

Sept. 22, 1959

S. LAPIDUS ET AL

2,905,910

WAVEGUIDE SWITCH

Filed July 12, 1955

4 Sheets-Sheet 1

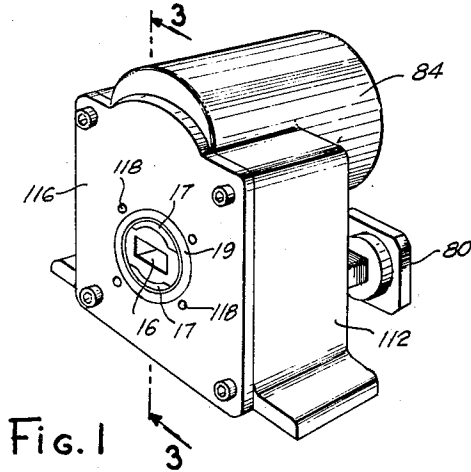


Fig. 1

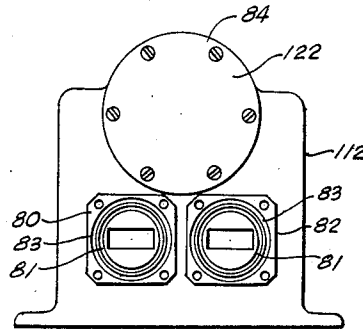


Fig. 2

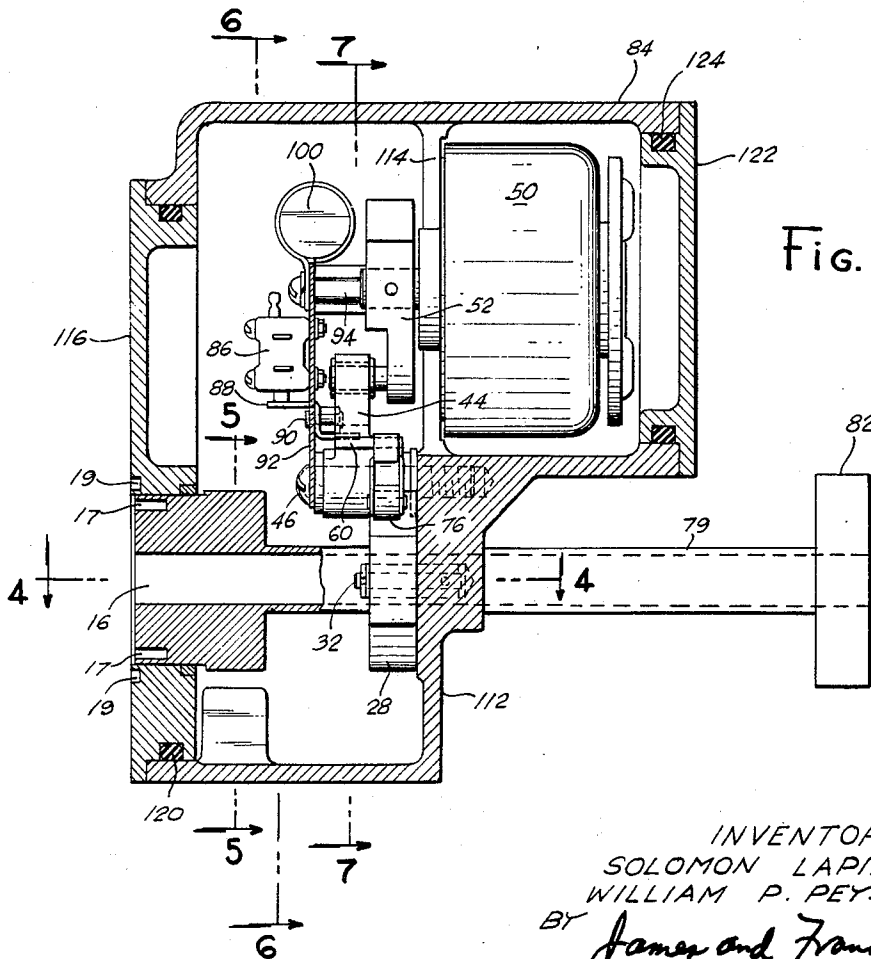


Fig. 3

INVENTORS.
SOLOMON LAPIDUS
WILLIAM P. PEYSER
BY *James and Franklin*
ATTORNEYS.

Sept. 22, 1959

S. LAPIDUS ET AL
WAVEGUIDE SWITCH

2,905,910

Filed July 12, 1955

4 Sheets-Sheet 2

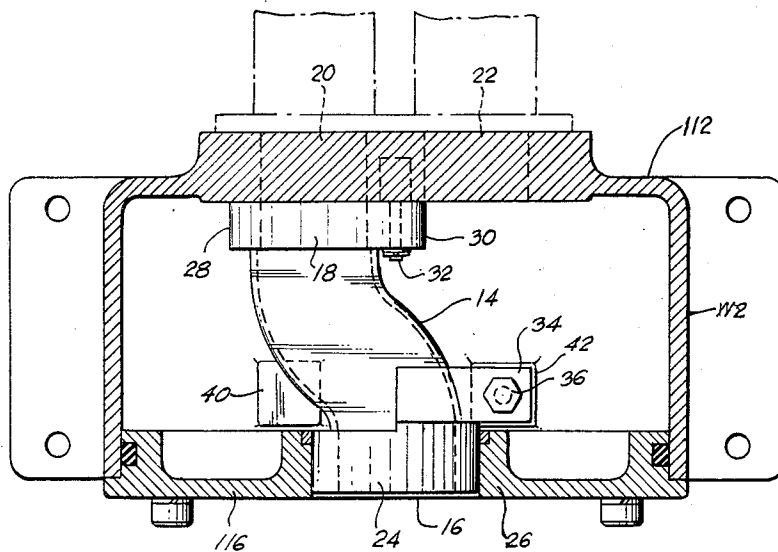


Fig. 4

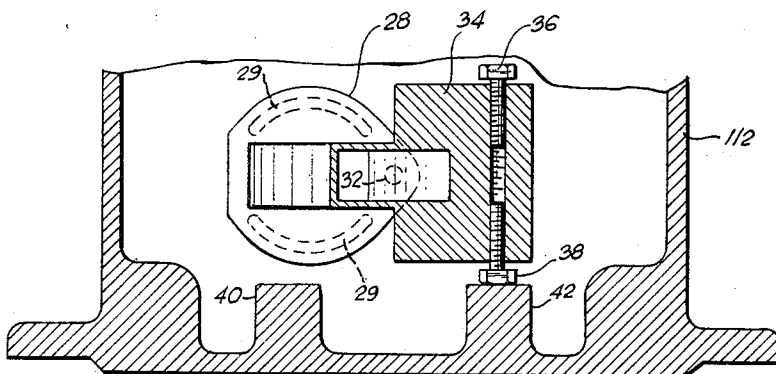


Fig. 5

INVENTORS.
SOLOMON LAPIDUS
WILLIAM P. PEYSER
BY *James and Franklin*
ATTORNEYS.

Sept. 22, 1959

S. LAPIDUS ET AL

2,905,910

WAVEGUIDE SWITCH

Filed July 12, 1955

4 Sheets-Sheet 3

Fig. 6

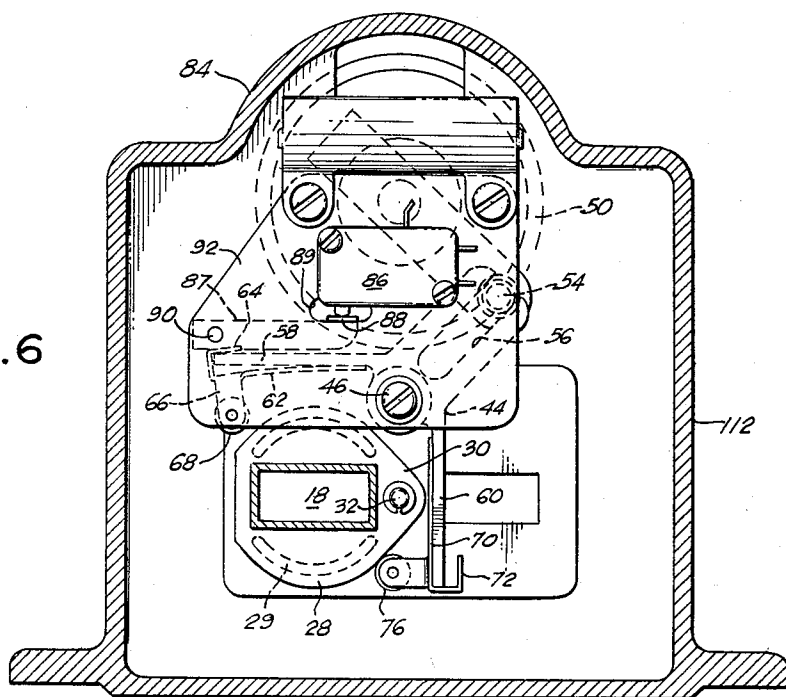
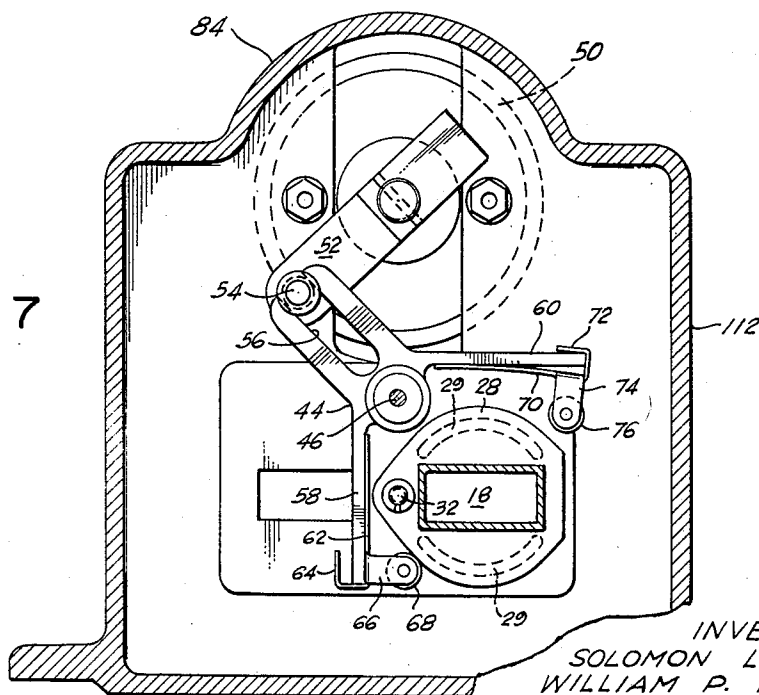


Fig. 7



INVENTORS.
SOLOMON LAPIDUS
WILLIAM P. PEYSER
BY *James and Franklin*
ATTORNEYS.

Sept. 22, 1959

S. LAPIDUS ET AL

2,905,910

WAVEGUIDE SWITCH

Filed July 12, 1955

4 Sheets-Sheet 4

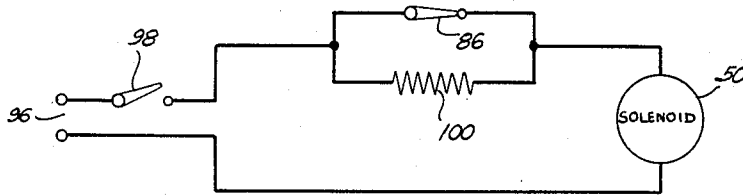


Fig. 8

Fig. 9

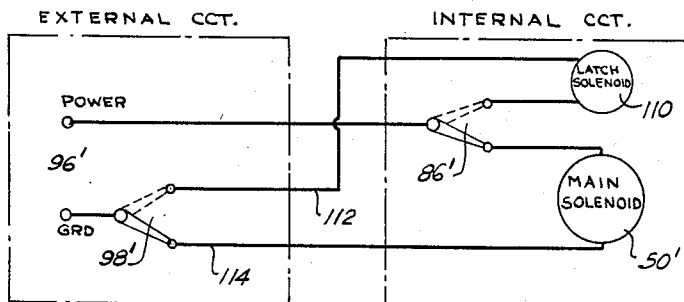
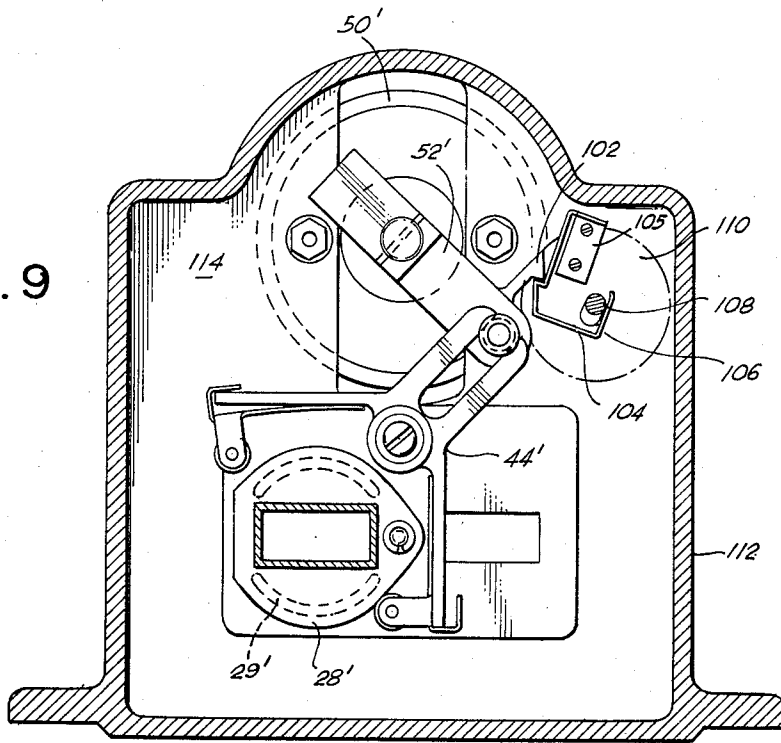


Fig. 10

INVENTORS.
SOLOMON LAPIDUS
WILLIAM P. PEYSER
BY *James and Franklin*
ATTORNEYS.

1

2,905,910

WAVEGUIDE SWITCH

Solomon Lapidus, Flushing, and William P. Peyser, Valley Stream, N.Y., assignors to Bogart Manufacturing Corporation, Brooklyn, N.Y., a corporation of New York

Application July 12, 1955, Serial No. 521,499

15 Claims. (Cl. 333—98)

This invention relates to microwave systems, especially waveguide plumbing, and more particularly to a switch therefor.

The primary object of the present invention is to generally improve waveguide switches. More particular objects are to provide a waveguide switch which is compact, fast in operation, dynamically balanced, and which has a good isolation and a low voltage standing wave ratio.

A further object is to provide a waveguide switch the relatively movable or internal flanges of which are flat, thus simplifying manufacture of the switch. Another object is to make possible parallel outlets which are close together. Another object is to provide a switch requiring oscillation for only 180°, and permitting use of positive stops accurately limiting the motion at each end.

Further objects center about the motor mechanism to operate the switch under remote control. In one form we employ a rotary solenoid and improved linkage between said solenoid and the movable part of the switch. Additional means are provided to reduce the energization of the solenoid when left energized. In a modification we provide a latch and a latch solenoid, and both solenoids may be wholly de-energized except when actually shifting the waveguide switch.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, our invention resides in the waveguide switch elements, and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings, in which:

Fig. 1 is a perspective view of a waveguide switch embodying features of our invention;

Fig. 2 is a rear end view of the same showing the outlet flanges;

Fig. 3 is a longitudinal section taken approximately in the plane of the line 3—3 of Fig. 1;

Fig. 4 is a horizontal section taken approximately in the plane of the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary vertical section taken approximately in the plane of the line 5—5 of Fig. 3;

Fig. 6 is a vertical section taken approximately in the plane of the line 6—6 of Fig. 3;

Fig. 7 is a vertical section taken approximately in the plane of the line 7—7 of Fig. 3;

Fig. 8 is a wiring diagram for the control circuit;

Fig. 9 is a section generally similar to Fig. 7, but showing a modification; and

Fig. 10 is a wiring diagram for the control circuit of the modification.

Referring to the drawing, and more particularly to Fig. 4, the waveguide switch there shown comprises a switch body 112 and an S bend 14, with an inlet end 16 and an outlet end 18 having parallel axes. The S bend is preferably in the H plane, as will be clear from inspection of Figs. 1, 2, and 5—7. Reverting to Fig. 4, the S bend 14 is mounted for oscillation about the axis of the inlet end 16. There are a plurality, in this case two,

2

outlet passages 20 and 22, and these are offset from the axis of the inlet passage in order to come into alignment with the outlet end 18 of the S bend.

The inlet end of the S bend is made cylindrical on its outside surface, as indicated at 24, and this cylindrical part acts as a journal which is rotatable in a bearing 26 formed in the switch body. The outlet end 18 preferably has a flange 28, and this has an offset part 30 which carries or receives a pivot 32 which is aligned with the axis of the inlet end 16. This supports the outlet end of the S bend for the desired oscillation (or rotation, should that be desired).

Near the inlet end 16, and preferably just inside the switch body, the S bend is provided with a stop arm 34. The switch further comprises adjustable stop means 36 and 38 (Fig. 5) to limit the motion of the S bend, usually to a motion of 180°, as here shown.

On inspection of Fig. 5 it will be seen that stop 36 is an adjustable screw which cooperates with a fixed stop 40 forming a part of the switch body, and similarly the stop 38 is an adjustable screw which cooperates with a fixed stop 42. Appropriate locknuts or other means (not shown) may be provided to fix the adjustment of the stops. It will be understood that stop screws may be provided in the fixed stops 40 and 42, instead of in the movable arm 34. In the present case it is preferred to make the arm 34 massive, in order to balance the offset or outlet end 18 of the S bend, and with the stop arm 34 made as massive as shown, it is convenient to put the stop screws on the stop arm. However, this is not essential, and we have made generally similar switches in which the adjustable stop means were mounted on the stationary switch body.

The S bend is moved electrically under remote control by appropriate motor means. In the present case there is a lever and cam arrangement operated by a rotary solenoid.

Referring now to Figs. 6 and 7, the flange 28 at the outlet end 18 of the S bend is preferably given a cam shape, as shown. A lever 44 of inverted Y-shape is pivoted at 46, preferably at a point in vertical alignment with the pivot 32 of the S bend. The lower part of lever 44 is bifurcated and straddles the cam 28. The rotary solenoid is indicated at 50, and it carries an arm 52 which is turned about 90° by the solenoid, as is indicated by the change from Fig. 6 to Fig. 7 in the drawing. Arm 52 has a pin 54 received in a slot 56 of operating lever 44, thereby oscillating the same between the positions shown in Figs. 6 and 7. This in turn causes the furcations 58 and 60 to bear against and shift the cam 28 between the positions shown.

Considering the linkage in greater detail, the arm 58 preferably carries a leaf spring 62 having a reverse bend 64 to limit the separation of the spring 62 from the arm 58. Spring 62 has bearing ears 66 which carry a cam roller 68. In similar fashion, and referring to Fig. 7, the arm 60 has a leaf spring 70 the movement of which is limited by a reverse bend 72. This spring has bearing ears 74 carrying a cam roller 76. The spacing of the cam rollers 68 and 76 is preferably somewhat greater than the diameter of the cam 28, so that only one roller at a time bears against the cam, thereby reducing friction. The spring arrangement has the advantage of providing considerable tolerance in the linkage and cam action, and further provides a resilient force urging the S bend to one endmost position or the other, as set by the adjustable stops previously described.

The pin 54 preferably receives a small antifriction bearing, typically a ball bearing or a roller bearing, and the slot 56 is dimensioned to slidably receive the outer race of the bearing, the latter then acting as a roller.

Referring now to Figs. 1, 2 and 3 of the drawing, the

3

inlet is shown at 16, while stationary outlet flanges are shown at 80 and 82. The operating solenoid is housed at 84. The rotary solenoid is shown at 50 in Fig. 3, and may be of a conventional type which is commercially available under the name "Ledex" made by G. H. Leland Inc. of Dayton, Ohio. It has its own restoring spring which brings it back normally to rest position. In Fig. 3 attention is directed to the microswitch 86. This is a normally closed, single pole single throw switch which is opened by the linkage when solenoid 50 is energized. Microswitch 86 is mounted on a plate 92 carried at its lower end by bearing 46 and at its upper end by suitable spacers 94. The manner in which the switch 86 is operated may be seen in Fig. 6, which shows how the arm 58 of bifurcated lever 44, when raised to the position shown in Fig. 6, bears against a finger 87, pivoted at 90 on the inside of the mounting plate 92. This plate carries the switch 86 on its outer side, and a part 88 of finger 87 passes outwardly through a window 89 in plate 92, to push upward on the operating pin of switch 86.

Referring now to Fig. 8, the solenoid 50 is energized from a power supply line shown at 96 and controlled by a manually operable switch 98, which may be an ordinary toggle switch. The normally closed microswitch 86 is shown connected in parallel to a resistor 100. It will be evident that when manual switch 98 is closed the solenoid 50 is energized through closed switch 86, thereby shifting the waveguide switch from one outlet to the other. It has been found that the current required to hold the solenoid in energized position is very much less than the current required to operate the solenoid, and accordingly at the end of the solenoid movement the microswitch 86 is opened, thereby putting the resistor 100 in series, and so reducing the holding current of the solenoid to a small value. The solenoid remains energized through resistor 100 until toggle switch 98 is opened, whereupon the waveguide switch moves back to initial position, and the microswitch 86 is opened, thus preparing the circuit for another closing of the manual switch 98.

If it be desired to avoid continuous flow of even the reduced current described in connection with Fig. 8, a modified motor mechanism may be used, as shown in Figs. 9 and 10 of the drawing. Referring to Fig. 9, the cam 28', bifurcated lever 44', operating solenoid 50', and the linkage therebetween are all substantially as previously described, except that the arm 52' has a detent 102 projecting transversely. This cooperates with a latch 104, and it will be evident that when the solenoid 50 moves from the de-energized position shown in Fig. 7 to the energized position shown in Fig. 9, the detent 102 is engaged by the latch 104, thereby holding the linkage in that position, so that the operating solenoid 50' may be de-energized.

There is another rotary solenoid 110 which may be of smaller size and may be considered an auxiliary or latch solenoid. It has a shaft 108 carrying an eccentric cam 106. When the auxiliary solenoid 110 turns about 90° in counterclockwise direction the cam 106 bears against the adjacent part of latch 104, thereby moving the latch to the right and so disengaging the detent 102 whereupon the main solenoid 50' turns back to initial position because of its own return spring.

In the particular structure shown the latch 104 is formed out of resilient sheet metal and has an integral part 105 bent downwardly from its upper end and provided with holes for mounting screws which attach the same to the front face of the partition 114. Thus as viewed in Fig. 3, the spring latch 104 is mounted on the left side of partition 114, while the auxiliary solenoid 110 is mounted on the left side of plate 92, the shaft of the solenoid passing through the plate, so that the cam is on the right side of the plate for movement of the spring latch.

To complete the apparatus the waveguide switch is provided with a microswitch corresponding to the micro-

4

switch 86 as shown in Figs. 3 and 6, but in the present case the microswitch is wired to act as a single pole double throw switch, instead of a single pole single throw switch.

Referring now to Fig. 10, the main solenoid 50' is energized under remote control by means of a power supply 96'. The manually operable control switch 98' is in this case a single pole double throw toggle switch. The latch solenoid is shown at 110, and the microswitch 86' is a single pole double throw switch which is normally closed to its bottom contact and so to the main solenoid 50', as shown in solid lines.

When manual switch 98' is moved to its down position the solenoid 50' is energized, thereby shifting the waveguide switch from one outlet to the other. At the end of this movement the switch 86' is moved from bottom to top contact, thereby de-energizing the solenoid 50' and establishing a circuit connection to the latch solenoid 110. However, this solenoid is not energized because its return wire 112 is open at the switch 98'. Thus both solenoids remain de-energized.

When manual switch 98' is moved from bottom to top position the latch solenoid 110 is energized, thereby releasing the latch and permitting the waveguide switch to move back to initial position. Concurrently the microswitch 86' moves to its bottom contact, thus de-energizing the latch solenoid 110 and connecting the main solenoid 50' in circuit. However, the latter is not energized because the manual switch 98' at this time is in its upper position, and the return wire 114 of the main solenoid is open at the switch 98'.

The main body 112 of the switch is preferably cast, and as cast may include the partition 114 which carries the solenoid 50. The open front end of body 112 is closed by a large plate 116, which acts also as a flange to receive a waveguide flange at the mounting holes 118 shown in Fig. 1. This plate 116 acts also as a bearing for the rotatable inlet flange of the rotor. The plate 116 may be provided with a suitable gasket or O ring, as shown at 120 in Fig. 3, for pressurized waveguide systems. The rear end of the housing includes the cylindrical part 84 which encloses the rotary solenoid 50. This rear end is open as cast, and is closed by a circular closure plate 122 best shown in Figs. 2 and 3. Here again the plate may be provided with an O ring or other suitable gasket 124 for pressurized systems.

The flanges for connection of waveguide plumbing to the switch may be provided with chokes when desired. Thus referring to Fig. 2, the outlet flanges 80 and 82 have a conventional annular choke indicated at 81. Another annular groove may be provided outside the chokes 81, as shown at 83, for the reception of suitable gaskets such as O rings, to seal the system when it is to be pressurized. Similarly the rotatable part of the inlet flange may be provided with arcuate chokes indicated at 17. Because of space limitation, the choke is interrupted rather than continuous. The stationary wall or flange is provided with an annular groove 19 to receive a suitable gasket or O ring for a pressurized system. The chokes 17 and gasket groove 19 are shown in section in Fig. 3. The offset or cam-shaped flange 28 of the rotor itself may be either plain, or provided with choke slots. Because of limited space requirements, the latter are preferably interrupted, and may have the configuration shown at 29 in Figs. 5, 6 and 7.

The particular switch here illustrated is in the "X" band, covering a range from 8.2 to 10.0 km. c./s. It has a VSWR (voltage standing wave ratio) of less than 1.10; an isolation greater than 60 db; will take pressurization up to 60 lbs. per square inch; and has a radio frequency switching time of less than 0.10 second.

It is believed that the construction and operation of our improved waveguide switch, as well as the advantages thereof, will be apparent from the foregoing description. Because the rotor turns on the axis of the input flange

the latter remains fixed, and close tolerances may be used at the input. It is therefore possible to entirely eliminate the usual extra auxiliary input arm. Instead the connecting waveguide flange mates directly with the rotatable flange shown, and radio frequency leakage is eliminated by the use of standard flanges which may be either plain or broad band choke flanges. Thus an extra pair of input flanges is eliminated, which reduces the inherent standing wave ratio of the switch.

The coplanar arrangement of the switch makes it possible to employ normal straight flange design, which are less expensive to manufacture than flanges having curved faces. The coplanar configuration permits the use of closely spaced parallel output waveguides. However, the output waveguides may be made to fit the particular needs of the purchaser of the switch. They are not an integral part of the switch, therefore the basic or cast body unit may be quite compact. The operating mechanism is positive, and the operating current may be either cut off or reduced to a small value.

The linkage and cam arrangement shown has the advantage of gradual acceleration and deceleration. This is important in order to obtain rapid switching. The true switching time includes the time during which the rotor vibrates or chatters at the end of its movement, because the transmission of radar or other microwave energy is spoiled during any such vibration or chatter. Thus some other switch mechanism might move its rotor faster, and yet the true switching time, from the viewpoint of effective transmission of microwave energy, might be much longer than the time used for the mechanical movement alone. In the present case there is no significant vibration or chatter, so that the time needed for the mechanical movement corresponds to the switching time, which is less than one-tenth of a second.

The output arm configuration may be curved, instead of having the straight sections 79 shown in Fig. 3, and when made straight, they may be shorter than shown in Fig. 3, say to bring the flange 82 beneath or flush with the end of the housing 84. Various plumbing adaptations may be made for connection to the switch body, as shown in broken lines in Fig. 4. While we have shown the switch with two output arms, and with a motion of 180°, many features of the invention are applicable to a switch having three output arms and a motion of 120°, or four output arms with a motion of 90°. Also a motion of 90° or 120° may be used instead of 180°, even when providing only two output arms. Other motor mechanisms may be used to turn the rotor, instead of the preferred mechanisms shown.

It will therefore be apparent that while we have shown and described our invention in several preferred forms, changes may be made in the structures shown without departing from the scope of the invention, as sought to be defined in the following claims. In the claims the terms "inlet" and "outlet" are used for convenience, but it will be understood that the microwave energy may flow through the waveguides in opposite direction as, for example, if one or another of two different transmitters is to be connected to a common antenna.

We claim:

1. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, a bifurcated lever straddling said cam, and motor means to move said lever in such fashion as to rotate the cam and with it the S bend from one outlet passage to the other.

2. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes,

said S bend being in the H plane and being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, said inlet end being cylindrical and acting as a journal rotatable in said switch body, a stop arm near the inlet end, adjustable stop means cooperating with said stop arm to limit the motion of the S bend, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, a bifurcated lever straddling said cam, leaf spring means carried by each furcation of said lever, a cam roller carried by each leaf spring for bearing against the cam for oscillating said S bend, and motor means to move said lever.

3. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, a bifurcated lever straddling said cam, and motor means to move said lever, said motor means comprising a rotary solenoid having its own return spring, an arm turned about 90° by said solenoid, a pin carried by said arm, said bifurcated lever being Y-shaped and having a slotted arm receiving said pin.

4. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being in the H plane and being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, said inlet end being cylindrical and acting as a journal rotatable in said switch body, a stop arm near the inlet end, adjustable stop means cooperating with said stop arm to limit the motion of the S bend, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, a bifurcated lever straddling said cam, and motor means to move said lever, said motor means comprising a rotary solenoid having its own return spring, an arm turned about 90° by said solenoid, a pin carried by said arm, said bifurcated lever being Y-shaped and having a slotted arm receiving said pin.

5. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, a bifurcated lever straddling said cam, leaf spring means carried by each furcation of said lever, a cam roller carried by each leaf spring for bearing against the cam for oscillating said S bend, and motor means to move said lever, said motor means comprising a rotary solenoid having its own return spring, an arm turned about 90° by said solenoid, a pin carried by said arm, said bifurcated lever being Y-shaped and having a slotted arm receiving said pin.

6. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being in the H plane and being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, said inlet end being cylindrical and acting as a journal rotatable in said switch body, a stop arm near the inlet end, adjustable stop means cooperating with said stop arm to limit the motion of the S bend, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch

7

body, a bifurcated lever straddling said cam, leaf spring means carried by each furcation of said lever, a cam roller carried by each leaf spring for bearing against the cam for oscillating said S bend, and motor means to move said lever, said motor means comprising a rotary solenoid having its own return spring, an arm turned about 90° by said solenoid, a pin carried by said arm, said bifurcated lever being Y-shaped and having a slotted arm receiving said pin.

7. A waveguide switch comprising a switch body, an S bend with inlet and outlet ends having parallel axes, said S bend being in the H plane and being mounted in said body for oscillation about the axis of the inlet end, a plurality of outlet passages offset from said inlet axis for alignment with said outlet axis, said inlet end having a choke flange which is cylindrical and acts as a journal rotatable in said switch body, a stop arm near the inlet end, adjustable stop means cooperating with said stop arm to limit the motion of the S bend, a flange at the outlet end shaped like a cam and having an offset part carrying a pivot aligned with the axis of the inlet end for rotation in the switch body, said outlet flange being a choke flange, a bifurcated lever straddling said cam, leaf spring means carried by each furcation of said lever, a cam roller carrier by each leaf spring for bearing against the cam for oscillating said S bend, and motor means to move said lever, said motor means comprising a rotary solenoid having its own return spring, an arm turned about 90° by said solenoid, a roller carried by said arm, said bifurcated lever being Y-shaped and having a slotted arm receiving said roller, the arrangement being such that said arms come into approximately perpendicular relation at the ends of travel of the solenoid.

8. A waveguide switch as defined in claim 3, in which there is a resistor in series with the solenoid, a line switch in shunt with said resistor, and in which the waveguide switch assumes one position when the solenoid is de-energized, and in which it assumes a second position when the solenoid is energized, and in which said line switch is opened in said latter position to put the resistor in series with the solenoid when the solenoid remains energized.

9. A waveguide switch as defined in claim 4, in which there is a resistor in series with the solenoid, a line switch in shunt with said resistor, and in which the waveguide switch assumes one position when the solenoid is de-energized, and in which it assumes a second position when the solenoid is energized, and in which said line switch is opened in said latter position to put the resistor in series with the solenoid when the solenoid remains energized.

10. A waveguide switch as defined in claim 5, in which there is a resistor in series with the solenoid, a line switch in shunt with said resistor, and in which the waveguide switch assumes one position when the solenoid is de-energized, and in which it assumes a second position when the solenoid is energized, and in which said line switch is opened in said latter position to put the resistor in series with the solenoid when the solenoid remains energized.

11. A waveguide switch as defined in claim 6, in which there is a resistor in series with the solenoid, a line switch

8

in shunt with said resistor, and in which the waveguide switch assumes one position when the solenoid is de-energized, and in which it assumes a second position when the solenoid is energized, and in which said line switch is opened in said latter position to put the resistor in series with the solenoid when the solenoid remains energized.

12. A waveguide switch as defined in claim 3, in which there is a latch and a latch solenoid and a line switch to connect either the main solenoid or the latch solenoid in circuit, said latch engaging the linkage when the main solenoid is energized to hold the linkage in energized position, and in which there is means to simultaneously shift said line switch from the main solenoid to the latch solenoid, and in which a manually operable control switch may be shifted from the main solenoid to the latch solenoid to energize the latter in order to disengage said latch, whereby both solenoids are de-energized except during changeover of the waveguide switch.

13. A waveguide switch as defined in claim 4, in which there is a latch and a latch solenoid and a line switch to connect either the main solenoid or the latch solenoid in circuit, said latch engaging the linkage when the main solenoid is energized to hold the linkage in energized position, and in which there is means to simultaneously shift said line switch from the main solenoid to the latch solenoid, and in which a manually operable control switch may be shifted from the main solenoid to the latch solenoid to energize the latter in order to disengage said latch, whereby both solenoids are de-energized except during changeover of the waveguide switch.

14. A waveguide switch as defined in claim 5, in which there is a latch and a latch solenoid and a line switch to connect either the main solenoid or the latch solenoid in circuit, said latch engaging the linkage when the main solenoid is energized to hold the linkage in energized position, and in which there is means to simultaneously shift said line switch from the main solenoid to the latch solenoid, and in which a manually operable control switch may be shifted from the main solenoid to the latch solenoid to energize the latter in order to disengage said latch, whereby both solenoids are de-energized except during changeover of the waveguide switch.

15. A waveguide switch as defined in claim 6, in which there is a latch and a latch solenoid and a line switch to connect either the main solenoid or the latch solenoid in circuit, said latch engaging the linkage when the main solenoid is energized to hold the linkage in energized position, and in which there is means to simultaneously shift said line switch from the main solenoid to the latch solenoid, and in which a manually operable control switch may be shifted from the main solenoid to the latch solenoid to energize the latter in order to disengage said latch, whereby both solenoids are de-energized except during changeover of the waveguide switch.

References Cited in the file of this patent

UNITED STATES PATENTS

2,413,298	De Tar	Dec. 31, 1946
2,597,607	Alford et al.	May 20, 1952
2,673,962	Kock	Mar. 30, 1954
2,715,210	McClain	Aug. 9, 1955