Nov. 14, 1967 S. F. STRYKER 3,352,324

CONTROL VALVE STRUCTURE AND LINKAGE THEREFOR

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Fig. 1

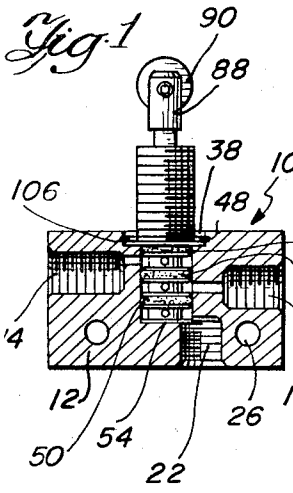


Fig. 2

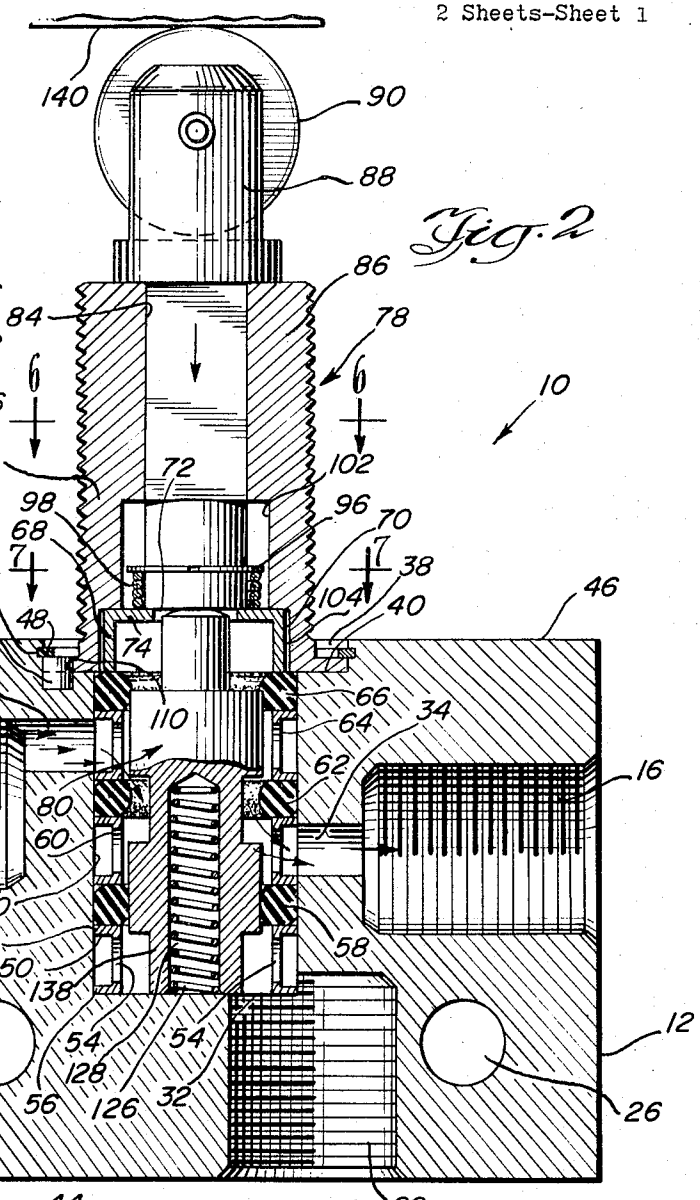


Fig. 4

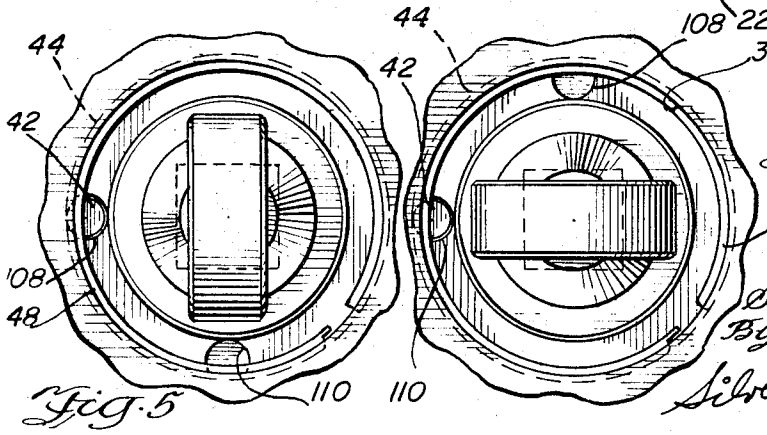


Fig. 5

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Fig. 8

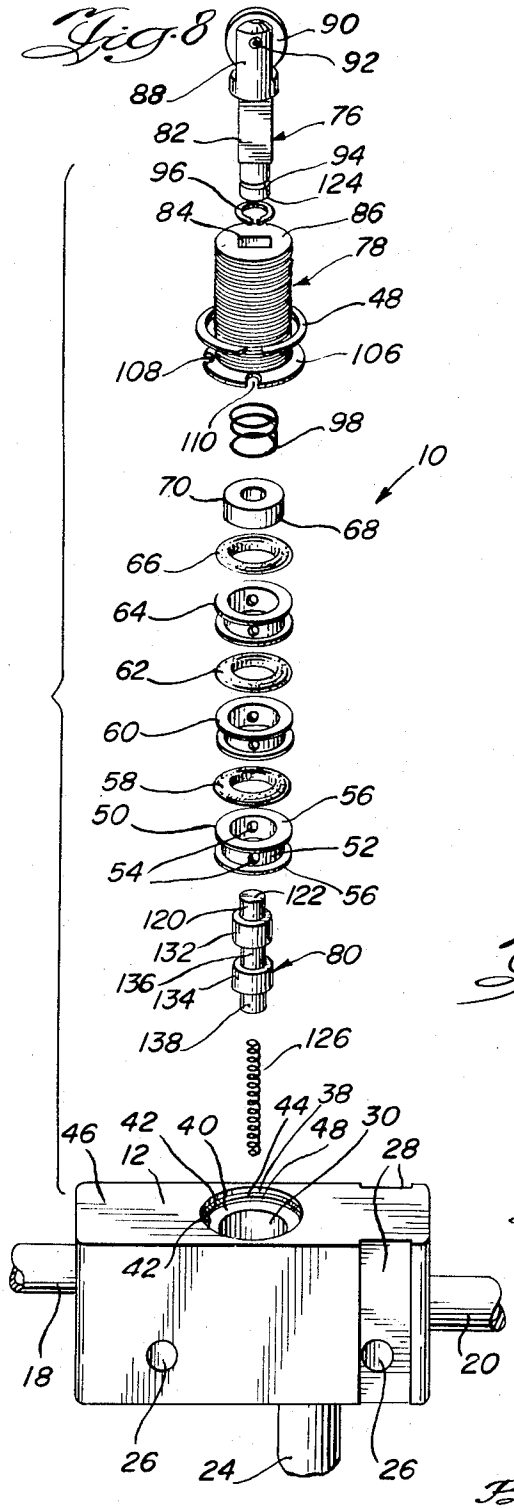


Fig. 3

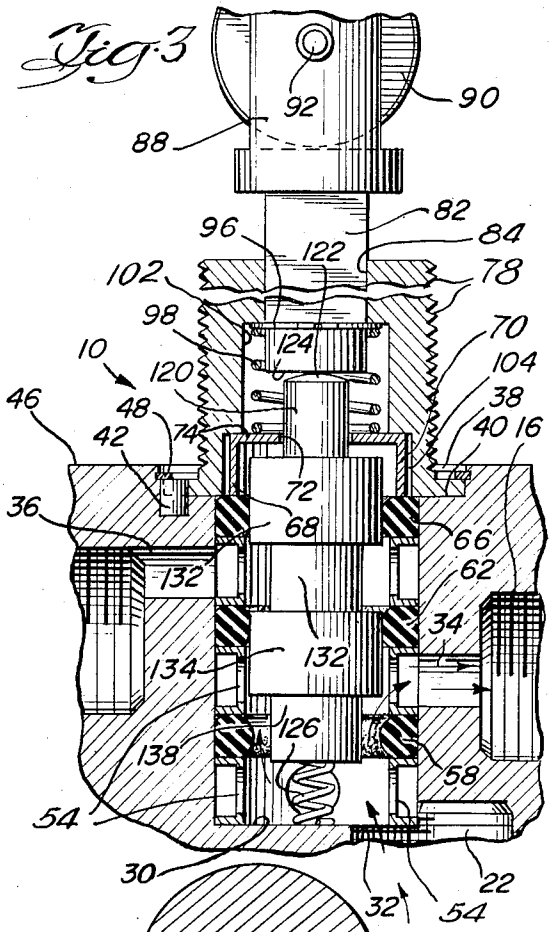


Fig. 6

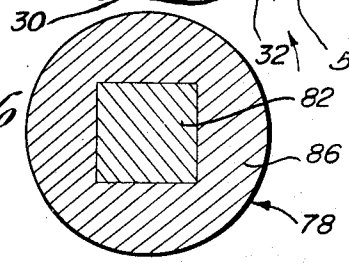
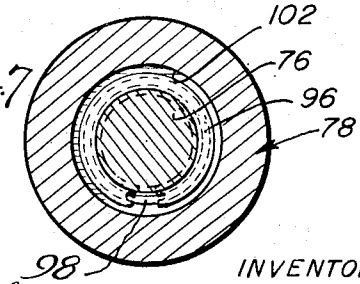


Fig. 7



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CONTROL VALVE STRUCTURE AND LINKAGE THEREFOR

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5 Claims. (Cl. 137—625.69)

ABSTRACT OF THE DISCLOSURE

A miniature valve apparatus for controlling the selective passage of air through a pneumatic system by mechanical actuation of a plunger retained in the valve by a plunger housing having a roller actuator and a single ring which holds all parts together, the ring being easily removable to give access to the interior of the valve and the plunger housing being rotatable after disassembly from the remainder of the valve and indexed to either of two positions 90° apart so that the roller axis may be disposed for actuation of the roller from either of two directions at right angles to one another.

The invention relates generally to control valve structures and linkages therefor, and more particularly is concerned with a novel type of valve structure which is especially suitable for application to valves of relatively small sizes.

The valve structures of the invention are especially intended for installation into pneumatic systems and hence operate by virtue of air pressure of vacuum. These valves are used to control the operation of power cylinders, other valves and the like, which are operated by air, all of such latter operated structures being generally referred to hereinafter as air-actuated devices. The valve structures to be described use relatively small diameter tubing and miniature fittings and are ideally suited for use in substitution of electrical switches on production lines, in machinery and the like. Such uses include limit switches, actuating switches, both automatically and electrically operated. The construction of the valves of the invention enables same to be made in miniature and with small and easily fabricated parts.

The principal objects of the invention include the provision of a control valve structure which is easily assembled or disassembled without destruction or the need for cutting or shearing any parts; the provision of a valve structure of this type in which there is a plunger adapted to be reciprocated by means of a roller and push-rod and in which the axis of the roller is readily rotated 90° without destructive disassembly of the valve structure; the provision of a control valve structure in which there are novel means for controlling the mechanical pressure applied to the assemblage of O-rings and annular spacer sleeves of the valve and within which the plunger reciprocates.

Other objects of the invention, advantages and features of the valve structure will become more apparent as a description of the invention proceeds hereinafter, in connection with which the details of a preferred embodiment will be set forth and illustrated in the accompanying drawings.

In such drawings:

FIG. 1 is a median sectional view through a control valve constructed in accordance with the invention, shown fully assembled and with a roller for reciprocating the push rod arranged with its axis at right angle to the long dimension of the valve body.

FIG. 2 is a view similar to that of FIG. 1 but on a much larger scale, and with certain parts shown in section that are shown in elevation in FIG. 1. In this view, the push rod has been fully depressed to establish one condition of valving in the passageways of the valve.

FIG. 3 is a fragmentary view similar to that of FIG. 2 but in this instance, the push rod has been urged fully outward of its housing by the springs of the valve, whereby to establish a second condition of valving in the passageways of the valve.

FIG. 4 is a fragmentary top plan view of the valve of FIG. 2 showing the arrangement for changing the axis of the roller of the push rod.

FIG. 5 is a view similar to that of FIG. 4 but in this case the axis of the roller has been changed to coincide with the long dimension of the valve body.

FIGS. 6 and 7 are fragmentary sectional views taken through FIG. 2 along the lines **6—6** and **7—7**, respectively, and in the indicated directions.

FIG. 8 is an exploded perspective elevational view of the control valve and all of its parts.

The invention is generally characterized by the provision of a control valve structure which is assembled by means of a single ring which holds all parts together, and which can easily be removed in the field or on a bench to give access to the interior of the valve. In this manner parts may be replaced or inspected or cleaned quickly and simply, and without the need for special tools. Snap rings of a variety requiring special pliers may be used, but convenience would indicate as a preference those rings which can be readily removed or installed by means of any sharp pointed instrument. Some rings are of the split variety and others are of multiple convolution construction. All will be referred to hereinafter as snap rings.

The invention is further characterized by an arrangement which enables the push-rod housing to be rotated once it has been disassembled from the remainder of the valve and indexed to either of two positions 90° apart so that the roller axis may be disposed for actuation of the roller from either of two directions at right angles to one another. Other details are concerned with the novel means for enabling the push-rod and housing to be readily separated from the remainder of the valve, while still being reciprocable one relative to the other, and novel means for maintaining proper pressure on the packing rings.

Referring now to the drawings, the valve structure of the invention is designated generally by the reference character **10**. In the description hereinafter, the word "valve" will be used as a collective word to include the entire structure rather than any particular parts which perform valving operations. The valve **10** is formed of several components, or groups of parts, which perform the various functions contributing to the operation as a whole.

Basically there is a body having various passageways, a principal valving cavity or chamber in the body which has the passageways connecting therewith and provides the multiple packing means in the form of various suitably spaced O-rings to cooperate with the movable plunger to form the several paths for flow of the air during operation of the valve. Means are provided to reciprocate the plunger, and structure for securing the means in assembly with the valve.

It is appreciated that the basic concept of such a plunger type of valve is well-known, but as previously pointed out, certain structures to be described and claimed are believed novel, and these render the resulting valve more economical to manufacture and service, and more efficient in operation and flexible in use than prior valves of this type.

The body **12** is a simple block of aluminum or brass, which is somewhat elongate as shown in the drawings, this configuration being one of design although probably

the most economical when considering the need for screw threaded receptacles **14** and **16** formed at the opposite ends. These receptacles are required to receive the threaded male ends of suitable connecting air conduits **18** and **20** respectively (FIG. 8) when the valve **10** is connected into an air system. Another receptacle **22** is formed in the body **12** opening to the bottom thereof, for receiving the air conduit **24**. The block is bored transversely at **26** to provide holes for bolts for enabling the valve **10** to be secured in position to a suitable mounting. Likewise, bracket grooves **28** may be milled or cast in the block as shown in FIG. 8 to assist in mounting the valve. As will be seen, the pushrod housing is threaded for mounting on panels or the like.

The body **12** has a vertical valving cavity **30** of cylindrical configuration bored therein and connecting with the bottom receptacle **22** at **32** to provide a bottom port, connecting with the right hand receptacle **16** by means of a small passageway forming a port **34** and connecting with the left hand receptacle **14** by means of another passageway forming port **36**. The cavity **30** has an enlarged entrance **38** thereby providing a shoulder **40** into which a short vertical pin **42** is inserted as shown in FIGS. 2, 3, 4, 5 and 8. This entrance **38** is often called a gallery or recess hereinafter. The pin **42** is for indexing the position of the push-rod housing as will be described. The gallery **38** has a shallow annular groove **44** spaced from the top wall **46** to receive therein a snap ring **48** of conventional construction, shown in place in FIGS. 4 and 5, and shown independently in FIG. 8.

A string of annular spacers of sleeve-like configuration and O-rings is located within the valving cavity, and held in place by the snap ring **48** in a manner to be described. Each annular spacer has the same construction and hence attention may be directed to the bottom-most one **50** for the description of all. There is an axial cylindrical portion **52** with radial holes **54** circumferentially spaced about the cylindrical portion, and each end has a flange **56** integral therewith. The O-rings are conventional in construction.

Starting at the bottom of the cavity **30**, there is a spacer sleve **50**, above which is an O-ring **58**, second spacer sleeve **60**, second O-ring **62**, third spacer sleeve **64** and third O-ring **66**. The spacers and O-rings are held in the relationship described with a predetermined pressure, since the O-rings are made of rubber of equivalent material, and are resilient. Pressure is applied by means of the skirt **68** of the pressure thimble **70** that is in the form of an inverted cup-like member having a central opening **72** located in the upper wall **74** for a purpose to be described.

Mention has been made hereinbefore of a push-rod housing, push-rod and plunger. These three elements are shown separated in FIG. 8 and assembled in several of the other figures. The push-rod is designated generally **76**, the housing **78** and the plunger **80**. The push-rod **76** has a central square shaft **82** reciprocally engaging through a square opening **84** in the end **86** of the housing **78**. The outer end of the push-rod has a bifurcated fitting **88** either integral with the push-rod or fixed thereto, and a roller **90** is journalled for free rotation therein at **92**. The lower end of the push-rod **76** is cylindrical and provided with an annular groove **94** which receives the split washer **96**, the latter serving both as a stop member to prevent the push-rod **76** from being ejected from the housing by the helical spring **98** seated on the wall **74** and engaging against the split ring when the valve is in assembled condition, and as means to prevent the push-rod being withdrawn from the housing.

The housing **78** is tubular, and has a square cross section passageway **84** in its end **86**, as explained above. At its lower end **100** there is an enlarged cylindrical bore **102** to accommodate the movement of the washer **96** and the flexing of the spring **98** without interference. A still further enlarged cylindrical bore **104** provides a socket for reception and seating of the pressure thimble **70**.

The bottom end or base of the housing **78** is provided with an annular flange **106** that has two notches or perforations **108** and **110** which are circumferentially spaced 90° apart. When the housing is engaged into the enlarged entrance **38**, the flanged base **106** fits within the gallery in a sliding fit with the lower surface thereof seated on the shoulder **40**, and with the pin **42** engaging into one or the other of the perforations **108** or **110**. Obviously, the snap ring **48** must be removed before the housing can be installed, after which replacement of the ring will hold the entire structure in assembled condition. The pin **42** serves to index the disposition of the housing relative to the body **12**. If assembled in the order shown in FIG. 8, the pin **42** will engage the perforation **108** and the axis of the roller **90** will be at right angle to the longer dimension of the body **12**.

Obviously the push-rod may be assembled to the housing **78** with the roller disposed 90° from its disposition in FIG. 8 in which case the plane of the roller will be in alignment with the perforation **110** instead of the perforation **108**. This condition is assumed in FIGS. 4 and 5. In FIG. 4, the roller axis is vertical on the paper, while in FIG. 5, it is horizontal on the paper. The difference between the two arrangements is that the pin **42** is engaged with the perforation **110** in FIG. 4. and with the perforation **108** in FIG. 5. This is easily accomplished by temporarily removing the snap ring **48**, rotating the housing and thereafter replacing the snap ring. The push-rod **76** is not as readily changed relative to the housing, because it requires a long-nosed pliers or the like for the particular type of washer, but this change will not usually be necessary.

Shifting the disposition of the roller **90** is simply done in the field and this gives great flexibility to the use of the valve **10**.

The valve includes a plunger **80** which is disposed in the valving cavity in engagement with the O-rings. The plunger has a reduced diameter follower end **120** with a rounded tip **122** that engages against the end **124** of the push-rod so as to follow the same during movement of the push-rod. The plunger is biased against the push-rod end **124** by means of a coil spring **126** that is retained in a hollow recess **128** formed in the plunger **80** and opening to the bottom end thereof and engaging on the bottom surface **130** of the cavity **30**. The follower end **120** passes through the opening **72** in the pressure thimble **70** and its reciprocation does not effect the pressure applied by the thimble to the spacer-O-ring string.

The plunger **80** has two spaced cylindrical valving surfaces **132** and **134** separated by a necked portion **136**, the lower surface **134** being spaced from the bottom end of the plunger by means of a reduced diameter portion **138**.

Movement of the plunger **80** up and down accomplishes the valving functions of the valve **10**. This is done in a more or less conventional manner and involves cooperation between the valving surfaces and the O-rings. This may be explained as follows:

Assume initially that the valve **10** is in the condition shown in FIG. 3, in which the push-rod **76** is pressed outward of the housing **78** by the spring **98**. The plunger **80** is biased upward to its maximum extent by the spring **126** and with the tip **122** engaging the end **124**. In these circumstances, the port **36** opens into the cavity by way of the holes of the spacer **64**, but the valving surfaces **132** and **134** are in engagement with the O-rings **66** and **62**, respectively, and hence a blind end is produced at the spacer **64**. The O-rings are under sufficient compression such that they act as packing means to prevent any passage of air by way of the port **36** to other parts of the valve **10**.

The same conditions prevailing, there is free passage between the receptacles **22** and **16** by way of the cavity **30**. A direction of fluid flow is assumed to be from the

conduit **24** to the conduit **20**, although this is not essential. Air follows the arrows of FIG. 3, entering from the bottom port **32**, passing through the center of the spacer **50** past the O-ring **58**, through the holes of the spacer **60** and out of the port **34**. The connection is thus established between the conduits **24** and **20**.

Assuming that a moving member **140** (FIG. 2) engages the roller **90** and pushes the same inward, the conditions of the valve **10** are shown in FIG. 2. Both springs **98** and **126** are compressed. The plunger **80** has been pushed downward until the reduced diameter end **138** is engaged against or close to the surface **130**. Now the valving surface **134** has moved out of engagement with the O-ring **62** and into engagement with the O-ring **58** thereby blocking passage of any air by way of the port **32**. The valving surface **132** has moved axially with the plunger **80** but has not left its engagement with the O-ring **66**. Accordingly, it will be appreciated that this O-ring is a continuously engaged packing member which prevents escape of any fluid out of the cavity **30** by way of the housing during the operation of the valve. The necked portion **136** is now disposed alongside the O-ring **62** so that air is free to pass this O-ring. Accordingly, air may now pass from the receptacle **14** by way of the port **36** into the cavity **30** through the holes of the spacer **64**, past the O-ring **62**, through the holes of the spacer **60** and out of the port **34** into the receptacle **16**. The connection is thus established between the conduits **18** and **20**.

The housing **78** has its exterior threaded to enable the same to be mounted in any suitable opening by means of a nut engaging this threaded surface, if desired. Instead of a roller, other pusher means may be used to reciprocate the push-rod **76** to operate the valve, but the roller arrangement is the most common and desirable. Manual buttons, solenoids and the like may be substituted therefor, but the particular feature of the invention concerned with being able to easily to change the rotational axis of the roller would not apply without the presence of a roller or some other directional actuating means.

The invention has been sufficiently described such as to enable those skilled in this art to understand and appreciate the same and to build structures embodying the same. Considerable variation is capable of being made in the details of the structure without in any way departing from the spirit or scope of the invention as described in the appended claims.

What it is desired to secure by Letters Patent of the United States is:

1. A valve having a body provided with a valving cavity, a plurality of alternately stacked annular packing members and perforated spacers co-axially engaged and mounted in said cavity to define a passageway, a plurality of ports in said body opening to said cavity, a plunger disposed in said passageway defined by said annular packing members and spacers and provided with a plurality of valving surfaces, such that upon reciprocation of said plunger, said valving surfaces are adapted to engage said packing members upon movement of the plunger selectively to establish different paths of communication between the ports, a push rod, an extension on the plunger engaged by the push rod such that the plunger may be moved axially, spring means for biasing the plunger in opposition to said push rod to an axial position with the plunger disposed toward the outer end of said cavity, an annular recess portion surrounding the said valving cavity to define a shoulder at the entrance thereof in said body, a cup-shaped push rod housing having an open end and an aperture in the opposite end thereof, an annular surface formed on the open end of said housing, said housing being partially received in said annular recess with the annular surface on the housing seated on the annular shoulder formed by said recess and a portion of the said push rod disposed in and protruding from the aperture in said housing, means associated with said push rod housing and said body removably to lock said housing in the annular recess to retain the valve elements in assembled relationship in said valve cavity and thereby to provide access to said valve elements upon disengagement of said last named means and the removal of said housing.

2. A valve as defined in claim **1** wherein the annular surface on the cup-shaped push rod housing is defined by an outwardly extending annular flange provided with a plurality of perforations, pin means mounted on the annular shoulder formed by said recess, said pin means engaged with one of said perforations to fix the relative rotative position of said push rod housing, said push rod being non-rotatively disposed in said housing aperture.

3. A valve as defined in claim **1** wherein said means to removably lock said push rod housing in engagement with the shoulder defined by the annular recess comprises an annular groove in the circumferential wall of said recess, and a snap ring engaged in said groove and retaining said push rod housing in said recess.

4. A valve as defined in claim **1** further including biasing means for said packing members comprising an annular thimble mounted within said push rod housing, spring means engaging said thimble to bias it axially into engagement with the alternately stacked packing members and spacers.

5. A valve having a body with a valving cavity opening to one surface of said body, an annular gallery in said body surrounding the entrance to the cavity to thereby define a shoulder therein, a plurality of alternately stacked annular packing members and annular perforated spacers, co-axially engaged in the cavity to define a passageway, a plurality of ports in the said body opening to said cavity and adapted to be selectively connected for the valving operation, a plunger disposed in said passageway defined by said packing members and annular perforated spacers, movable axially therein and having the valving surfaces for engaging said annular packing members, the packing members being arranged relative to the ports and plunger such that the axial movement of the plunger selectively establishes communication between different ports, spring means for biasing the plunger to a first axial position with the plunger disposed toward the outer end of the valving cavity, a housing secured in said gallery and having means protruding therefrom associated with said plunger and adapted to be engaged to bias said plunger axially inward, an annular thimble mounted within said housing, spring means engaging said thimble to bias it axially toward the inner end of said cavity and into engagement with said alternately stacked packing and spacer members.

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