the normally closed assembly. The only difference between the normally closed and normally open contact assemblies is in the mounting position.

10. CONTACT GAP—OVERTRAVEL—PRESSURE—The proper contact gaps, overtravels, and pressures for the main and auxiliary contact assemblies are shown on Figs. 7 to 11.

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 similar to one of the methods illustrated in Instruction Leaflet 6000-1.

11. CONTACT MAINTENANCE

a. Main Contacts—Both the stationary and moving contacts should be replaced when the overtravel shown on Fig. 9 between the moving contact spring support and bearing bracket (38) and the moving contact support (40) decreases to $1/16$ inch. It is usually undesirable to operate the contacts until the maximum possible amount of wear has been obtained as the contact pressure will also decrease. A low contact pressure may cause excessive heating of the contacts. Excessive heating increases the contact resistance which may, in turn, cause arcing at and welding of the contact tips. If the contact pressure falls below the values shown on Figs. 7 to 9, the contact spring (39) should be checked to make certain that it is in good condition.

The moving contact should always move freely on its bearing and in the spring support guide.

The main contacts are made from hard drawn copper and oil or other lubricants should not be applied to the contact surfaces. In general, the copper contacts normally wear in a manner that will provide a very good contact surface. A roughened contact surface is no indication that good contact is not being obtained.

The moving contact is pivoted and supported in such a manner that a slight wiping action occurs on the closing and opening of the contacts. This action helps to maintain a clean and low resistance contact surface.

b. Auxiliary Contacts—Both the stationary and moving contacts should be replaced when the silver button or silver inlay wears or burns down to 1/32 inch from the steel or copper support. The contact supports do not operate very satisfactorily as contacts and may cause overheating or welding of the contact supports. In general, burned and blackened silver contacts do not require replacement or dressing as the discolored surface is usually still a good conductor.

As the contacts wear, the overtravel will decrease. If the overtravel becomes less than 1/16 inch as shown on Figs. 10 and 11, the location of the bearing pin (58) should be changed with respect to the operating lever (53) so that a proper amount of overtravel is obtained.

The moving contact (69) should always slide freely on its guide pin (65). Any friction between these parts may prevent the moving contact from properly seating on the stationary contacts and eventually may cause overheating.

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

12. BEARING MAINTENANCE

a. Contactor Armature Bearing—Oil or other lubrication should not be used on the armature bearing pin (3) or in the bearing bushing which is moulded into the die cast bronze moving contact spring support and bearing bracket (38). The bearing pin and bushing are made of hardened corrosion-resisting steel. These parts operate more satisfactorily without lubrication than with lubrication as oil or grease collects dust and dirt. Unless lubricated parts are frequently cleaned, the contactor armature may become sluggish in closing or opening.

The bearing pin (3) must always be rigidly held in the armature stop bracket so that all rotational sliding of the bearing bushing on closing or opening of the armature occurs between the bearing surfaces.

b. Contactor Moving Contact Support Bearing—The moving contact support bearing pin (29) is held securely in the moving contact support (40) by the bearing pin set screw (34) as shown on Fig. 7. This pin rotates in hardened corrosion-resisting bushings which are moulded into the die cast bronze moving contact spring support and bearing bracket (38). The set screw (34) should always be securely tightened so that the pin rotates only in the bearing bushings. These parts operate very satisfactorily without lubrication.

c. Auxiliary Contact Operating Lever Upper Bearing — The operating lever bearing (56) shown on Fig. 10 is made from bronze. The bearing bushing (57) about which it rotates is made of a nitrided alloy steel. These parts require no lubrication. The operating lever bearing bushing mounting bolt (52) should be maintained as tight as possible so that the bushing (57) does not rotate with respect to the bearing bracket (38).

d. Auxiliary Contact Operating Lever Lower Bearing—A nitrided alloy steel bearing pin (58) operates in a bronze bushing which is moulded into the phenolic operating lever (61). The nitrided steel bearing pin is not subject to rusting and will provide an extremely long operating life without the necessity of lubrication.

After the position of the bearing pin (58) has been adjusted on the operating lever (53), the bearing should be checked to make sure that the pin is properly aligned in the phenolic operating lever (61) bearing bushing and is free from friction. Excessive friction in the bearing can be eliminated by rotating the bearing pin (58) on the operating lever (53) until it is properly aligned in the bearing bushing.

e. Auxiliary Contact Operating Arm Bearing—The bearing pin (63) is a nitrided alloy steel pin which operates in bronze bushings moulded into the phenolic contact base (64). This bearing operates more satisfactorily without than with lubrication.

13. FAILURE TO OPERATE—Failure of the contactor armature to operate may be caused by the coil circuit being opened, power failure, low voltage, or mechanical interference. Failure of the contactor armature to open can result from the coil circuit being energized, mechanical interference, excessive bearing friction, or a broken contact spring.

Sluggish operation or failure of the contactor to fully seal may be caused by improper adjustment of the normally closed auxiliary contact which may be used to insert resistance in series with the operating coil when the contactor armature is in the fully closed position. Poor contact between the moving and stationary auxiliary contacts can also cause this trouble.

WEIGHT OF CONTACTOR AND SPARE PARTS

DESCRIPTION	NO. PER SET	WEIGHT
Complete Contactor with Blow-out—Fig. 7		
Without Coil	..	24 lbs.-4 oz.
With Coil	..	30 lbs.
Complete Contactor without Blow-out		
Without Coil	..	18 lbs.-4 oz.
With Coil	..	24 lbs.
Spare Parts—Fig. 7		
Coil (20)	1	5 lbs.-12 oz. } 6 lbs. 3¼ oz.
Main Contacts (43-44)	2	6 oz.
Contact Spring (39)	1	1¼ oz.
Normally Closed Auxiliary Contact Assembly—Fig. 10		
Moving Contact (69)	1	½ oz. } ¾ oz.
Stationary Contact (59)	2	¼ oz.
Contact Spring (68)	1	......
Normally Open Auxiliary Contact Assembly—Fig. 11		
Moving Contact (69)	1	½ oz. } ¾ oz.
Stationary Contact (59)	2	¼ oz.
Contact Spring (68)	1	.....

Fig. 5—Weight Table

CIRCUIT DIAGRAM SYMBOL

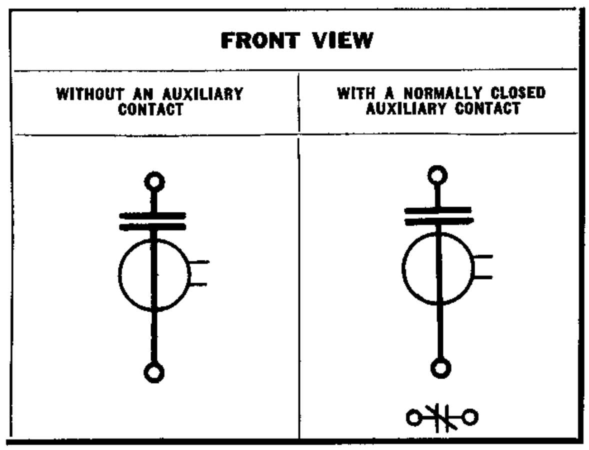

Fig. 6—Wiring Diagram Symbol (Dwg. 13-D-6404)

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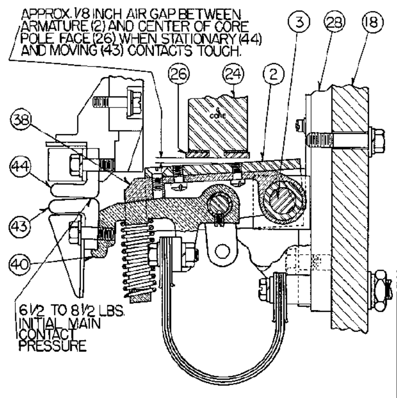


FIG.8-AMATURE ASSEMBLY IN CONTACT TOUCH POSITION

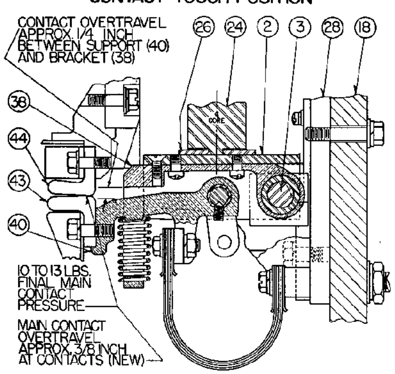
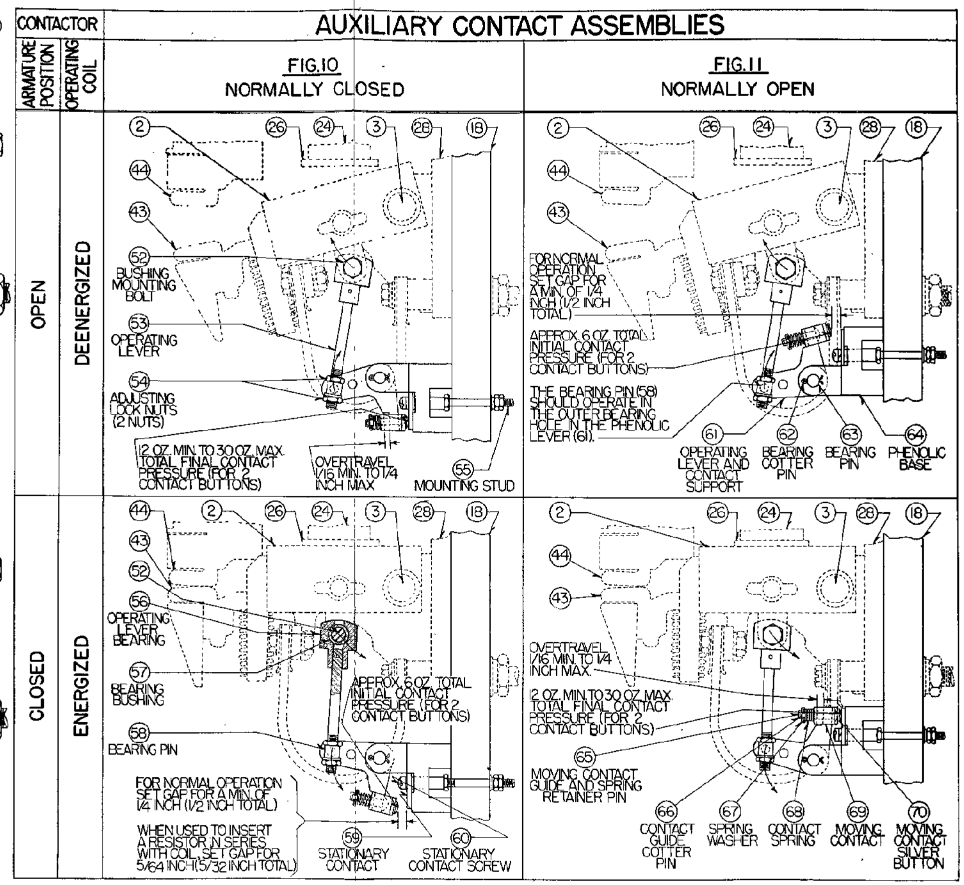


FIG.9-ARMATURE ASSEMBLY AND CONTACTS IN SEALED POSITION

AUXILIARY CONTACT ASSEMBLIES



(Dwg. 47-J-258)

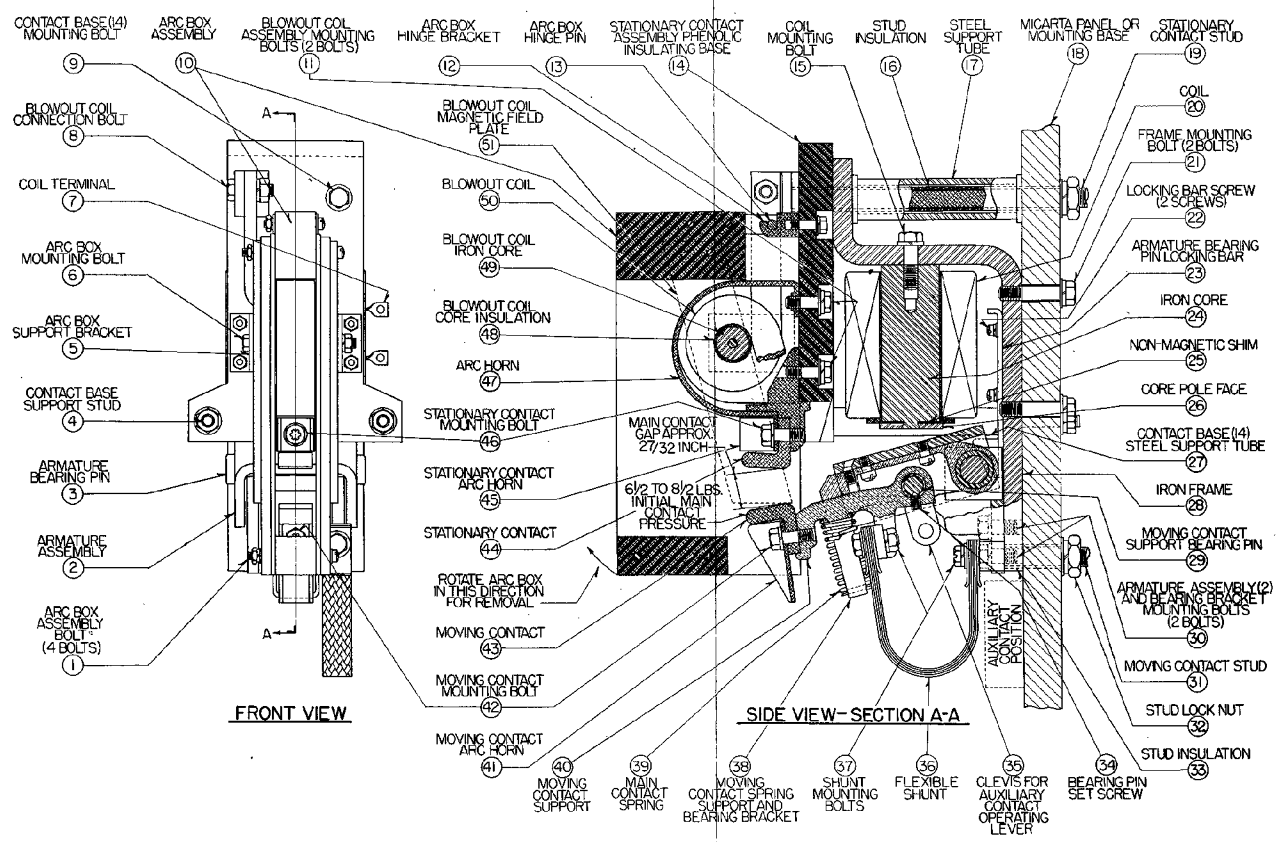


FIG.7-FRONT AND SIDE SECTIONAL VIEWS OF A TYPE 204 NSM CONTACTOR WITH BLOWOUT

(Dwg. 47-J-249)