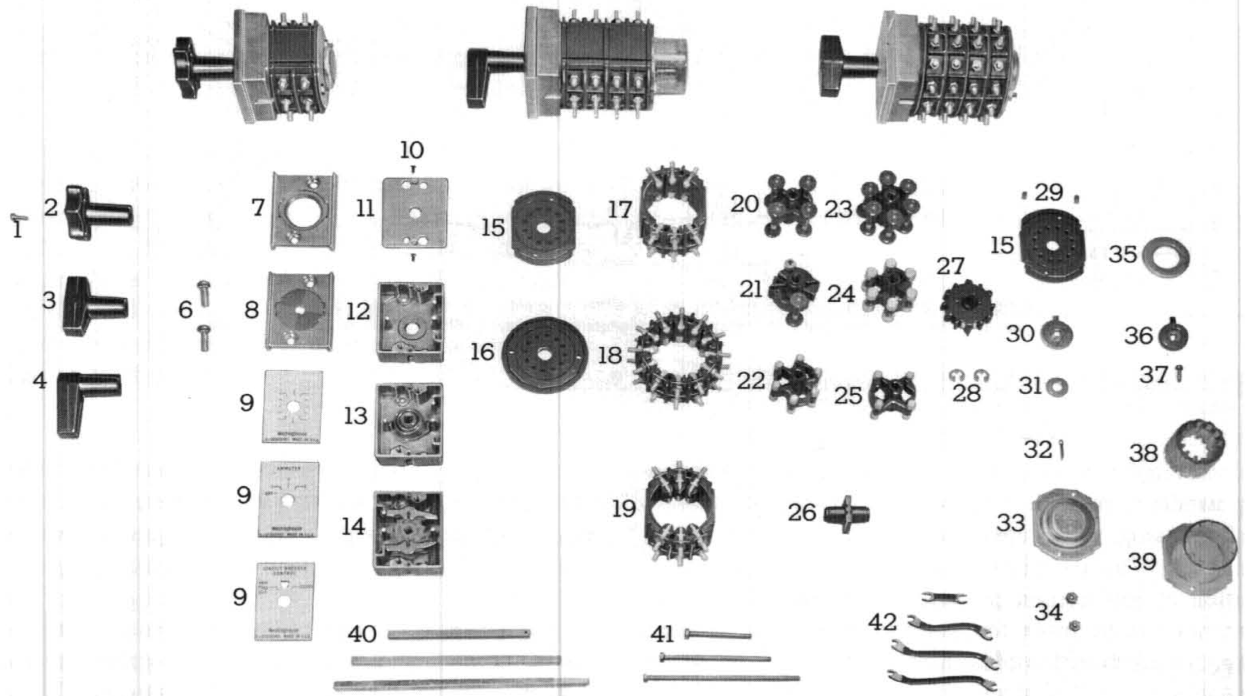
Type W-2 Rotary Instrument & Control Switch



1. handle retaining screw
2. round notched handle
3. oval handle
4. pistol grip handle
6. mounting screws
7. dial plate
8. dial plate with target
9. standard nameplates
10. cover screws
11. control housing cover
12. control housing
13. control housing with spring return mechanism
14. control housing with maintained contact mechanism
15. spacer—half frame (6 contacts)
16. spacer—full frame (12 contacts)
17. frame—6 contacts
18. frame—12 contacts
19. frame—with 6 normal closed contacts
20. rotor—standard 4 roller contacts
21. rotor—1 slip contact and 1 standard contact
22. rotor—6 roller ammeter contacts (used with normally closed contacts)
23. rotor—standard 6 roller contacts
24. rotor—standard 6 roller overlap contacts (make before break)
25. rotor—4 roller ammeter contacts (used with normally closed contacts)
26. rotor—operating lever to open normally closed contacts
27. rotor—pull contact
28. retaining rings for item 27
29. stop pins
30. stop
31. spacer
32. cotter pin
33. end cover—rear
34. nuts for tie bolts
35. stop pin cover
36. pull slide lever
37. pull guide screw
38. pull guide
39. pull cover
40. shafts
41. tie bolts
42. connectors

Fig. 1 *Standard Design W-2 Switches*

DESCRIPTION

The type W-2 is a rotary switch for instrument and control applications. It is used to transfer meters, instruments, and relays and for the control of electrically operated circuit breakers, small motors, and control systems.

The W-2 switch is designed for both current and poten-

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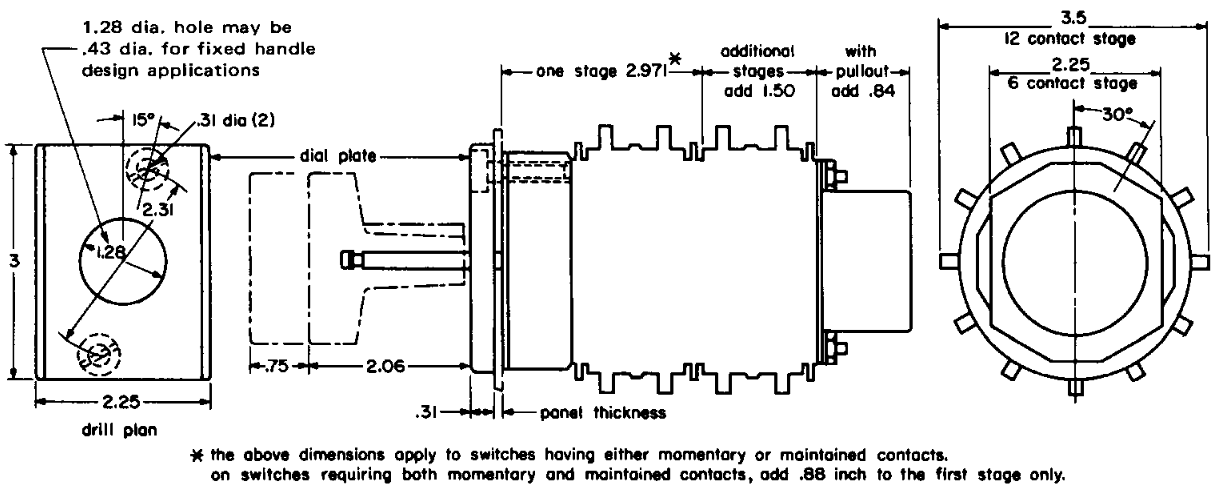

Fig. 2 *Drilling Plan & Outline Dimensions of Standard W-2 Switches*

tial circuitry with contacts making and breaking as operating handle is rotated. Also available are contacts making and breaking when operating handle is pulled out or pushed in. This lateral movement can be arranged for operation at just certain positions or at all positions. All switches can be made for maintained contacts, momentary, or a combination of both.

CONSTRUCTION

Figure 1 shows a general layout and the interchangeable parts that comprise the standard design of W-2 switches. Along with the pictorial view is the identification nomenclature of parts and assemblies.

The W-2 switch consists of an operating handle, face plate, control housing, and contact frame. It is built up in any number of stages from 1 to 9 and clamped together by 2 tie bolts to the control housing. A common steel operating shaft ties the contact rotors together. A metal cap is on the rear to hold the position stop pins, to retain shaft, and to give switch identification. For push or pull switches, the metal cap is replaced by a polycarbonate cap that houses the pull out mechanism. Several control housings can be added to switches for increased momentary or maintained loads or for combination of both.

Two contact frames are available: (1) One with 6 contacts, 3 sets on top at 11, 12, and 1 o'clock locations, and 3 sets on bottom at 5, 6, and 7 o'clock locations, and (2) the other with 12 contacts each set at the 12 positions of a clock. The contacts for standard applications are between terminals front and rear. Both housings are made of glass polyester insulating material.

A stage of contacts consists of a frame (either 6 or 12 contact) and a rotor inside. Switches are usually described as so many stages long. A standard stage can have 6 contacts or 12 depending on the frame size used.

The rotors are standard in design to hold the roller contacts. Each rotor is made of glass polyester insulating material; it rotates independently between the stage spacer plates. The roller contacts are made of bronze material and silver plated. The contact springs are made of stainless steel.

The head of the terminal screw is the contact face and is silver plated bronze material. The polycarbonate windows that hold the terminals in place also serve to lock the terminal nut.

The control housing is aluminum die cast and shaped to house either the positioning starwheel or return spring. The starwheel is standard for 30° throw between positions and shaped to provide positive positioning to prevent stopping between positions. It is made of texin composition. The stainless steel return spring is double wound and is shaped to fit on a die cast retainer; the projection pins on the housing produce the return action with the spring ends.

Three molded phenolic composition handles are available in the shapes of oval, pistol grip, and round. The nameplate is a molded white cycolac ABS material upon which are hot press stamped markings as required. The dial plate is aluminum die cast and seats the mounting screws and holds the nameplate. The nameplate snaps onto the dial plate and covers the mounting screws. The double prong stop pins under the rear cap are adjustable and can be placed in different holes to change number of consecutive switch positions.

CONTACT MARKING

Each terminal on frame has its own identification. Beginning at front of switch the terminals are in bands around the frame, the first band being A, the 2nd B, the 3rd C, etc, continuing alphabetically to rear. The rows of terminals at the rotary positions from front to rear are the same marking as those on a clock: 12, 1, 2, etc., around the dial. Therefore, terminal at row 12 and second band back is B12; terminal at 5 o'clock location, 4th band back is D5. A standard contact at 11 location is A11-B11, at 12 location is A12-B12, etc. Refer to switch style drawing for specific switch tabulation.

MOUNTING

The switch is designed for panel mounting. It can be made for any panel thickness desired. Basic switch styles ending in G01 are designed for 1/8"-3/16"-1/4"-1/2" panel thickness, those ending G02 are for 1"-1-1/2" panel thickness, and those ending G03 are for 2"-2-1/2" panel thickness. Figure 2 shows the drilling plan and outline dimensions of standard W-2 switches.

COVERS

Special protective covers are available for enclosing the terminal studs as well as entire switch. These covers are made of black polyethylene material and are fastened to switch at the rear tie bolt studs allowing the rear caps of switch to protrude through a hole in cover; the covers are supported at front (panel end of switch) by a special u-shaped cover on mechanism box. 2 designs are available: one for 6 contact frame and other for 12 contact frame switch. The cross-section dimensions of the 6 contact frame cover are 4-15/16 high x 2-3/4 wide and the 12 contact frame cover are 4-15/16 high x 4-15/16 wide.

RATING

The switch is rated 600 volts 20 amps continuous. Interruption rating depends on voltage, current, inductance of circuit and life of contact. Interruption values of potential contacts are as follows:

Voltage	Inductive Current Amperes			Non-Inductive Current Amperes
	.01H	.10H	.21H	
115 A-c			30	60
230 A-c			20	30
600 A-c			8	15
125 D-c	6	3	2.4	8
250 D-c	1.7	1.3	1.1	1.8
Using 2 contacts in series				
125 D-c	20	10	5	28
250 D-c	8	4.5	3.3	9.5

The limitation between adjacent terminals is the common roller for both contacts. Higher interruption can be obtained by not using 2 adjacent terminals. In addition 2 contacts or more in series will produce greater interruption of current where desired.

INSTALLATION

For panel mounted switches, holes are provided on panel per drilling plan Fig. 2. A drilling template is provided on envelope containing dial plate and cover with each switch.

Upon opening carton containing switch it will be noted that switch is not completely assembled. The carton will contain a basic switch with 2 mounting screws partially screwed in mechanism box, an envelope containing dial plate assembly and drilling template, an envelope containing terminal hardware, an envelope containing handle hardware, a handle, and an envelope containing face plate in plastic folder, terminal connectors for external wiring, and a drawing of switch position tabulation, connector instructions, and wiring diagram. In lieu of last envelope some cartons may have these items loosely furnished.

Before mounting switch on panel put connectors on switch per table instructions on drawing furnished. The number in bill of material after word connectors gives approximate length of connector between hole centers; this is for proper identification of part. Use nuts from envelope containing terminal hardware.

The tabulation drawing accompanying each switch should explain the contacting and application of switch. The style number in upper left corner of drawing is the complete switch number and consists of the items listed in bill of material at upper right corner. The basic switch number is always 100 units lower than complete number and is the switch minus handle, face plate, connectors, and any other extra parts. Where the X note to left of basic switch number is not crossed off, refer to bottom of bill and note states: "put stop pins on locations Nos__,__." Where stop pins must be changed from basic switch design, numbers will appear. This requires the removing of the rear plate and nuts and moving the pins to the corresponding numbered hole locations appearing on back insulating plate. Some nameplates are printed and some are typed. Where the Y note appears, the blank plate is typed per the chart at the right center section of drawing. Plates received will be typed per chart. Printed plates will be as shown on face plate picture in upper right corner of drawing. This drawing also gives reference to the switch description and outline drawing.

Diagram terminal arrangement has been set up showing top terminals rear view looking directly down on switch and bot (bottom) terminals rear view looking down and through the switch. Thus on 6 contact stages, the top terminals are 1-12-11 for each band and bottom terminals are 5-6-7 for each band. For the 12 contact state, the top terminals include the ones on the horizontal and are 3-2-1-12-11-10-9 while the bottom terminals are 4-5-6-7-8 for each band.

To mount switch, remove mounting screws; hold switch in place behind panel and insert mounting screws through the dial plate into mechanism housing tapped holes and tighten. Remove paper face plate from plastic cover and place inside of plastic cover, push bottom lip on dial plate and snap top lip of cover onto dial plate. Use handle screw and two 1/16" thick spacers for mounting handle on 1/4" thick panel; omit both spacers for 1/8" mounting. Fasten handle on end of shaft with screw and spacers as required.

The target, when supplied, is furnished completely assembled in the dial plate. Care should be exercised when assembling with switch so that target does not become disengaged from dial plate. Two springs are furnished; should one be lost, the target will function properly with only one.

For removable key handle switches the above instructions apply except no handle screw is furnished as this is with the assembled removable key handle, and the key bearing itself projects through the dial plate cover.

OPERATION

The type W-2 switch is a rotary roller action switch. Rotation of shaft causes the rotor rollers to roll from one set of stationary contacts to another. The stationary terminals are fixed by location on the stationary frame. The number of roller contacts can vary from 1 to 6 depending on the number of rotary positions required for the switch application. Each roller contact moving radially is held in rotor arm guided by a slot in the arm and pushed outward by spring pressure. Between roller and spring is an insulated spring seat to reduce friction and wear. On standard potential contacts, an insulated wheel is used on both ends of roller contact for rotating on stationary frame. They reduce friction load of roller spring in riding up on stationary contact and produce a longer air gap by breaking contact quicker.

Over-lapping contacts are obtained simply by increasing the diameter of the roller shorting bar. At mid position, the roller spans the space between the stationary contacts. In addition, a special assembly of a normally closed contact is furnished for current circuits only. This contact operates opposite from standard contacts in that it opens instead of closing at each position as handle rotates. The contact assembly is mounted between front and rear terminals at each position on stationary stage and consists of a shorting bar across the two terminals and held closed by spring pressure. The rotor is simply a rotating arm that pushes the shorting bar away from the 2 terminals. Thus when the arm is not actuating the switch assembly, the contact remains closed. Along with this contact in another stage regular rollers are used that are larger than standard, but not large enough to overlap two adjacent terminals. For identification, these roller contacts are specified as ammeter contacts. They do overlap the normally closed contact so that before normally closed contact opens, these contacts close. Therefore, if a current circuit were put into a normally closed contact and if each side of this contact were connected to one terminal of the ammeter contact whose other terminal is connected to an ammeter or any other current device, then a current would be transferred at a position when normally closed contact opens. This circuit is independent due to the fact the ammeter contacts of 2 adjacent positions are not closed simultaneously at some mid position of switch rotation.

On 3 position switches, slip contacts are available. These are contacts that close when switch is turned to right position and remain closed after operating handle has returned to center position; the contacts open when handle is turned to left position and remain open upon return to center position. These contacts require a special rotor assembly such that the roller contact seats itself between 2 stationary contacts. The rotor assembly is in 2 parts: one moving with shaft, the other free from shaft. Stops on moving part pick up the free moving part after a delay of approximately 33° rotation and move the rollers to lodge between next adjacent stationary contact. This means after rotating to 30^{o} position on one side of center, contact will not move till rotor is turned back to center and 3^{o} further on the other side of neutral. In one standard slip assembly, a forward and reverse slip contact is obtained with a common terminal between them.

In addition to rotary motion, the W-2 switch has lateral movement (push-pull). Spring actuated roller contacts are housed in waffer housing fastened on shaft by E-rings. Only push or pull movement will move the housing. The roller contact spans 2 adjacent terminals on a band and it moves back or forth between 2 bands or terminals in a stage. The mechanism allowing the lateral movement is assembled at rear of switch in a clear polycarbonate cover. The cover holds a guide piece in which is a slot or slots to receive the arm on end of shaft. Lateral movement can only occur when arm and slot match. The numbering on guide piece indicates the position where the pull out of handle occurs, namely, positions 1 to 12. When the numbering is 13 to 24, the switch is push in (pull out to rotate) and the location of push position is the marked number less 12.

End position stops on the W-2 switch are obtained by 2 pins on rear stage spacer. To see these pins, remove nuts on tie bolts, pull cover, and directly exposed are the pins. The numbering has meaning for the end positions on face plate: CCW rotation (F.V.) the stop pin number is same as position, CW rotation it is 1 hole beyond the position. For a 3 position switch with position locations at 11, 12 and 1, the pin is put in hole 11 and 2.

MAINTENANCE

In general, no maintenance program is necessary. However, those circuits where strong arcing may occur, the switch should be examined for wearing and pit marks and dressed with a fine file where minor damage has occurred. Replacement of stationary contact or roller contact is recommended where bad errosion has occurred.

REPAIR AND REPLACEMENT

Stationary contact can be removed from contact housing without dismantling entire switch. Simply unscrew nut on terminal, lift the clear polycarbonate window, push terminal to outside of stage and pull out. It is easier to do if contact roller is not making contact with terminal being removed. To replace terminal, put window and nut on terminal, insert terminal head in larger hole and slide into smaller hole; tighten nut.

Caution: **Do not remove terminal screws from the normally closed contact housing. Doing so will allow the entire mechanism to fall apart. Switch should be taken apart to repair this mechanism.**

Replacement of return spring or star-wheel assembly is done simply by removing cover on mechanism housing at front of switch and pulling out parts. The return spring is assembled on a spring retainer; to remove simply release spring arm from retainer ears. To assemble, put small turn spring arm in retainer ear, and pull large turn spring arm into opposite retainer ear.

The rotors are removable only by dismantling the switch. Remove tie bolt nuts, rear cap, cotter pin on end of shaft, washer, end stop bearing, and end stage spacer in respective order. The full stage (frame & rotor) can then be pulled off rear of switch. Rollers can be removed from rotor by removing actuating spring allowing roller and spring seat to drop out of slot into center of rotor frame and slide out of large hole between the slots of the frame.

GENERAL INSTRUCTIONS

Shaft lengths are standard for 1/8, 1, or 2 inch panel mounting. To fit properly handle's tips should come within 1/16" of face plate cover. As the panel thickness increases, the handle is pushed outward on shaft by inserting spacers between shaft end and handle to suit mounting. Two 1/16" thick spacers are furnished standard with handle hardware.

Blank Nameplates are obtainable for stamping or engraving any special markings desired. The manufacturer uses a hot press stamping machine for making special markings. Blank nameplates are available in white color (standard) or in black, red, green, yellow and blue.

Terminal Stud Length has been standardized at 3/4" length. 1" or longer length can be used but this will require special ordering and longer delivery time. The standard terminal with 8-32 threads allows 5/16" length for mounting and securing wires to the switch.

Terminal Wiring permits the use of a flat strap jumpers or wire jumper with flat ring indent type terminal and one wire using eyelets and crimp terminal combinations. When the connecting wires are equipped with flat ring tongue indent, stake-on, or crimp type terminal, then 2 wires should be the limit to terminal or 3 wires if no jumpering is required. Standard hardware furnished is one brass tin plated nut.

Terminal Jumpers furnished standard for external wiring of switches for specific applications are of 2 types (1) flat copper straps with insulating tubing and (2) #14 insulated wire equipped with plastic sleeve flat ring indent type terminals. Adjacent terminals are connected with flat copper straps un-insulated. Insulated copper strap jumpers are used to connect alternate terminals, diagonal terminals or alternate diagonal terminals. All other jumpers are wire type with terminal lugs. For specific detail information refer to Westinghouse drawings 677C526 for 6 contact stage switches and 677C527 for 12 contact stage switches.

Additional Stages can be added to switches by changing the shaft and tie bolts. The added length to each per stage is 1.5 inches. It is recommended that new switches with additional contacts be manufactured at the factory to insure proper assembly and working requirements.

Contact Flexibility of the W-2 switch is due to the standardization of the internal contacting of the switch resulting in more contacts available for various combinations. The contact terminals externally can be jumpered to obtain sequences as may be needed. To obtain a contact made in two positions, 2 contacts must be jumpered in paralled. To have one made in 3 positions, 3 contacts must be jumpered in parallel. Each contact on the switch is an independent contact - the only exception being slip contacts which use a common terminal between a slip trip or slip close contact. Pull contacts are independent make or break doing so when rotor is moved laterally regardless of rotary position. When 2 pull positions are required and a separate contact make or break in both, then the pull contact and rotary contact at the position must be jumpered in series. In general, the switch required for an application is determined by knowing the number of positions and the number of closures in each position; the lower the number of positions, the greater the flexibility of contacts.

RECOMMENDED SPARE PARTS LIST

Rather than make exact lists of spare parts for individual switch styles, standard kits are available for general use.

1. Standard Repair Parts Kit S#793A828G01
2. Mechanism Box Parts Kit S#499A432G01
   a. Starwheel Kit S#499A432G02
   b. Return Spring Kit S#499A432G03
3. Rotor Parts Kit S#499A433G01
   a. Std. Contact Kit S#499A433G02
   b. Overlap Contact Kit S#499A433G03
   c. Ammeter Contact Kit S#499A433G04
   d. Slip Contact Kit S#499A433G05
   e. Pull Contact Kit S#499A433G06
   f. Normally Closed Contact Kit S#499A433G07
4. Pull Assembly Parts Kit S#499A434G01