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Spyra

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[54] **VARIABLE STROKE CYLINDER**

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[51] **Int. Cl.** **F01b 31/00**

[58] **Field of Search** 92/13, 13.51, 13.8, 255, 92/257, 258

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[57] **ABSTRACT**

In a variable stroke cylinder having a pair of pistons in which the distance between the pistons is selectively variable for selectively varying the stroke of the cylinder, a vent communicates with the space between the pistons for venting the space when the distance between the pistons is being varied.

5 Claims, 3 Drawing Figures

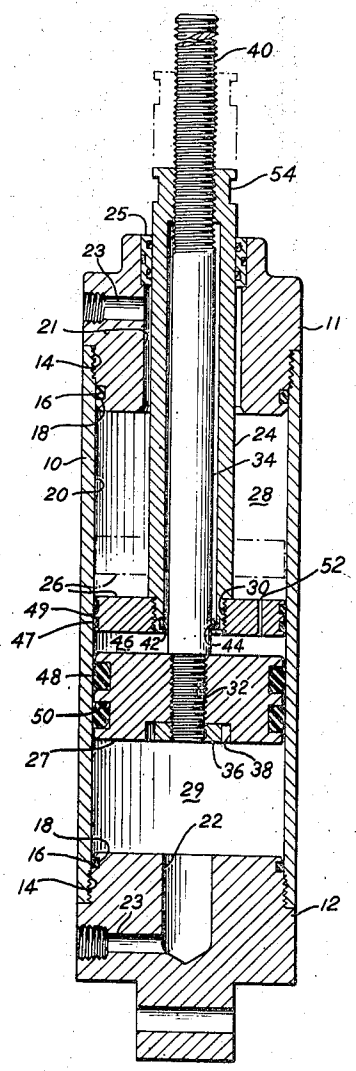


Fig. 1

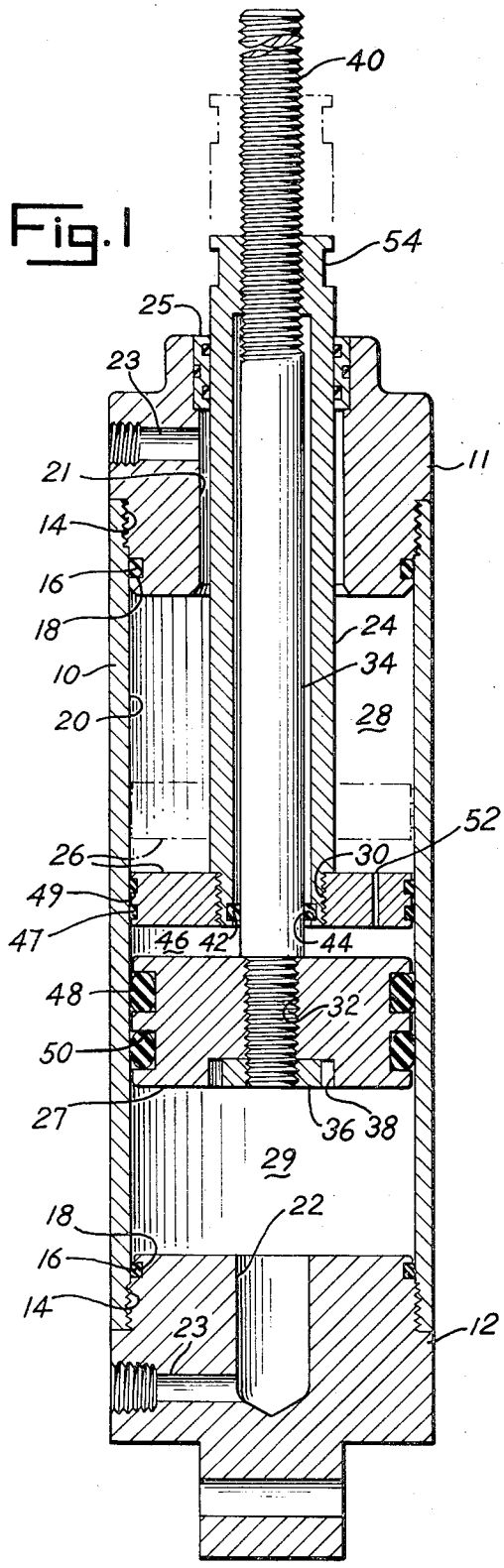
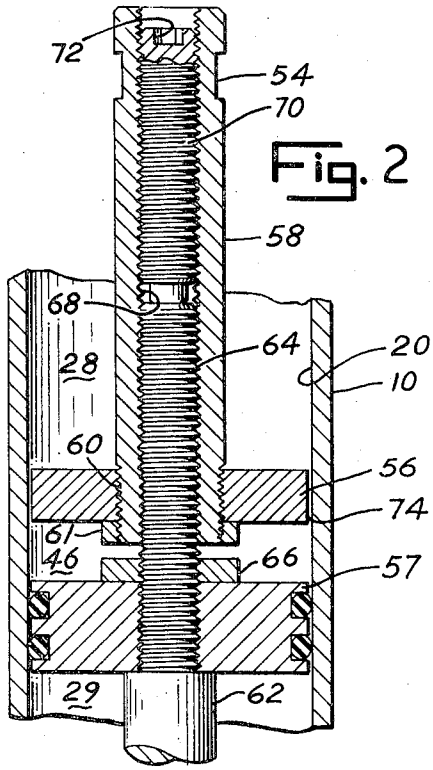


Fig. 2



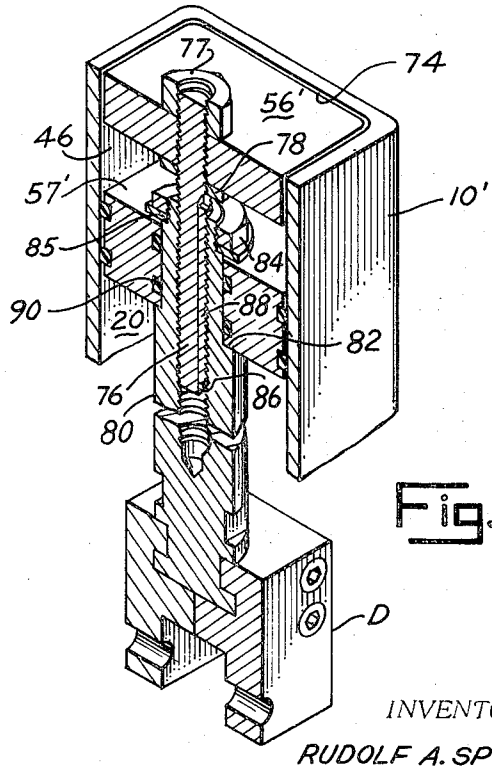


Fig. 3

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VARIABLE STROKE CYLINDER

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a variable stroke cylinder and, more particularly, to a double piston cylinder in which the distance between the pistons may be easily and readily varied to vary the stroke of the cylinder.

It is frequently desirable that a given pneumatic or hydraulic motor or pumping cylinder be capable of varied input and/or output depending upon conditions encountered during use in a given system. One manner which has been employed in the past to so vary the input and/or output of such cylinders, has been to selectively increase or decrease the stroke of the power member or piston of the cylinder.

Various methods have been employed in the past to vary or adjust the stroke for this purpose. One manner of effecting such variation, has been by the use of electrical switching devices. Mechanical methods have also been employed. In the mechanical method, rather than a single working piston, a pair of working pistons are provided in the cylinder and the distance between the pistons may be selectively varied to vary the stroke of the cylinder. When the pistons are moved toward each other, the stroke will be increased and when the pistons are moved away from each other the stroke will decrease. By way of example, a double piston variable stroke cylinder is shown in United States Letters Patent No. 1,325,006.

As shown in said patent, the pistons are fitted within the cylinder with a close tolerance between the outer perimeter of each of the pistons and the cylinder wall so as to effect a sealing engagement between the pistons and the cylinder wall. As a result of this sealing engagement, variable adjustment either of one of the pistons relative to the other or of both pistons simultaneously is rendered difficult, if not impossible under some circumstances, due to the compression or expansion of the fluid sealed between the pistons. For example, when the pistons are adjusted apart so as to decrease the cylinder stroke, a progressively increasing vacuum condition occurs in the space between the pistons as adjustment proceeds. This vacuum condition renders adjustment progressively more difficult and adjustment may even become impossible where the stroke is to be widely varied. Conversely, when the pistons are moved closer together so as to increase the stroke, a pressure condition arises between the pistons which also progressively increases as adjustment proceeds. Particularly in the latter situation and where the cylinder is for hydraulic use, any leakage which may occur between the pistons and the cylinder wall into the space between the pistons during prolonged minimum stroke operation, may render adjustment to the maximum stroke condition impossible due to the non-compressible nature of the hydraulic liquid.

The variable stroke cylinder of my invention overcomes these disadvantages. In the variable stroke cylinder incorporating the principles of my invention, a double piston cylinder is provided in which the stroke is capable of being readily and easily mechanically varied over a wide range. In the cylinder of my invention, the effort necessary to adjust the stroke is both minimal and uniform over the entire range of adjustment since the likelihood of vacuum or pressure conditions occurring in the space between the pistons is obviated. Moreover, in the cylinder incorporating the principles of my invention, the stroke may be readily adjusted from the exterior of the cylinder, without necessitating disassembly of same and, once adjustment has been made, the pistons may be locked relative to each other to insure reliable operation over continued periods at the adjusted stroke in one of the embodiments of my invention.

In a principal aspect, the variable stroke cylinder incorporating the principles of my invention includes a pair of piston members positioned in a cylinder and at least one of said piston members is selectively moveable relative to the other for adjustably varying the stroke of the piston members. In my invention, vent means is provided which communicates with the space between the piston members so as to vent the space when the distance between the piston members is varied to vary the stroke of the cylinder.

In another aspect, locking means is provided whereby once the stroke has been adjusted, the piston members may be locked relative to each other.

In another aspect, each of the pistons, as well as the cylinder, are of non-curvilinear cross section, whereby when one of the piston rods is rotated relative to its piston, stroke variation is effected.

These and other objects, features and advantages of the present invention will be more clearly understood through a consideration of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWING

In the course of this description, reference will frequently be made to the attached drawing in which:

FIG. 1 is an elevation cross sectioned view of one preferred embodiment of variable stroke cylinder constructed in accordance with the principles of my invention;

FIG. 2 is a partially cut away elevation cross sectioned view of a second preferred embodiment of variable stroke cylinder constructed in accordance with the principles of my invention; and

FIG. 3 is a partially cut away perspective view of a third preferred embodiment of variable stroke cylinder constructed in accordance with the principles of my invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, one preferred embodiment of variable stroke cylinder of my invention is shown. The cylinder comprises an elongated cylinder sleeve **10** closed at each end by cylinder heads **11** and **12** which may be threadedly secured to each end of the cylinder sleeve by way of threads **14**. A suitable sealing gasket, such as an O-ring **16**, may be carried in a groove **18** adjacent the inner end of each of the heads **11** and **12** so as to sealingly contact the inner wall **20** of the sleeve.

A duplex cylinder is shown in FIG. **1** in which intake and/or discharge passages **21** and **22** extend through each of the heads **11** and **12**, respectively. Connecting passages **23**, threaded to receive suitable fluid conduits, are provided to communicate passages **21** and **22** with the cylinder exterior. Passage **21** in head **11** is somewhat enlarged relative to passage **22** so as to receive a piston rod **24** therethrough. Passage **21** is preferably of

a diameter such that when the rod **24** is journalled through the passage, an annular space obtains between the head **21** and exterior of the rod which has a cross section substantially equal to the cross sectional area of passage **22** to provide for a uniform suction and discharge rate through each of the passages. A suitable sealing gland **25** is fitted in the top of passage **21** and engages the piston rod **24** to seal the passage, but provide for sliding movement of the rod.

A pair of pistons **26** and **27** are positioned within the cylinder sleeve **10** and divide the interior of the sleeve into a pair of working chambers **28** and **29.** Piston **26** is firmly threaded at **30** onto one end of piston rod **24** and the other piston **27** is also threaded at **32** on one end of another piston rod **34** and stationarily locked thereto by nut **36** which is received in a recess **38** in piston **27.** Rod **24** is annular in cross section and rod **34** extends upward therethrough in journalled relationship. The end of rod **34** opposite its piston is externally threaded at **40** and rod **24** is internally threaded so that rods **24** and **34** may be axially threadedly adjusted relative to each other between the position shown in solid in FIG. **1** and the dot and dash line position also shown therein. A drive fitting may be carried on the end of either of the rods similar to the fitting D shown in FIG. **3.**

A seal ring **42,** formed of suitable sealing material, is carried in a groove **44** about the inner periphery of rod **24** adjacent its piston and sealingly engages the external surface of rod **34** to seal off the space **46** between the pistons **26** and **27** from the small annular area between rod **34** and the interior wall of rod **24.** Suitable piston sealing rings **47** and **48** are also carried in annular grooves **49** and **50** about each of the pistons **26** and **27,** respectively, and are arranged to slidingly and sealingly engage the internal wall **20** of the cylinder sleeve to prevent leakage between the pistons and wall.

An important feature of my invention is the provision of means to equalize the pressure between space **28** and the space **46** between the pistons during adjustment of the piston stroke. As shown in FIG. **1,** this means comprises a bleed orifice **52** which extends between the faces of and through the thickness of piston **26** and communicates space **46** with the working space **28** above the piston. Bleed orifice **52** is of a size such that little fluid transfer will occur between space **28** and space **46** during normal operation of the cylinder either as a pump or as a motor. However, when it is desired to either increase or decrease the stroke of the cylinder, the bleed orifice operates to vent the space **46** and enable easy and uniform adjustment of the cylinder stroke.

For example, when it is desired to decrease the stroke of the cylinder, a suitable tool, such as a wrench, is applied to a suitable tool receiving surface **54** at the end of rod **24** and the rod is rotated while rod **34** is held stationary. If the rod **24** is rotated so as to move from the solid position to the dot and dash position shown in FIG. **1,** piston **26** will move relatively away from the piston **27.** Since the volume of the space **46** between the piston will increase, vacuum conditions would normally occur therein due to the tight seal provided by sealing rings **47** and **48** and continued adjustment would become progressively more difficult. However, due to the orifice **52,** a relatively constant pressure will be maintained at all times in space **46** due to the venting of fluid from space **28** to space **46.** If the storke is to be decreased, rod **24** is rotated in the opposite direction moving piston **26** closer to piston **27.** Again relatively constant pressure conditions will obtain in space **46** during such adjustment, since any pressure buildup will be vented from space **46** to space **28** by way to the bleed orifice.

Referring to FIG. **2,** another embodiment of variable stroke cylinder of my invention is shown in which locking means is provided to lock the piston heads relative to each other once stroke adjustment has been completed. Like the embodiment shown in FIG. **1,** a pair of pistons **56** and **57** are positioned within cylinder sleeve **10.** A tubular piston rod **58,** somewhat similar to rod **24** in FIG. **1,** is fixed by way of threaded end **60** and nut **61** to piston **56** and extends through one head of the cylinder (not shown) in a manner similar to that shown in head **11** in FIG. **1.** A second rod **62** extends through the other head (not shown) of the cylinder. The distal end of piston rod **62** is of reduced diameter and externally threaded at **64** over its reduced diameter length. Piston rod **62** is threaded through piston **57** and locked thereto by a locknut **66** and the remaining threaded portion is threadedly received in the tubular rod **58** which is also internally threaded at **68** over its length. A threaded plug **70** is threaded into the rod **58** from the other end and into contact with the distal end of the piston rod **62** so as to lock the rod **62** at whatever depth it has been threaded. The plug **70,** includes a suitable tool receiving surface **72** at its outer end to allow for tightening and loosening of the plug.

In order to adjust the stroke of the cylinder shown in FIG. **2,** plug **70** is rotated so as to move upward and out of contacting relationship with the distal end of piston rod **62.** Piston rod **62** is now held stationary and tubular rod **58** is rotated as previously described. Rotation of rod **58** causes the rod and its associated piston **56** to move axially toward or away from piston **57** and threadedly along the piston rod **62.** Once piston **56** has been positioned in its desired spaced relationship from piston **57,** plug **70** is again threadedly tightened into contact with the distal end of the piston rod **62,** locking the pistons in their adjusted spaced relationship.

The venting arrangement shown in FIG. **2** is somewhat different than that previously described. Instead of providing a bleed orifice through piston **56,** the seal rings **47** have been eliminated and the diameter of piston **56** is reduced slightly so as to provide for a small annular clearance space **74** between the perimeter of piston **56** and the inner wall **20** of the cylinder sleeve. Thus, during adjustment fluid will vent to or from spaces **46** and **28** through the annular clearance space.

Another embodiment of variable stroke cylinder of my invention is shown in FIG. **3.** In this embodiment, a rod **76** threaded over its length, is threaded through piston **56'** and lock nuts **77** and **78** are threaded onto one end of rod **76** into firm contact with the opposite faces of the piston so as to fix rod **76** to the piston. Rod **76** extends downward through piston **57'** and is threaded into a tubular rod **80** which carries a drive fitting D at its other end. The tubular rod **80** is mounted to piston **57'** for rotation relative thereto by way of a shoulder **82** at one side of the piston and a washer and nut **84** which is spaced slightly above the upper face of the piston **57'** and in contact with a slightly raised shoulder **85** adjacent the end of rod **80.** A slot **86** extends over a portion of the length of the rod **76** and a

key-like insert **88**, threaded to match the threads on rod **76**, is received therein. The threads of the insert **88** are substantially flush with the threads on rod **76**. The insert **88** is formed of nylon or other non-metallic material and provides a tight fit and a pre-load effect between rods **76** and **80**.

To adjust the stroke of the cylinder shown in FIG. **3**, tubular rod **80** is rotated. Since rod **76** is fixed to piston **56'** and also since the pistons **56'** and **57'** are prevented from rotating due to their rectangular cross section, rod **76** will move axially into or out of rod **80** driving piston **56'** toward or away from piston **57'** to effect stroke adjustment.

Since tubular rod **80** is also rotatable relative to its piston **57'**, one or more seal rings **90** are preferably positioned in the piston for sealingly bearing against the external surface of the rod to prevent leakage between chambers **20** and **46** during operation of the cylinder. Again to insure venting of the space **46** between the pistons during adjustment, annular space **74** may be provided about piston **56'** or a venting arrangement similar to that shown in FIG. **1** may be provided.

It will be appreciated that although my invention has been described as employed in a duplex cylinder, it may also be employed in a cylinder of simplex design by merely positioning both passages **21** and **22** at one end of the cylinder and providing a sealed pneumatic cushion space at the other end thereof. Moreover, it will also be understood that the embodiments of the present invention which have been described are merely illustrative of some of the applications of the principles of the invention. Numerous modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

What is claimed is:

1. In a variable stroke cylinder, a cylinder member, a pair of piston members spaced a predetermined distance from each other so as to define a space therebetween, said piston members being mounted for simultaneous axial movement in said cylinder member during normal operation thereof, means for selectively moving at least one of said piston members relative to the other said piston member for adjustably varying the stroke of said piston members by moving said piston members relative to each other to vary said predetermined distance between said members, the improvement which enables rapid and extensive stroke adjustment therein and which comprises in combination therewith:

vent means communicating with said space between said piston members for venting said space when said predetermined distance between the piston members is varied to vary the stroke of the cylinder to maintain the pressure in said space substantially constant during said stroke adjustment, wherein said vent means comprises a bleed orifice in one of said piston members communicating between the face of said piston member adjacent said space and the opposite face of said piston member.

2. The cylinder of claim **1** wherein said bleed orifice is in said selectively moveable piston member.

3. The cylinder of claim **1** wherein said piston members include an elongated rod, the rod of one of said piston members being threadedly journaled through the other of said rods, whereby rotation of one of said rod effects said selective relative movement of said piston members.

4. The cylinder of claim **3** further including locking means, comprising threaded plug means positioned in the second mentioned rod and movable into contact with the first mentioned rod.

5. The cylinder of claim **3** wherein said piston members and said cylinder member are non-circular in cross section for preventing rotation of said piston members, and at least one of said rods is rotatable relative to its piston member to effect said selective relative movement of said piston members.

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