TECHNICAL SESSION - III

SAFETY: DESIGN AND INSTALLATION OF DEVICES FOR DEENERGIZATION OF SELF-PROPELLED ELECTRIC FACE EQUIPMENT AND AUTOMATIC EMERGENCY BRAKES

"The Bendix Panic Bar Study" [1]

by

Leslie D. Marrus [2]

Panic bars are a machine operator-actuated control for the emergency deenergization of the tram motors on self-propelled, electric and diesel face equipment; including haulage equipment such as shuttle cars. There are nine basic types of panic bars (and several variations) that were recommended by The Bendix Corporation in the study contract that we performed for the U. S. Bureau of Mines, Pittsburgh Mining and Safety Research Center. All of the panic bars were characteristically of the "fire door" type that is frequently encountered on outside exit doors of many public and some commercial buildings. It was also the intent of the panic bar designs that, when emergency brakes are added to the face equipment machinery for which they are required, that they be designed and hooked up so that actuation of the panic bar will result in automatic application of the emergency brakes (immediately following the deenergization of the tram motors).

Panic Bar Requirements

The following panic bar design requirements are a restatement of the proposed requirements defined in the Federal Register, requirements cited in "Guidelines for the Design and Installation of Devices for Deenergization of Self-Propelled Electric Face Equipment/Automatic Emergency Brakes" by C. E. Lester and J. D. Greenhalgh of MESA, and Bendix recommendations that were formulated as a result of discussions with personnel at the various machine manufacturers and underground coal mines that we surveyed and through discussions with our consultant, George L. Judy.

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1. The term "panic bar" refers to a rigid, bar-type actuation device (or devices) which, when coupled to:

   - an existing push button emergency stop switch or control,
   - an existing lever emergency stop switch or control,
   - an existing push-pull control,
   - or through the addition of a separate electromechanical switch assembly or functionally similar control,

   will deenergize the tram motors of self-propelled, electric and diesel face equipment that lack substantially constructed cabs, whenever the panic bar (and, in turn, the coupled switch or control) is actuated.

2. A panic bar must be provided on all electric- and diesel-powered equipment that is self-propelled (wheel or tracked), that is used at the mine face, and that does not have a permanent, substantially constructed cab. Face equipment is intended to include all mobile equipment that is taken into or used inby the last open cross-cut of a coal mine. Table 1 lists the types of equipment and models that were included in the Bendix study.

3. The panic bar must (minimally) deenergize the tram mode of operation. Deenergization of systems other than the tramming system is <u>not</u> precluded.

4. Vehicles that are provided with a substantially constructed cab, which meets the requirements of this part, shall not be required to install the tram motor deenergization panic bar.

   (a) A substantially constructed cab provides complete operator protection from both roof and rib. A protective canopy, only (without rib protection), will not qualify.

   (b) An operator's station that has a full operator's platform that is large enough to support the operator's body and also provides rib protection, with the addition of a securely constructed and permanently installed protective canopy, may be construed to be a fully protective cab.

   (c) Machines where the cab (or canopy, or components comprising a cab) are designed to be easily removed from the machines, will require a panic bar installation for emergency deenergization of the tram motors.

5. Machines with more than one control station, if equipped with tram controls, must provide tram motor deenergization panic bars at each control station. Disconnecting or otherwise disabling the tram controls in secondary control stations, or the fact that these tram controls are seldom (if ever) used, are not satisfactory exceptions to the requirement for a panic bar.

Table 1 - Types of Equipment (and Models) Studied

Continuous Borer Miners (14 models)
- Goodman Equipment Corporation (405, 425, 426, 427, 428, 429, 430)
- Joy Manufacturing Company (2BT-6, CU43)
- National Mine Service Company (557, 565, 570, 670, 675)

Continuous Rotating Drum Miners (32 models)
- Jeffrey Mining Machinery Company (120H, 120L, 120M, 121H, 121L, 121M)
- Joy Manufacturing Company (1CM, 5CM, 6CM, 8CM, 9CM, 10CM, 11CM, 12CM, 14CM)
- Lee-Norse Company (26CM, 28CM, 32CM, 35CM, 38CM, 45CM, 48CM, 60CM, 100CM, 105HH, 110CM, 115HH, 245CM, 265HH, 455HH, 606HH)
- National Mine Service Company (3080)

Cutters (7 models)
- Goodman Equipment Corporation (2500)
- Joy Manufacturing Company (10RU, 11RU, 12RB, 15RU-Narrow, 15RU-Wide, 16RB)

Face Drills (28 models)
- Dooley Brothers, Inc. (6600, 6700)
- Galis Division of the FMC Corporation (400, 410, 420, 430, 450, 460, 480, 4100, 4120, 4130, 4140, 4400)
- Joy Manufacturing Company (CD-41, CD-42, CD-43, CD-61, CD-71-High, CD-71-Low, CD-73, CD-81)
- Long-Airdox Company (TDF-20, TDF-24, TDF-44)
- Owens Manufacturing Company (400HMCD)
- Schroeder Brothers Corporation (CDB-2000A-A.C., CDB-2000A-D.C.)

Loaders (23 models)
- Goodman Equipment Corporation (968, 968-1, 970, 970-L, 970-LW)
- Jeffrey Mining Machinery Company (202-L, 202-LW, 202-M, 202-MW)
- Joy Manufacturing Company (8BU, 11BU, 14BU3, 14BU7, 14BU8, 14BU9, 14BU10-11, 14BU10-12, 14BU10-31, 14BU10-41, 14BU10-41C, 14BU10-42)
- Long-Airdox Company (88, 188)

Roof Bolters (46 models)
- Acme Machinery Company (D-1, D-2-New, D-2-Old, D-3-New, D-3-Old, D-4-New, D-4-Old, PDT-2)
- Dooley Brothers, Inc. (8800, 8900)
- J.H. Fletcher & Company (DB, DDJ, DDM-New, DDM-Old, DJ, DM-New, DM-Old, DO, LTDO, Dual LTDO)
- Galis Division of the FMC Corporation (300, 310, 320, 330, 340, 350, 380, 510, 520, 3500, 3510, 3520, 3530)
- Joy Manufacturing Company (RBD-11, RBD-15)
- Lee-Norse Company (TD1, TD2)
- Long-Airdox Company (LRB-5, LRB-12, LRB-15)
- Wilcox Manufacturing Company (WRDA, WRDA-J, WRDA-J-6, WRDD, WRDD-J, WRDD-J-6)

Shuttle Cars (41 models)
- Galis Division of the FMC Corporation (5L, 6L, 7L, 10L)
- Goodman Equipment Corporation (6632, 6636)
- Jeffrey Mining Machinery Company (404-H, 404-HR, 404-HR2, 404-M, 405-H, 405-HR, 405-M, 406-H, 406-HR, 406-M)
- Joy Manufacturing Company (10SC, 10SC22, 16SC, 18SC5, 18SC6, 18SC7, 18SC8, 18SC9, 18SC10, 18SC12, 21SC, 21SCB)
- National Mine Service Company (Lokar 28, Lokar 30, Torkar 30, Torkar 40, Torkar 48-3(Torkar 48-40, Torkar 48-43, Torkar 48-48, Torkar 60, Torkar 60-54)
- Wagner Mining Equipment, Inc. (HMTT-410S, MTT-F10S, MTT-F20S)

Tractors and Scoops (36 models)
- EIMCO Division of Envirotech Corporation (911E)
- Elkhorn Industrial Products Corporation (AR-4, AR-4T, AR-5, AR-5T, AR-75, DLE-1, DLE-1N)
- Kersey Manufacturing Company (15, 15S, 18S, 24S, 242, 244, 744D, 744DL, 944D, 944DL, 1144E, 1144F)
- Melroe Division of Clark Equipment Company (XPM-600E)
- S&S Machinery Sales, Inc. (74, 74SS, 86, 88, 100, 100M, 160, 200, 200L, 200S, 260SS, 320SS, CX-1, CX-2)
- Wagner Mining Equipment, Inc. (ST-5DS)

6. Machines with remote control capability are not exempt from the panic bar requirements, regardless of the location of the remote control unit.

7. Whenever the vehicle is in motion, the panic bar(s) must be "instantaneously" reachable by the machine operator (only); (a) from any reasonable operating position (so that it can be actuated, i.e., pushed in, by the operator's right or left hand), or (b), in the case of a rib pin, so that the operator's body will invariably be driven into the bar, resulting in its actuation. Item 7(b) is a design goal, not an absolute requirement that entails that the panic bar be located so that it will always be between the machine and the operator while the machine is being operated.

8. Generally speaking, (a) the panic bar shall be located just above or below (in a vertical direction) the tram controls, and (b) shall nominally extend the length (or width) of the operator's (tram) work station.

9. The required panic bar design and operational characteristics include:

   (a) In addition to deenergizing tram motors, the actuation of the panic bar must initiate the application of the automatic brakes on all rubber-tired (but not tracked), self-propelled, electric and diesel face equipment that do not have substantially constructed cabs.

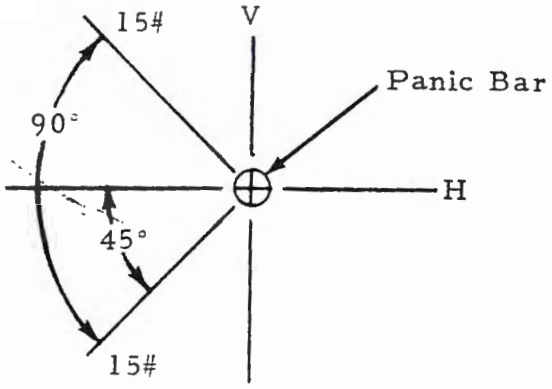
   (b) The panic bar shall not be used to reenergize the tram motors (either by re-actuating the panic bar by pushing inward or, even, by a distinctly different means of actuating the panic bar). A distinct operation and distinctly separate control from the panic bar are required to restart the tram motors.

   (c) Deadman switches, levers, or pedals are not acceptable as a substitute for panic bars.

   (d) Self-centering tram controls cannot be construed as acceptable panic bar substitutes.

   (e) A force, not to exceed 15 pounds, shall operate the panic bar when applied at any point along the effective length of the panic bar.

   (f) The 15 pound load limit shall be applicable to a 90° quadrant, $\pm$45° from the horizontal, and normal to the length of the bar. The horizontal load component shall be a push into the machine and the $\pm$45° components shall permit the operator to actuate the bar by "slapping" it from above or below. (see sketch)



(g) Panic bar travel, from rest to the actuation of the control that will result in machine deenergization, shall not exceed 2 inches.

(h) The shape of the usable portion of the rigid panic bar section that is exposed to the operator shall be round. Cables do not comply with this requirement because they may not be rigid initially or, if taut initially, they may sag with the passage of time.

(i) The panic bar must be located in such a position as to project a minimum of 2 inches beyond any structure and controls within 4 inches of the panic bar, with the exception of one of the switches or controls mentioned in Item 1, in order to permit ready access to the panic bar in an emergency situation, and/or ensure that the operator contacts the bar in the case of a rib pin.

(j) The separation from other controls and structure should be a minimum of 2 inches (from the outer circumference of the usable section of the panic bar), in order to "clear" the other control so that actuation of the panic bar will not cause inadvertent, control commands or impede panic bar actuation. Furthermore, if at all possible, the panic bar should be located a minimum of 2 inches down from the top, and inside the outboard edge, of the machine, in order to avoid inadvertent panic bar actuation by the roof and the rib.

(k) In the event that the requirements of Items 7(a), 7(b), or 8(a), and Item 9(j) conflict, the requirements of Item 9(j) will rule (to the extent of avoiding inadvertent control activation), but will require the panic bar position be optimized to the extent possible.

10. When required, automatic brakes must be applied when:

    (a) the tram motors are deenergized by the panic bar.

    (b) the machine is otherwise deenergized.

Panic Bar Designs

As stated above, there are nine types of panic bars that were defined in our study. The variations are primarily in their construction. The materials that are used in these panic bars are low carbon steels (SAE 1020, 1025), which are either hot or cold rolled, steel pipe (without galvanizing, if welding is to be done indoors or underground), or steel tubing in the form of electrical conduit.

The recommended panic bar designs fall into two categories:

1. Those in which the panic bar actuates the present tram power off switch (principally panic bar types 1, 2, and 3).
2. Those in which the panic bar interfaces with a new tram power off switch (generally panic bar types 4 through 9).

Panic bar types 1, 2, and 3 are designed to be constructed by the mining companies and are intended to provide adaptations to the machine's present tram power off switch. Panic bar types 4, 5, 6, and 7 contain purchasable components that are sometimes used as is or are intended to be modified as shown on the individual panic bar drawings. Panic bar types 8 and 9 are purchasable from Jeffrey Mining Machinery Company and may be obtained with or without a switch. Figures 1 through 9 depict the nine types of recommended panic bars. Our final report to USBM also includes weld assembly and hinge bracket detail drawings for the recommended panic bars.

Panic Bar Installations

The 540 panic bar installation drawings that we prepared for our final report to USBM define a specific panic bar type for each of the 227 models that we studied. Figures 10 through 13 provide examples of the installation drawings that were provided in the final report for each model that was studied. However, there are often significant variations within any one model from a given machine manufacturer and machines are frequently extensively modified by mine operators and/or machine rebuilders. We therefore recommended that it is advisable to determine if a particular machine configuration fully accepts the recommended type of panic bar before proceedings with the installation. With the same basic panic bar action being common to all of the types, the variations between the types are primarily a matter of mechanical expedience.

If one of the other types of panic bar is selected (or if the recommended panic bar type is modified to account for any variations in the construction of an individual machine), the general location designated in the installation drawing should be adhered to so as to ensure the satisfaction of the operational requirements and to provide the desired operator-panic bar interface. During installation, the installer should optimize the precise panic bar position so as

to permit free action of the various machine operating controls. The installation drawings are a guide to panic bar installation, and yet permit some degree of freedom to account for variations in machine design, as well as differences in mine operators' facilities, and materials availability.

Where the panic bar installation requires a new switch be installed, the switch which is to be wired into the machine should be hooked up in accordance with the applicable machine's electrical schematic and/or wiring diagram and the requirements of Bureau of Mines Schedule 2G.

The panic bars may, generally, either be welded or bolted in position. In those instances where panic bars are to be installed in front of valve bodies or starter boxes, it is recommended that bolting be used.

The following guidelines for panic bar installation were suggested:

1. Review the recommended panic bar location with respect to the machine that is to be modified. Check the machine dimensions and the recommended panic bar position to ensure that the machine to be modified will accept the recommended installation. If there is not a proper fit, determine if any interfering machine components can be moved, if any machine structure can be modified, or if any changes in the panic bar dimensions (within the intent of the recommended panic bar position) will correct the situation.

2. Compare the panic bar switch installation electrical schematic or wiring diagram with the schematic or wiring diagram for the machine that is to be modified. The machine may have been modified, which would affect the applicability of the recommended installation.

3. Any one of the nine types of panic bars will satisfy the operational requirements. If a particular installation problem prevents the use of the recommended panic bar type, the selection of a different panic bar type would be appropriate. For example, if a Type 1 panic bar is recommended and an existing component on the machine prevents mounting the hinge bracket in the specified location, the substitution of a Type 2 panic bar will permit relocating the hinge bracket, while still maintaining the recommended panic bar length.

4. Where additional supports have been recommended in the installation of the panic bar in order to improve its position relative to the operator, freedom of material choice is provided. The supports may be pipe, bar stock, angle iron, channel, etc., whichever is most readily available. However, the support must be sturdy and free of sharp edges and corners.

5. The panic bar assembly should be coated with a good grade of metal primer (e.g., zinc chromate) and final finished with red enamel paint that is suitable for finishing metal.

6. When the panic bar installation is completed and all adjustments have been made, the following performance requirements should be met:

   a. Power cutoff should be achieved with 2" or less of panic bar travel.

   b. A force of no more that 15 pounds applied to the panic bar should result in the activation of the tram power off switch.

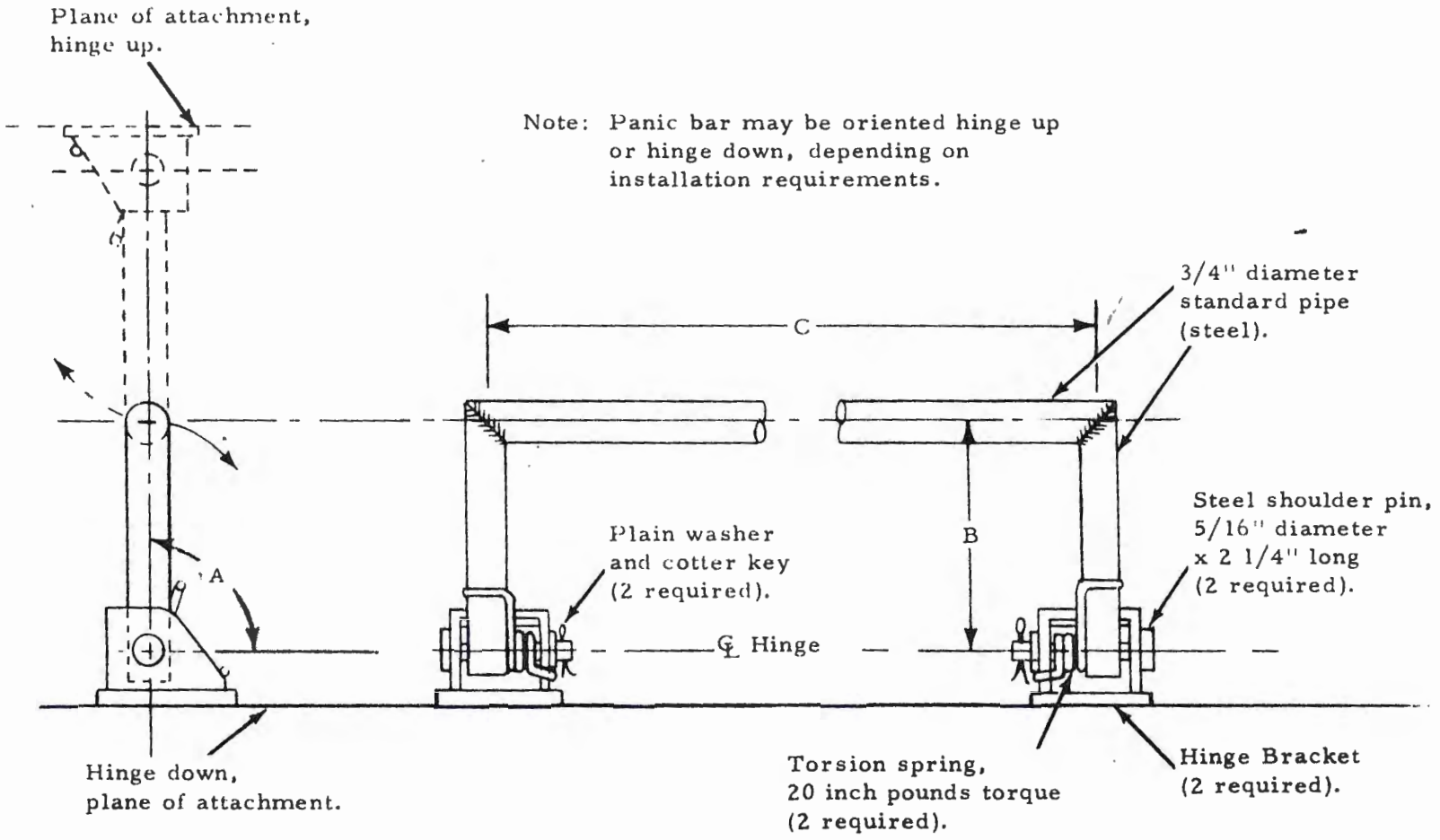


Figure 1 - Type 1 Panic Bar

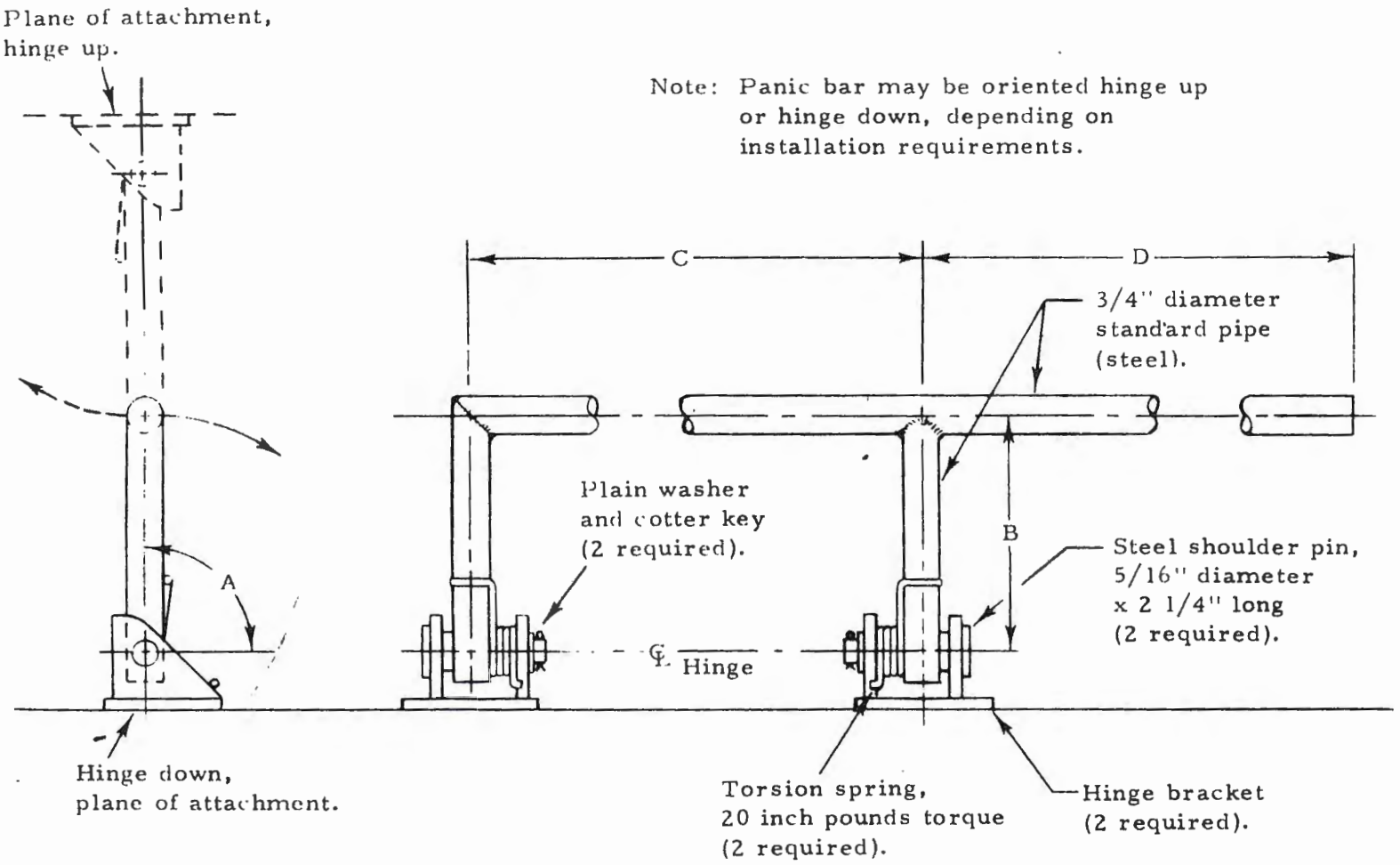


Figure 2 - Type 2 Panic Bar

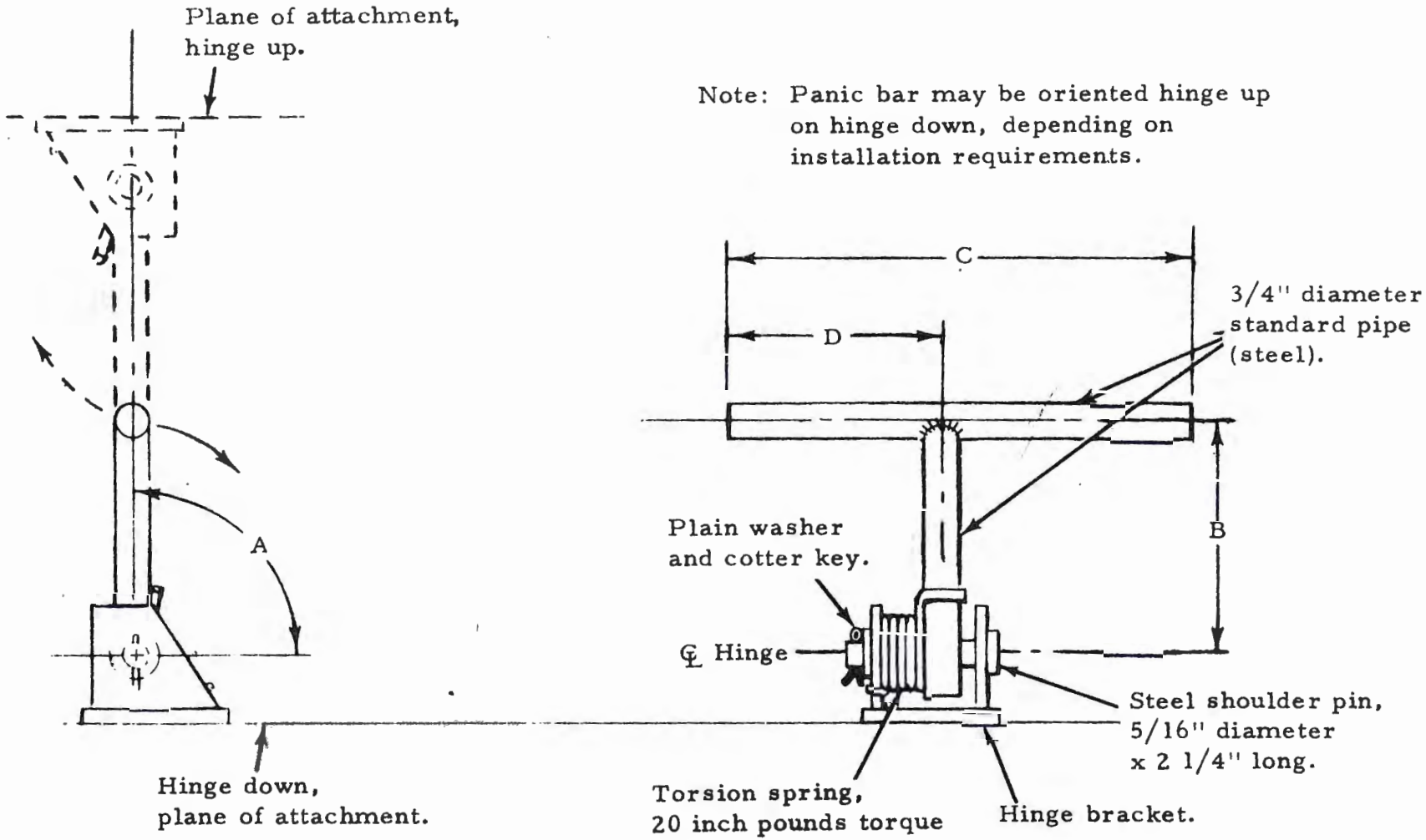


Figure 3 - Type 3 Panic Bar

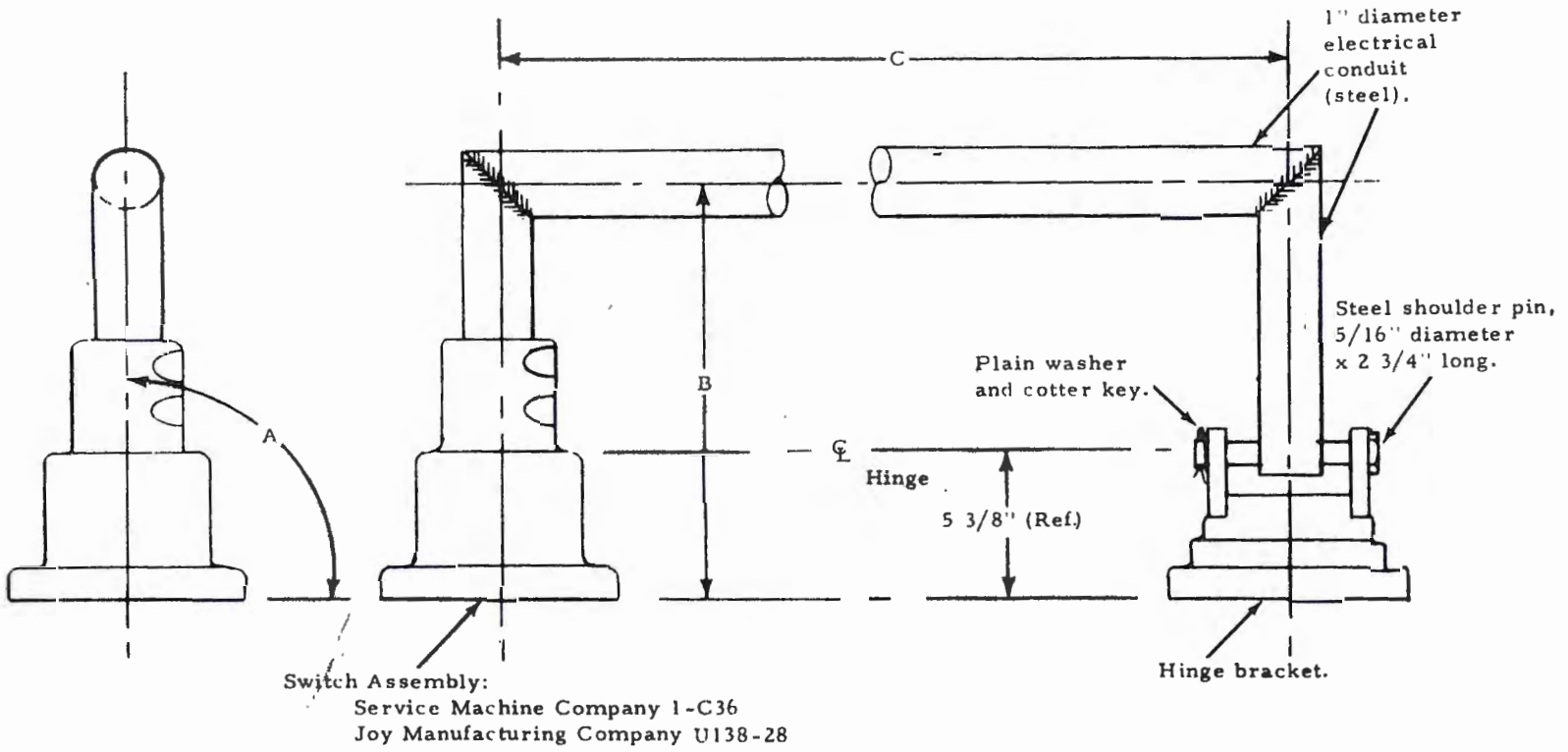


Figure 4 - Type 4 Panic Bar

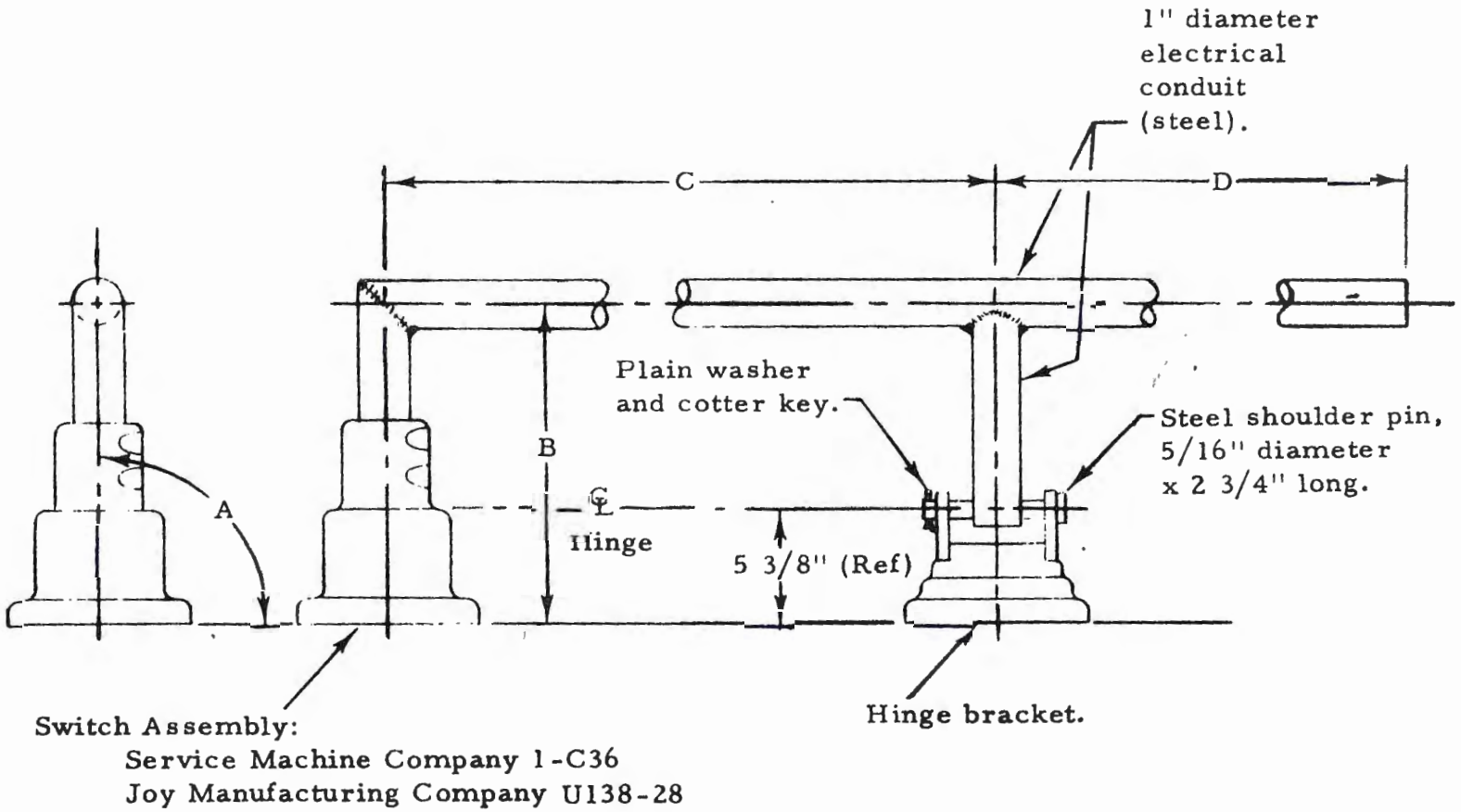


Figure 5 - Type 5 Panic Bar

1. When the assembly drawing calls out a Type 6 panic bar <u>with</u> switch option A-2, order part numbers 42553 and 42329.
2. When the assembly drawing calls out a Type 6 panic bar <u>without</u> switch option A-2, order part number 42553.

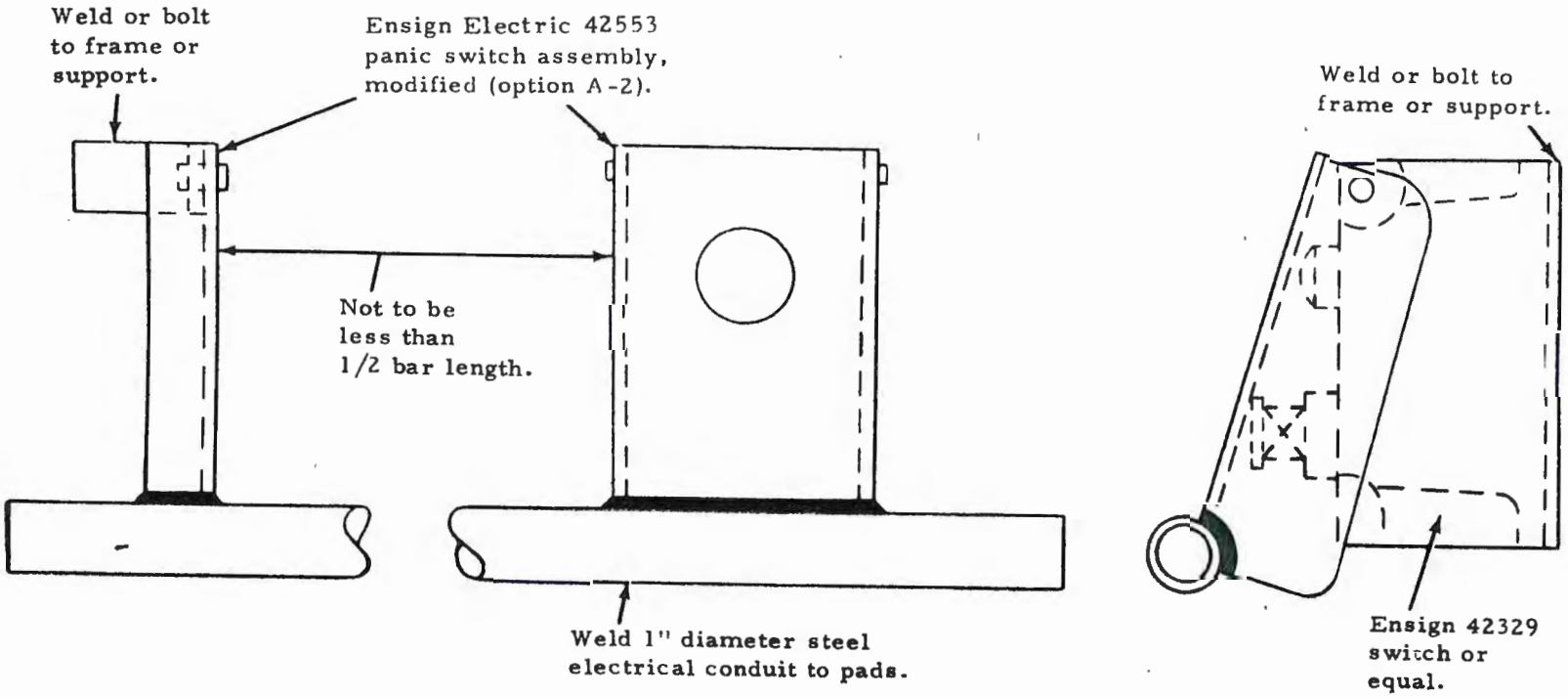


Figure 6 - Type 6 Panic Bar

Notes:

1. When the assembly drawing calls out a Type 7 panic bar with switch option A-2, order part numbers 42553 and 42329.
2. When the assembly drawing calls out a Type 7 panic bar without switch option A-2, order part number 42553.

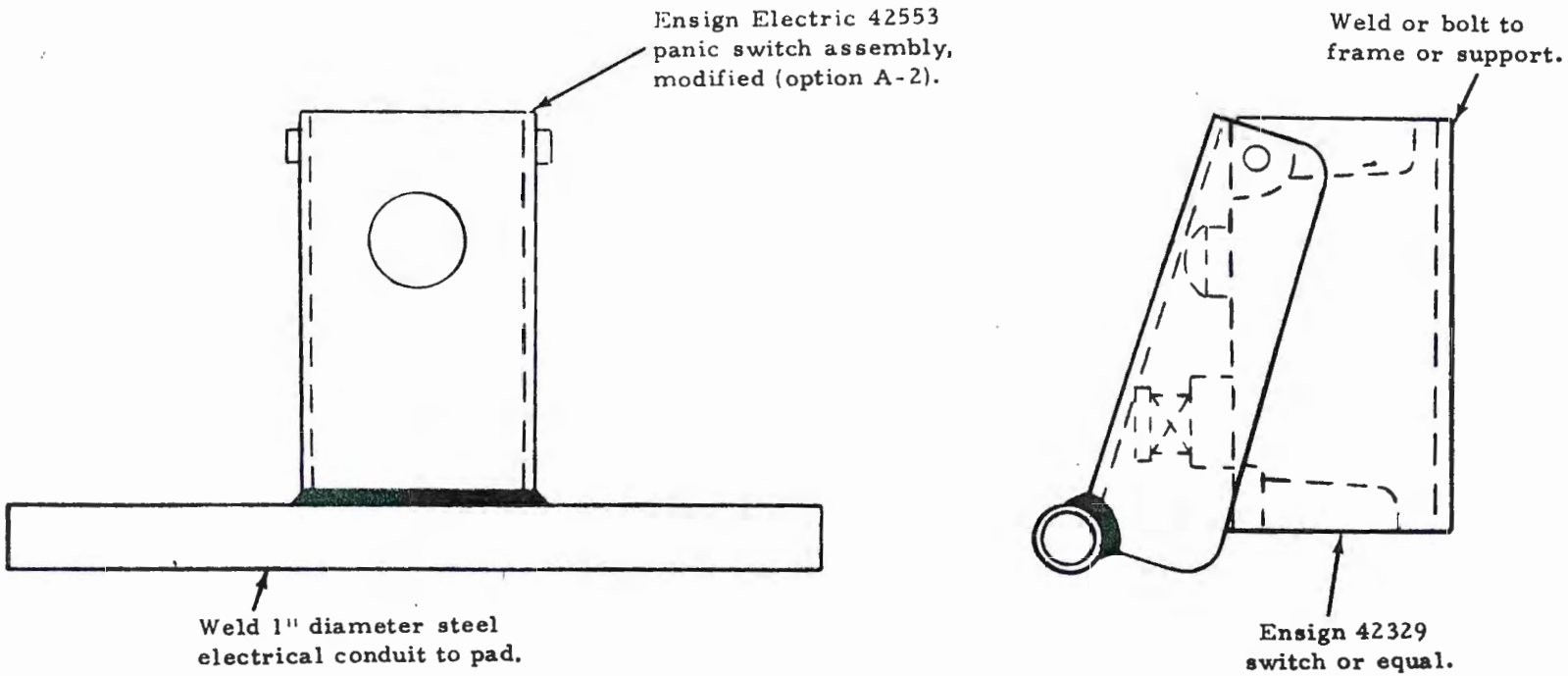


Figure 7 - Type 7 Panic Bar

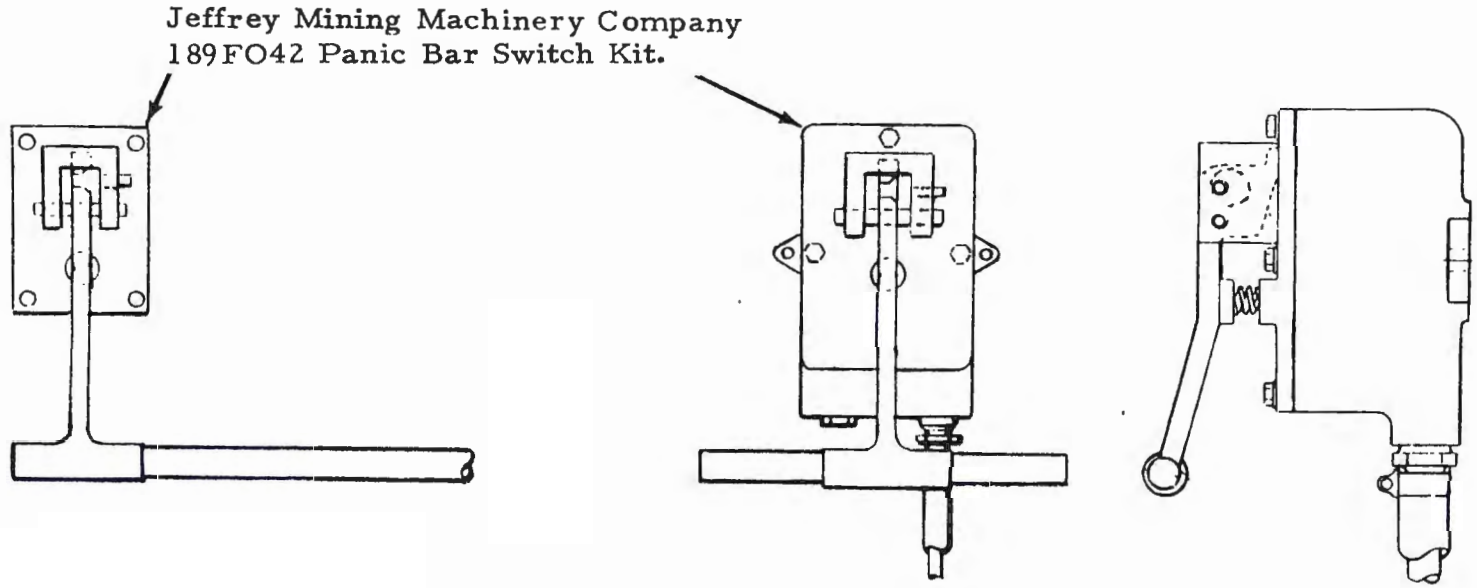


Figure 8 - Type 8 Panic Bar

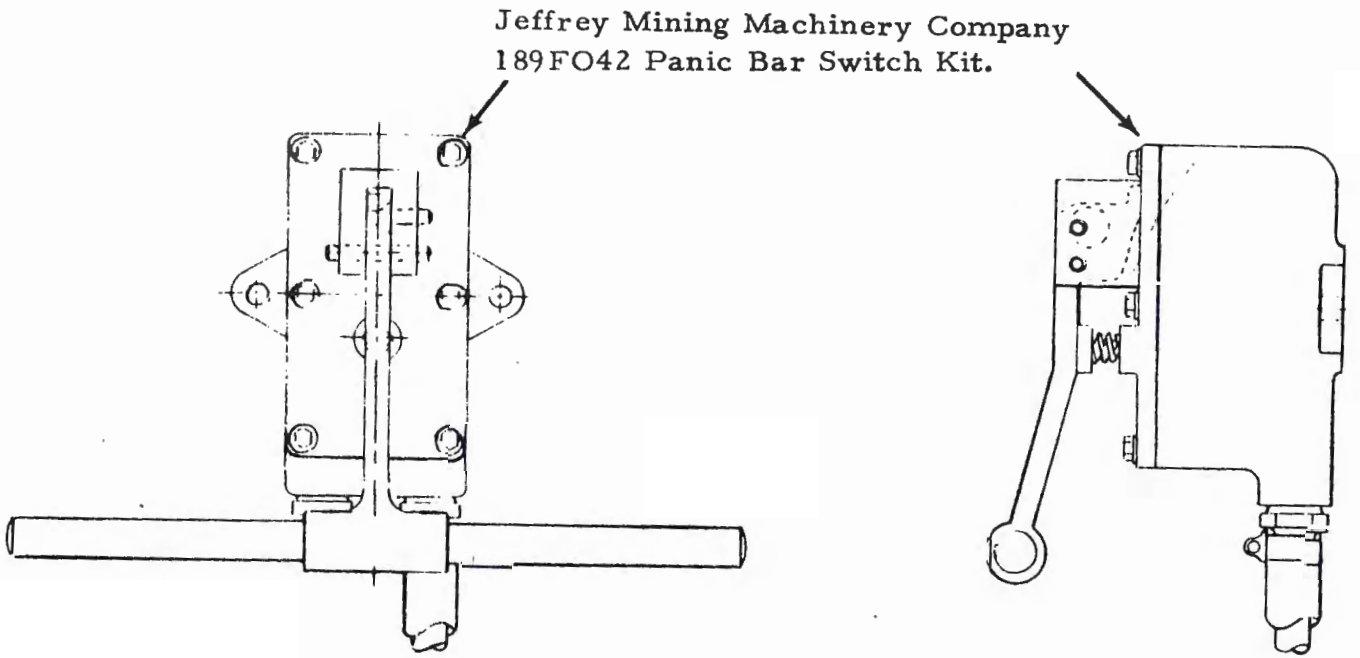


Figure 9 - Type 9 Panic Bar

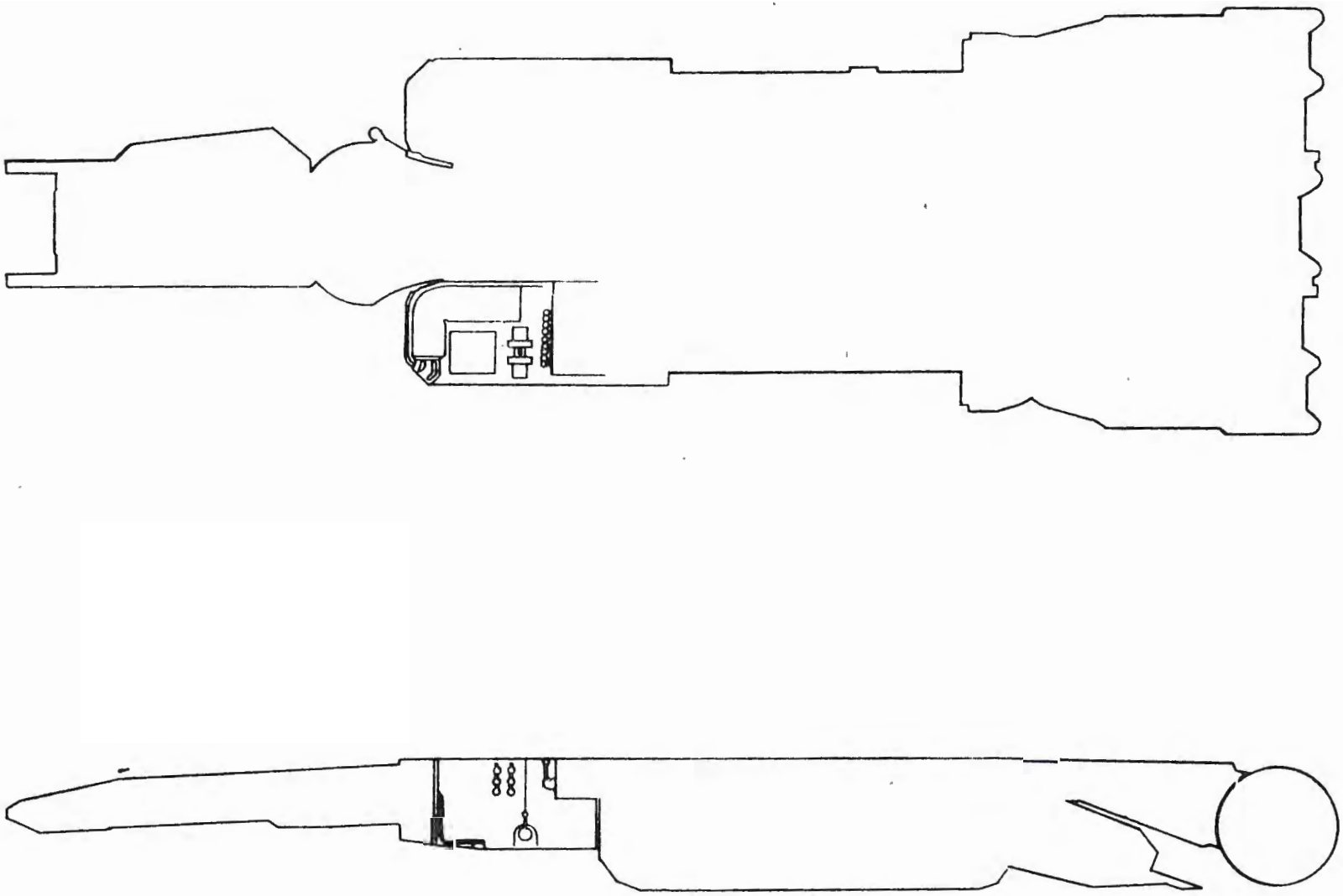
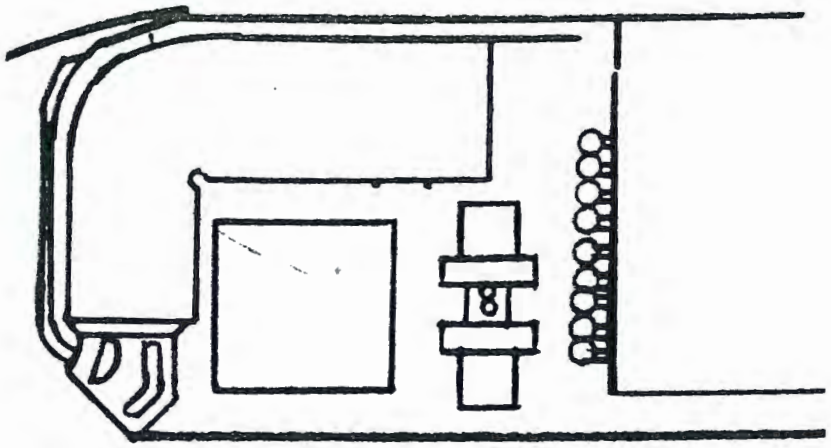


Figure 10 - Machine Layout Drawing for the
Joy 12CM Continuous Rotating Drum Miner



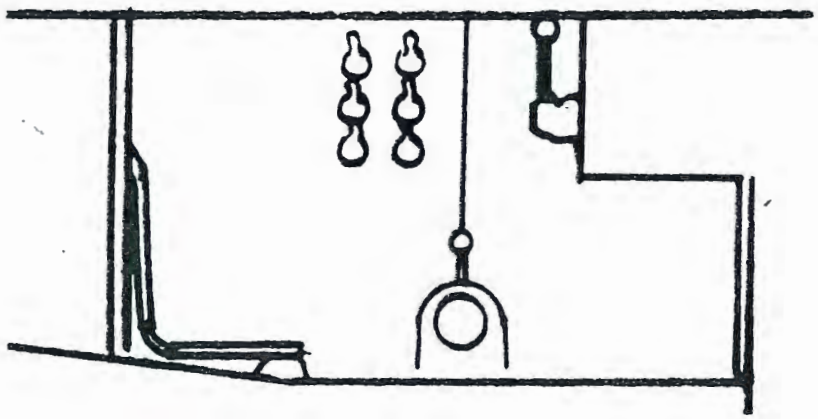
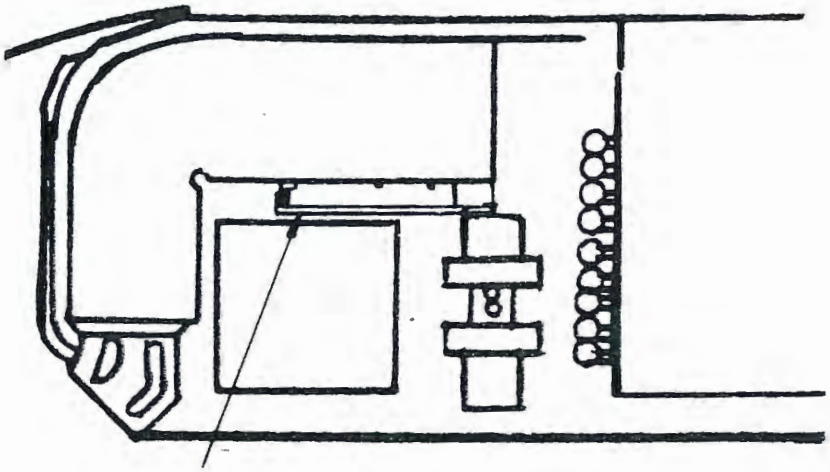


Figure 11 - Operator Station Drawing for the Joy 12CM Continuous Rotating Drum Miner



Type 6 panic bar with switch
option A-2.
Locate hinge down.
Bolt or weld to control panel.
See written instructions.

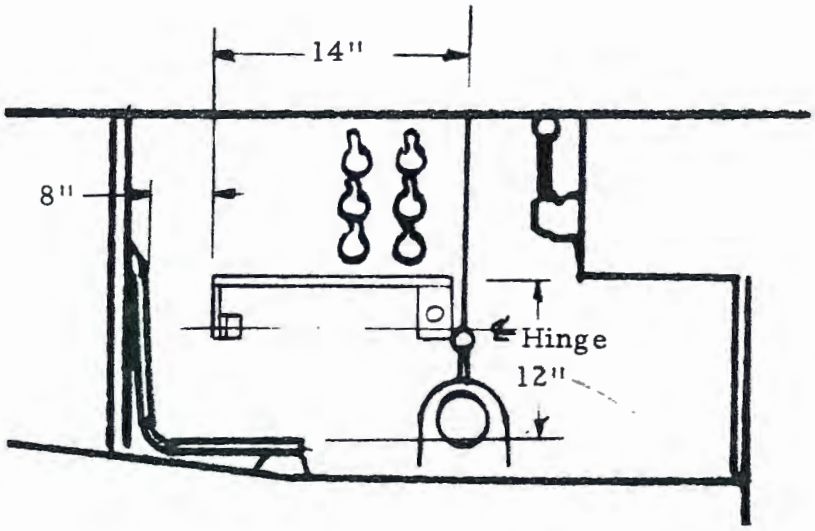


Figure 12 - Panic Bar Assembly Drawing for the Joy 12CM Continuous Rotating Drum Miner

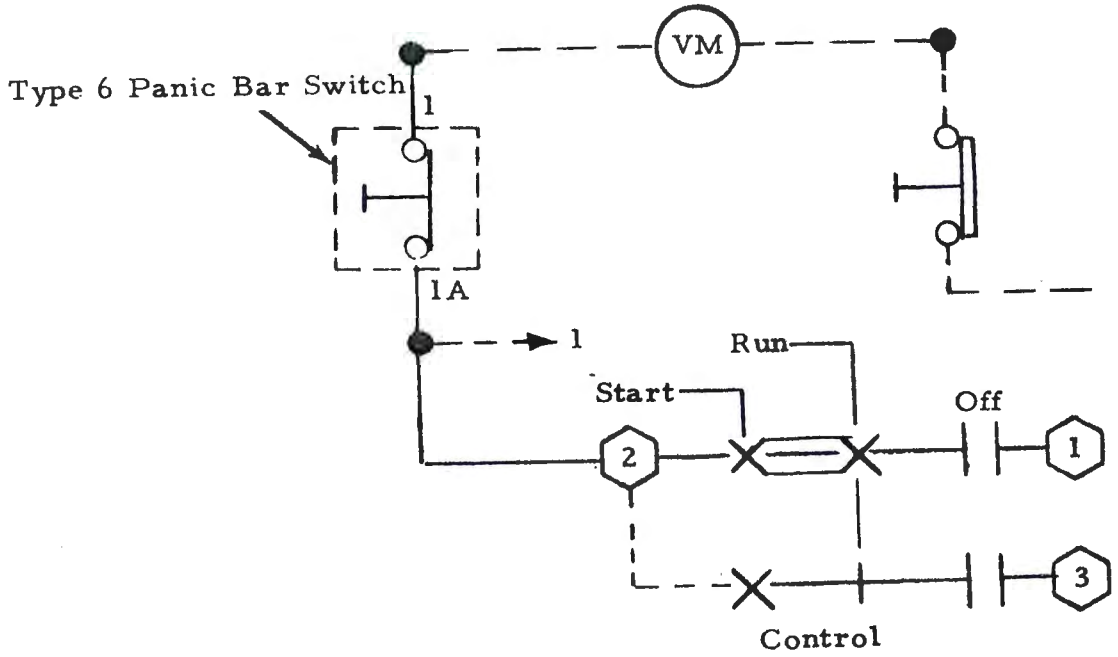


Figure 13 - Panic Bar Switch Electrical Schematic for the Joy 12CM Continuous Rotating Drum Miner

PROCEEDINGS
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