

KNIFE SWITCHES

1. GENERAL

1.01 This section covers knife switches per:

| | | |
|------------|------------|------------|
| KS-5018 | KS-5080 | KS-5329 |
| KS-5040 | KS-5080-01 | KS-5329-01 |
| KS-5040-01 | KS-5086 | KS-5412 |
| KS-5040-02 | KS-5101 | KS-5456 |
| KS-5047 | KS-5147 | KS-5457 |
| KS-5058 | KS-5147-01 | KS-5503 |
| KS-5062 | KS-5233 | KS-15515 |
| KS-5065 | KS-5327 | |

1.02 It is reissued to include an additional switch and to use a molybdenum disulfide dry powder lubricant (hereafter referred to as powder) instead of petrolatum for lubricating blades and clips. Significant changes are marked with arrows.

1.03 Reference shall be made to Section A400.001 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

1.04 Requirements and associated procedures marked with a number sign (#) need not be checked by the installer unless it is thought that the requirement is not being met, or performance indicates that such a check is advisable.

1.05 Requirements and associated procedures marked with an asterisk (*) need not be checked during maintenance unless the apparatus or part is made accessible for other reasons, or performance indicates that such a check is advisable.

1.06 The switches as covered in this section are of two general types: those having flat area contacts, and those having embossed line contacts.

1.07 A number of switches, have a high potential while in use. To avoid injury to the person, or damage to the equipment, care should be exercised when touching or working around these switches.

1.08 Unless stated to the contrary, the requirements in this section shall be gauged by eye or by feel.

1.09 Normal operation may be defined as a condition in which the switch is carrying any load from no load to maximum

available load in amperes not exceeding the current rating of the switch; with the temperature of any part of the switch not excessive, and the blades and clips, or tongues, engaging smoothly and positively.

2. REQUIREMENTS

2.01 Switch Blades

(a) Blades shall be straight, clean, smooth, and free from rough edges. Multiblade switches shall have their blades parallel.

(b) Contact surfaces, where possible, shall be lubricated with a thin film of powder initially and after every 200 to 300 operations of the switch. Hinge clips shall not be lubricated with oil.

2.02 Crossbars (multipole switches) shall be securely fastened to the blades or blade blocks. The KS-5412 switches equipped with the so called "floating" blades are designed for a small amount of play between the switch blades and their associated crossbar fittings; however, these crossbar fittings shall be firmly attached to the crossbar.

2.03 Handles: Except where a linkage is used between a separately mounted operating handle and the switch blades, and except on KS-5147 switches, the handle shall be securely fastened to the blade, blade-block, or crossbar. KS-5503 switches of the 6000-ampere size have detachable extension handles.

2.04 Mounting

(a) All assembly screws and nuts shall be tightened firmly and the switch fastened securely to the panel.

(b) Corresponding clips or tongues of the same pole, and fingers of the same clip shall be in the same horizontal or vertical plane.

2.05 Clips or Tongues

Switches with Flat Area Contacts

(a) Switch clips and tongues shall be clean, smooth, and free from rough edges.

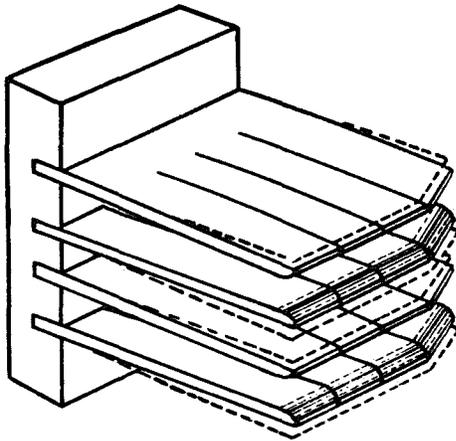


Fig. 1 - Illustrating Converging of Contact Clips

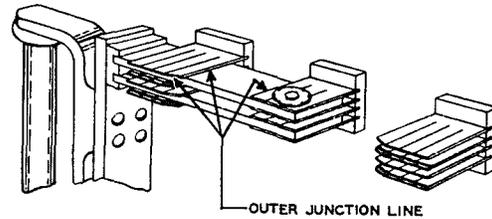


Fig. 2 - Illustrating Junction Line Between Blade and Clip

| Capacity | Min. |
|---|------|
| 30-60 Amps. (Inclusive) | 50% |
| 100 Amps. and over - Copper Contacts | 90% |
| Silver Contacts | 50% |

(b) All clips shall be straight and converging, that is, slightly closer together at the rounded edge where the blade enters.

(c) The hinge clip or tongue shall make positive contact but shall not bind.

(d) Contact surfaces shall be lubricated with a thin film of powder initially and after every 200 to 300 operations of the switch.

Switches with Embossed Line Contacts

(e) Switch tongues shall be clean, smooth, and free from any rough edges.

(f) All tongues shall be straight and sides parallel.

(g) Blades and tongues shall make positive contact at the hinge but shall not bind.

(h) Contact surfaces shall be lubricated with a thin film of powder initially and after every 200 to 300 operations of the switch.

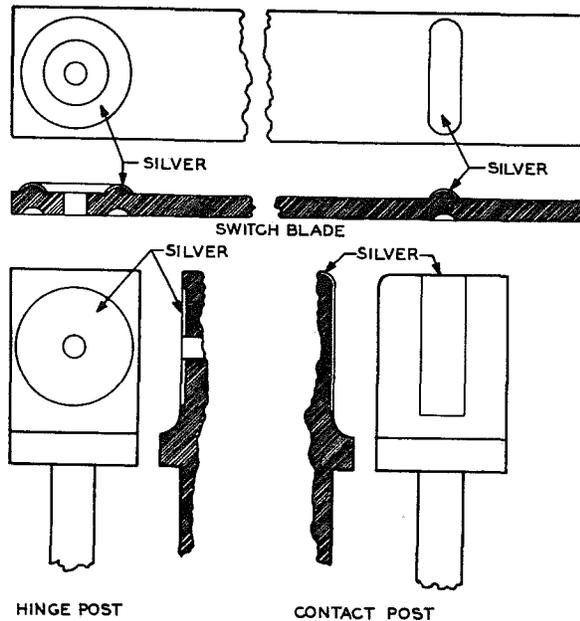


Fig. 3 - Illustrating Embossed Line Contact (LPI Switch with Silvered Contact Surfaces Shown)

*2.06 Contact Area

Switches with Flat Area Contacts

(a) Switches of less than 30-ampere capacity shall have a reasonably tight fit, sufficient to carry the current required for the particular installation.

(b) Switches of 30-ampere capacity or above in the fully closed position, shall refuse a 0.0015" thickness gauge at the accessible outer junction line to the extent of the following minimum percentages. Use thickness gauge.

Switches with Embossed Line Contacts

(c) Switches with embossed line contacts shall refuse a 0.0015" thickness gauge at all accessible points along the contact line. Use thickness gauge.

(d) If any question arises as to whether a switch meets requirements (a), (b), or (c), the temperature requirements shall determine the acceptability of the switch provided the other requirements of this section are met.

2.07 Contact Pressures*KS-5412 Switches Only**

- (a) With other requirements of this section met, the pounds pull to open any single-pole noncircuit maintaining switch shall be within the limits of the table given below which gives values for single-pole switches only.
- (b) The pounds pull on single-pole switches shall be measured at the base of the handle as near as possible to the crossbar or blade block.
- (c) For switches having more than a single pole, the crossbar of the knife switch holding two or more poles together shall be disconnected, and the pressure check shall be made on each individual blade.
- (d) Any noncircuit maintaining switch carrying full-rated ampere load and having a tendency to overheat, yet meeting the contact pressure requirements, shall have its contact pressures adjusted close to the maximum limit instead of the minimum limit of the values given the the table.

Flat Area Contact Switches

| Ampere Rating | Hinge Only Total Pull (Lbs.) | | | Complete Switch Total Pull (Lbs.) | | |
|---------------|---------------------------------|----------------|------|--------------------------------------|----------------|------|
| | Turn- over | during Life | Max. | Turn- over | during Life | Max. |
| 30 | 0.45 | 0.40 | 1.7 | 2.25 | 1.90 | 4.0 |
| 60 | 1.30 | 1.10 | 2.9 | 5.00 | 4.10 | 7.5 |
| 100 | 1.30 | 1.10 | 2.9 | 5.90 | 4.90 | 8.6 |
| 200 | 1.80 | 1.50 | 4.6 | 7.20 | 6.00 | 14.0 |
| 400 | 3.60 | 3.00 | 6.9 | 12.60 | 10.50 | 21.0 |
| 600 | 5.40 | 4.50 | 9.2 | 18.00 | 15.00 | 27.5 |
| 800 | 6.30 | 5.30 | 12.5 | 25.20 | 21.00 | 37.0 |
| 1200 | 10.80 | 9.00 | 18.5 | 36.00 | 30.00 | 58.0 |

Embossed Line Contact Switches

| Ampere Rating | Hinge Only Total Pull (Lbs.) | | | Complete Switch Total Pull (Lbs.) | | |
|---------------|---------------------------------|----------------|------|--------------------------------------|----------------|------|
| | Turn- over | during Life | Max. | Turn- over | during Life | Max. |
| 400 | 1.40 | 1.10 | 2.9 | 6.30 | 5.30 | 10.2 |
| 600 | 2.25 | 1.90 | 4.0 | 9.00 | 7.50 | 16.0 |
| 800 | 2.25 | 1.90 | 4.0 | 10.80 | 9.00 | 18.5 |
| 1200 | 2.70 | 2.30 | 5.8 | 13.50 | 11.30 | 22.0 |
| 1600 | 3.60 | 3.00 | 6.9 | 16.20 | 13.50 | 25.5 |

Use spring balance.

Circuit Maintaining Switches

- (e) Circuit maintaining switches, or switches with auxiliary clips, have no contact pressure requirements.

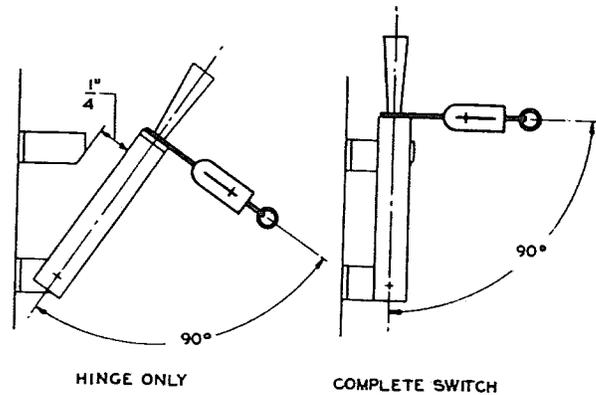


Fig. 4 - Illustrating Measurement of Contact Pressure

2.08 **Linkages:** Where a linkage is used between a separately mounted operating handle and the switch blades, for example, in KS-15515 shown in Fig. 10, the joints in the linkage shall be oiled sparingly with light mineral oil.

*#2.09 **Temperature:** The temperature of any part of the switch shall not exceed 70C (158F). If the temperature is thought to be excessive, measure by thermometer.

3. ADJUSTING PROCEDURES**3.001 List of Tools, Gauges, and Materials (Equivalents may be substituted)****Tools**

Kit #268, Knife Switch Adjusting Kit Including Shipping Case R-1883 consisting of:

| | |
|------------------------|--------|
| Benders, knife switch, | |
| 1 - Slot .104" | R-5960 |
| 1 - Slot .167" | R-5950 |
| 1 - Slot .189" | R-6180 |
| 1 - Slot .198" | R-5490 |
| Block, fiber | R-5510 |
| Clamp, knife switch | R-5550 |
| File, flat, smooth 10" | R-1776 |
| Hammer, claw, 1 lb. | R-9430 |
| Level, 24" long | R-8370 |
| Rods, knife switch, | |
| 1 - 1/8" x 5" | R-5940 |
| 1 - 1/4" x 5" | R-5930 |
| 1 - 5/16" x 5" | R-5920 |
| 1 - 3/8" x 5" | R-5500 |
| Thermometer, 0-200C | R-1032 |

Pliers, p-side cutting
Screwdriver, cabinet, 3"
Screwdrivers, regular, 4" and 5"
Wrench, adjustable, single end, 8"
R-2512

Wrenches, hex. flat, open double end with the following openings:

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7/16" and 5/8"; 1/2" and 3/4"; 9/16"
and 11/16"; 3/4" and 13/16"; 31/32"
and 1-1/16"; 1-5/16" and 1"; 1-7/16"
and 1-13/16"

Wrenches, hex. flat, open single end,
with the following openings:
7/8", 1-5/8", 2", 2-3/8"

Gauges

Balance, spring 0-6 lbs. - John Chatillon
& Sons, No. 06
Balance, spring 0-30 lbs. R-2481
Gauge nest, thickness, KS-6909

Materials (See Sections A710.011 and
A710.012)

Canvas or tape
Cloth, abrasive - 100 grade
Cloth, cleaning, twill jean, D-98063
→ Oil, mineral, light, 90-110S 100
Pad, felt
□ Powder, molybdenum disulphide, Western
Electric Company, Alpha Corp.,
Greenwich, Conn., or Westinghouse Elec. Corp.,
↳ Molkolube 8565-3.
Spirits, petroleum

3.002 Potential shall be removed from the
switch, if possible, before any ad-
justments are made. Disconnect the switch,
if practicable, from the power supply, or
remove the fuses. Should it not be practi-
cable to remove the potential from the
switch, wrap the adjacent clips of opposite
polarity with canvas or tape while adjusting
the blades or clips.

3.01 Switch Blades (Rq. 2.01)

(1) Wipe the contacting surfaces of the
blades and clips or tongues, with
a cloth either dry or moistened with
petroleum spirits, applying pressure
in order to remove all accumulated dirt
and lubricant. If the contacting
copper surfaces are rough or pitted,
they should be smoothed with abrasive
cloth, or a fine file, so that the
blade and clips or tongues engage
smoothly and positively. To avoid
unnecessarily shortening the life of
the switches, care should be used to
remove only a minimum amount of copper.
Silver contacts should not be smoothed
with abrasives. After smoothing, remove
all loose particles of copper by
wiping with a clean, dry cloth.

(2) Adjust as outlined in 3.05. It
is very improbable that multiblade
switches will become bent. Should it
become necessary to straighten single
blade switches, remove the blades
from the hinge clips, where practicable,
as outlined in 3.05. Lay the individual
blades upon a clean, smooth, flat surface
and straighten with a hammer and fiber

block. The fiber block is used so that
blades will not be marred during the
straightening process.

(3) The end of the hinge bolts on some
makes of switches are spun over, or
riveted over the hinge nut, permanently
locking them in place, and no attempts
should be made to adjust the hinge
clips or remove the switch blade on
switches of this type. If necessary,
remove the blade and hinge clip and
replace as a unit.

(4) Where the moving blade closes be-
tween fixed clips, apply a small
amount of powder to a clean, dry cloth
and rub well into the contacting surfaces
of the blade with this cloth, taking care
not to apply lubricant to other parts of
the switch. Wipe off any excess lubricant
with another clean, dry cloth.

(5) Where the moving blades close around
a fixed tongue, lubricate the tongue
and the blades in a manner similar to the
method outlined above.

(6) If a switch is dismantled for other
reasons, the hinge contact surfaces
should be cleaned and lubricated. A
small amount of powder can be worked into
the hinge by applying it to the exposed
surfaces and operating the switch several
times.

3.02 Crossbars (Rq. 2.02)

(1) Loose crossbars on other than KS-5412
switches with so-called "floating"
blades should have their mounting screws
or nuts tightened with a screwdriver or
wrench of the correct size.

3.03 Handles (Rq. 2.03)

(1) On switches having an even number of
poles, tighten loose handles by
tightening the associated screws or nuts
with a screwdriver or wrench of the proper
size. Straight handles on switches hav-
ing an odd number of poles may be tight-
ened by turning the handle itself, holding
the mounting screw or bolt from turning,
if necessary. Spade handles on switches
having an odd number of poles may be
tightened with a screwdriver or wrench
of the proper size.

3.04 Mounting (Rq. 2.04)

(1) If any part of the switch is loose
on the panel, tighten the mounting
nuts or screws with a wrench or screw-
driver of suitable size. Check the
alignment of the switch and clips or
tongues, with a level having a wooden
frame. When necessary, the switches
may be aligned in the following manner.

(2) With a wrench or screwdriver, loosen the mounting screws, or nuts, on the switches. Set the hinge contact so that it will be approximately vertical or horizontal (whichever the case may be) and then tighten the mounting screws or nuts on the blade block.

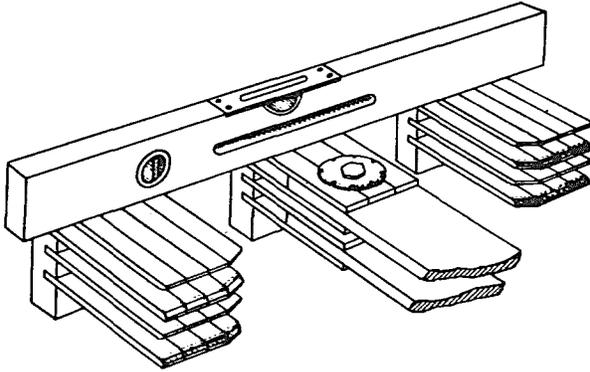


Fig. 5 - Illustrating Leveling of Contact Clips

(3) Place a level across the hinge contact as shown in Fig. 5 and align the tongue or clips on the side or sides of the hinge as closely as possible. (When the spring washer interferes with the placing of the level, tilt the top of the level away from the panel, allowing the edge of the level to rest on the hinge.) Tighten the mounting nuts or screws on the studs of the tongue or clips sufficiently to retain this alignment.

(4) Clean the contact surfaces of the blades and tongues or clips with a cloth moistened with petroleum spirits; apply powder to a clean cloth and rub well into the contact surfaces.

(5) Move the switch blade, or blades, over to the clips or tongue, and note that the blades of the switch line up in their proper relation to the tongues or clips. If the switch is double throw, do the same with the other side. Adjust as required and tighten all mounting screws or nuts firmly.

(6) Recheck for alignment after the nuts and screws are finally tightened.

3.05 Clips or Tongues (Rq. 2.05)

(1) Clean the contact surfaces of clips with a clean cloth moistened with petroleum spirits and lubricate with a thin film of powder. Fold a clean cloth

over a flat stick which will fit between the clips, apply powder to the cloth and rub well into the inner contacting surfaces of the clips. Wipe off excess lubricant with another clean cloth.

Switches with Multiple Finger Clips

(2) Contact clips, other than those with silvered contacts, that have any slight roughness or burrs should be smoothed with abrasive cloth or a fine file so that the blade engages the clip smoothly and positively. Wipe the clips with a clean cloth, either dry or moistened with petroleum spirits, and shape

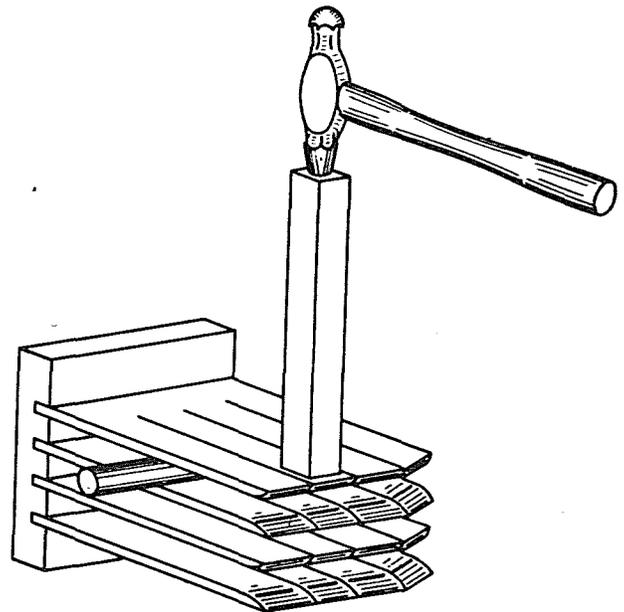


Fig. 6 - Illustrating Contact Clip Adjustment

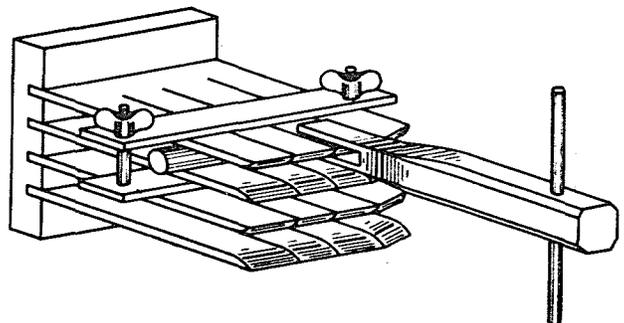


Fig. 7 - Illustrating Contact Clip Adjustment

as required in accordance with one of the preceding figures. Care should be taken to remove only a minimum amount of copper.

(3) When the amount of adjustment is large, insert a round rod of the proper size between the clips, as shown by Fig. 6, and shape the clips in their proper relation with a hammer and fiber block. Remove the round rod and try the clips for contact surface. Repeat this procedure, if necessary, until the desired adjustment has been obtained.

(4) When the amount of adjustment is small, a bending tool may be used as shown by Fig. 7 or Fig. 8.

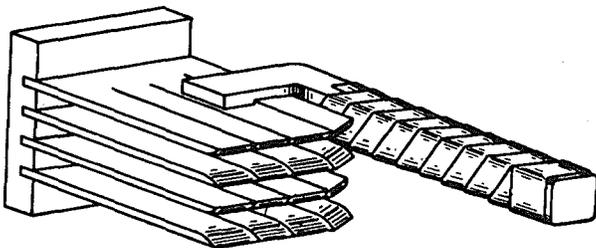


Fig. 8 - Illustrating Contact Clip Adjustment

(5) On laminated switches, it will be found that the inner clips can be adjusted by inserting a round rod of the correct size between the clips; securing a clamp over the outside of the clips as shown by Fig. 9; and tightening the wing nuts until the clips are properly shaped. No more shaping than is absolutely necessary should be done on the contact clips.

(6) In case the hinge clip binds, adjust the switch, when practicable, as follows: Remove the locknut, or set screw, from the hinge bolt, or nut, and remove the switch blade from the switch. See that the individual blades and hinge clips are clean, free from any roughness, and straight. Adjust the clips, if necessary, in a manner similar to that outlined in (3) and (4). Apply a small amount of powder to a clean cloth and rub well into the contact surfaces of the blades and clips and tighten the locknut or set screws so that the contact between the blades and clips is positive but does not bind.

(7) Should the blades be loose in the hinge clips, so that the proper contact is not made, loosen the locknut

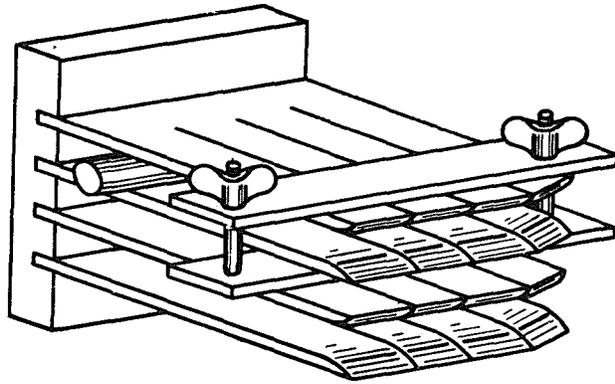


Fig. 9 - Illustrating Contact Clip Adjustment

or set screws, tighten the nut on the hinge bolt until the required contact is obtained, and lock it into place by tightening the locknut or set screws.

Switches with Tongue Contacts

(8) Contact surfaces should be cleaned thoroughly with a dry cloth or one moistened with petroleum spirits. Apply a small amount of powder to a clean cloth and rub well into the contact surfaces. Abrasive cloth, or a fine file, should be used only on copper surfaces, and then only to remove burrs or rough projections. Do not attempt to use emery or other abrasive to grind the blades into good contact. Such practice generally results in poor contact and overheating. Replace any tongues which are not satisfactory.

*3.06 Contact Area (Rq. 2.06)

Switches with Flat Area Contact

(1) Move the switch blade, or blades, over to the tongue or clips, and be sure the switch blade rests firmly against the blade stop. See that the blades of the switch line up in their proper relation to the tongue or clips, by inserting a thickness gauge along the outer junction line between the blades and the tongue or clips. If the switch is double throw, do the same with the other throw. Whenever possible, the switch shall be adjusted as outlined in 3.05 so as to have the required contact.

Switches with Embossed Line Contact

(2) Proceed in a similar manner to that outlined in (1) above, by attempting to insert a thickness gauge between the blade laminations and the

tongue at all accessible points along the line of contact. Contact is satisfactory if it is impossible to insert the gauge at any point and the contact pressure requirement is met.

*3.07 Contact Pressures (Rq. 2.07)

(1) Contact pressure is measured by the pounds pull required to open a switch blade from its contact clip or tongue; or to move the blade on its hinge clip after the switch has been opened. To measure the contact pressure, first operate the switch several times and then, using a spring balance, or where the pull exceeds the capacity of a single balance using two in tandem, attach the balance to the switch in the following manner: On single-pole switches, hook the end of the spring balance to the switch handle at the base, and as near as possible to the point where the handle attaches to the crossbar or blade. On multipole switches, after the crossbar holding the individual blades together has been removed, the spring balance should be attached to the end of the individual switch blades, or blade block, as near as possible to the point of its normal connection to the crossbar so disconnected. In either case, the spring balance shall be at right angles to the center line of the switch in the plane of travel of the switch blade. Readjust, only when the pull required goes outside the maximum or minimum values given in the table or the switch overheats (see 2.07 (d)).

(2) To adjust for contact pressure, where the pressure is too little, squeeze the blades of the clips (if of the multifingered type), or blades of the switch (if of the contact-tongue type), slightly with a knife-switch clamp or pliers at the point where the blades make contact with the tongue or clips, until the distance between the clips or blades is approximately 1-32 less than the thickness of the blade or tongue. If the pressure is too great, it may be lessened by opening the clips or blades slightly by means of a knife-switch bender or by rods and clamps.

(3) Where hinge bolts are present, contact pressure may be adjusted in the hinge by tightening or loosening

the hinge bolt in a manner similar to that outlined in 3.05.

(4) For the larger capacity LP-1 switches, adjustment of pressure is made by tightening or loosening the associated blade block holding nuts uniformly, and maintaining the blade laminations parallel with each other and with the contact tongue until the desired adjustment has been obtained.

3.08 Linkages (Rq. 2.08)

(1) On switches having linkage between the operating handle and the switch blade, wipe off the joints with a clean cloth to remove accumulated dirt. Apply oil sparingly to the joints and remove excess oil with a clean cloth.

*#3.09 Temperature (Rq. 2.09)

(1) The temperature of a switch may be determined by placing the bulb of the thermometer as close as possible to that part, the temperature of which is desired; by covering the remainder of the bulb with a piece of felt; and by observing the highest temperature indicated.

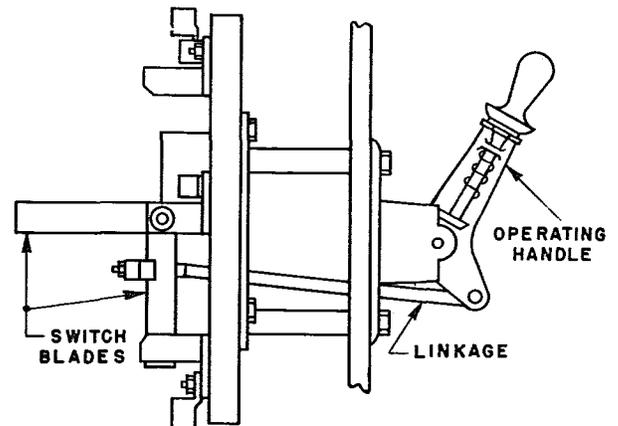


Fig. 10 - KS-15515, Showing Operating Handle and Linkage to Switch Blades