

[54] SYNCHRONIZER FOR HYDRAULIC CYLINDERS

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[22] Filed: Sept. 3, 1971

[21] Appl. No.: 177,589

[52] U.S. Cl. 60/547, 60/581, 60/593, 92/151

[51] Int. Cl. F15b 7/00, F01b 7/00

[58] Field of Search 60/54.5 R, 54.5 E, 60/54.6 E, 54.5 P, 547, 581, 593; 92/151, 86, 258

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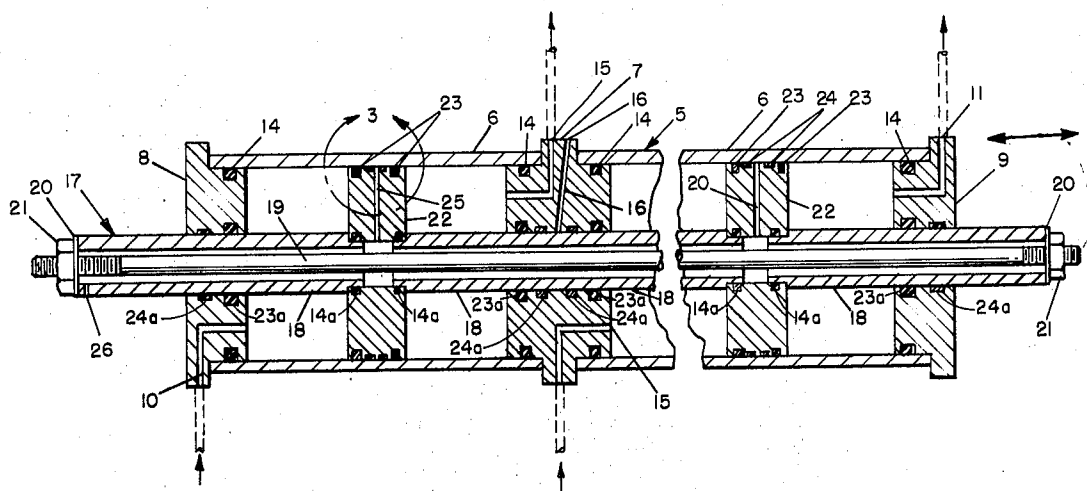
Primary Examiner—Edgar W. Geoghegan

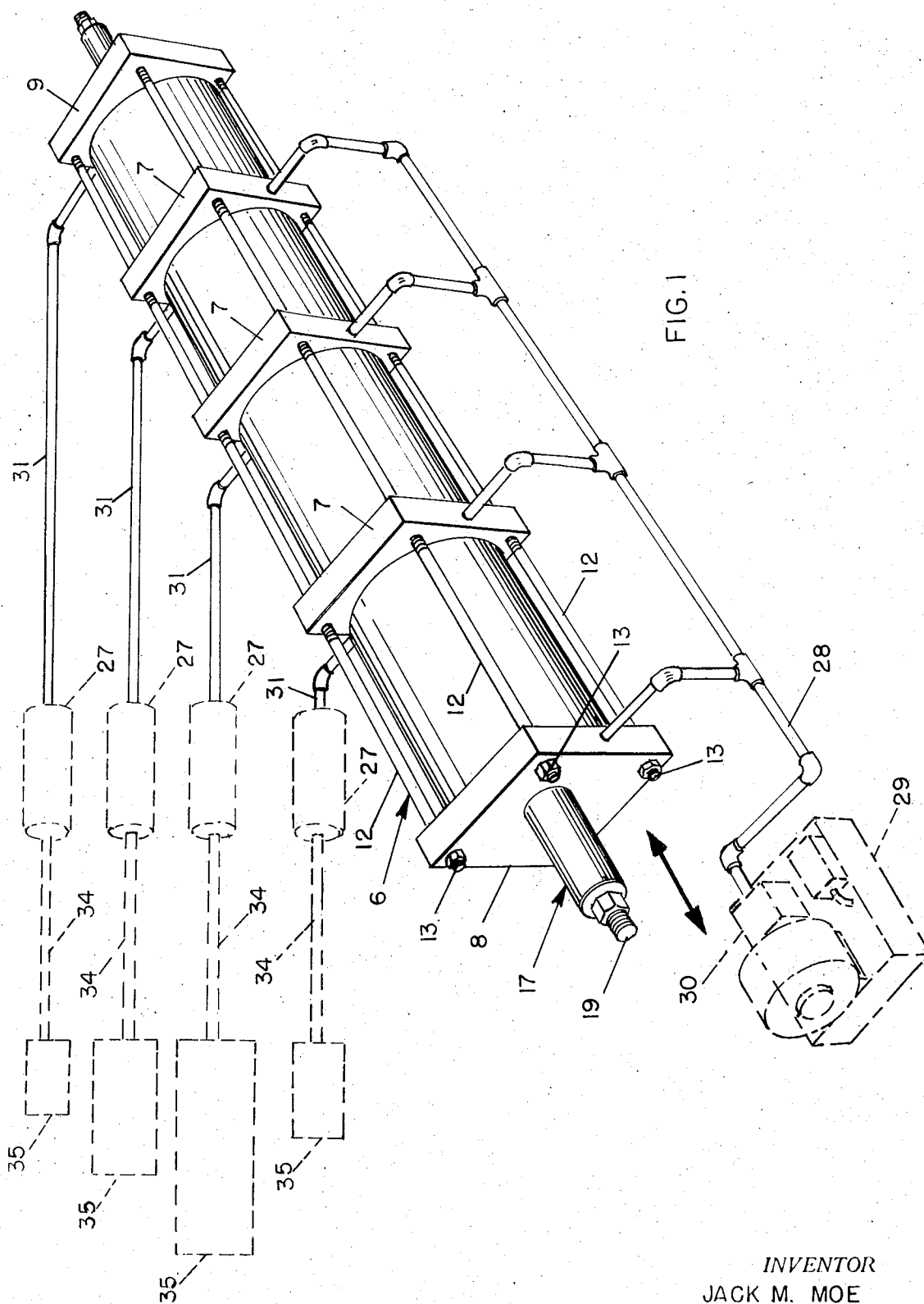
Assistant Examiner—A. M. Zupcic

[57] ABSTRACT

This invention consists of a plurality of steel tubes placed end to end with a divider plate between the ends of the aforesaid tubes; and an end plate on the outer end of each tube. The aforesaid invention is held together by a plurality of longitudinally disposed tie bolts or rods that pass through all of the dividers and the aforesaid end plates. The piston rod is provided with a plurality of pistons while the aforesaid divider plates and the end plates are all provided with L-shaped fluid passages, the invention being suitably connected by pipes or tube to a plurality of hydraulic cylinders, each hydraulic cylinder having a different load imposed thereon; and the said invention also being connected by pipes or tubes to a source of hydraulic fluid under pressure, the synchronizer adapted to keep all of the aforesaid hydraulic cylinders in unison.

5 Claims, 3 Drawing Figures





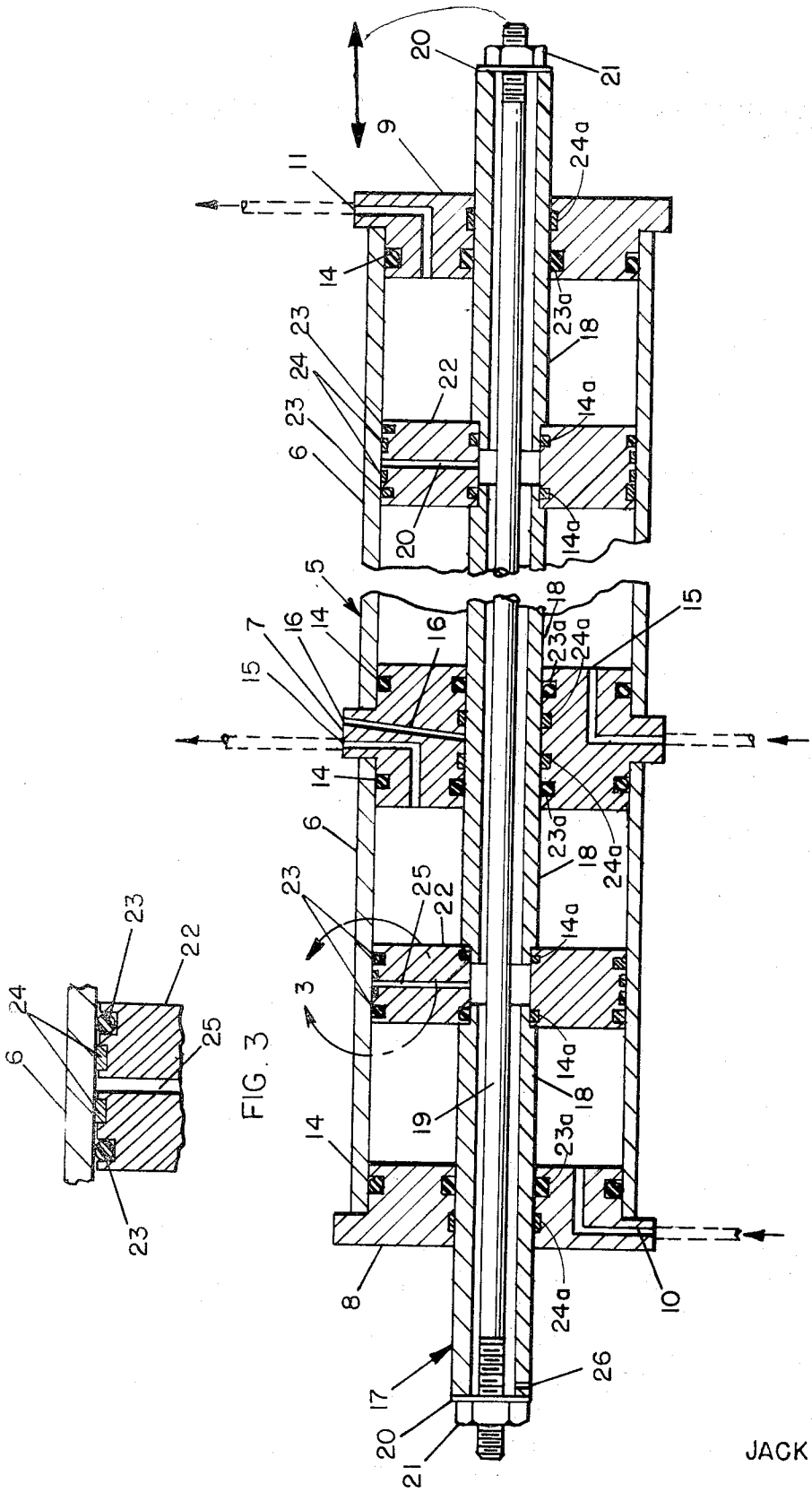


FIG. 2

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SYNCHRONIZER FOR HYDRAULIC CYLINDERS

This invention relates to machinery or the like that is operated by hydraulic mechanism; more particularly, to a synchronizer that will permit the piston rods of a number of hydraulic cylinders to travel simultaneously and in exact unison from a single supply of hydraulic fluid.

Although a number of different types of mechanisms have no doubt been developed to synchronize a plurality of hydraulic cylinders operating from a single hydraulic supply line, none have to date been known to be completely satisfactory as is well known to those experienced in the art.

It is therefore the principal object of this invention to provide a synchronizer for hydraulic cylinders of the character described that will give complete synchronization of all of the hydraulic cylinders that are connected to a single hydraulic supply line through this invention.

Another object of this invention is to provide a synchronizer for hydraulic cylinders that embodies a single piston rod having a plurality of pistons thereon, as will hereinafter be described.

Another object of this invention is to provide a synchronizer for hydraulic cylinders that takes up a minimum amount of space on a machine or other hydraulically operated mechanisms.

Still another object of this invention is to provide a synchronizer for hydraulic cylinders that can be manufactured to operate any number of hydraulic cylinders whose pistons will travel in exact unison regardless of the varying or unequal loads on the individual cylinders.

Other and further objects and advantages of this novel invention will no doubt appear as the reading of this specification and its appended claims proceeds and the accompanying drawings are examined in connection therewith.

In the drawings:

FIG. 1 is a pictorial view of this invention connected to a single source of hydraulic fluid and a plurality of hydraulic cylinders. Only the invention is drawn in solid black lines.

FIG. 2 is a longitudinally disposed sectional view of this invention.

FIG. 3 is an enlarged view of that portion of this invention that is encircled by the arrowed line and indicated by the number 3 in FIG. 2.

In the several views of this invention, like parts of the device are indicated by like reference numbers. The reference number 5 indicates this invention in its entirety.

Directing ones attention to the first two figures of the accompanying drawings it will be seen that this invention of a synchronizer 5 consists of a plurality of metal cylinders 6 assembled end to end and separated by divider plates 7. The two outer ends of the aforesaid synchronizer 5 are capped with end plates 8 and 9. End plate 8 is provided with an L-shaped hydraulic fluid passage 10 while end plate 9 is likewise provided with a similar hydraulic fluid passage 11. The metal tubes, divider plates, and end plates are all held in place by means of a plurality of tie bolts or rods 12 that pass longitudinally through the aforesaid divider plates 7 and the end plates 8 and 9. Each end of each tie bolt or rod is provided with threads on which are screwed nuts 13

that firmly secure the so-far parts of this invention together. Looking now at FIG. 2 of the drawings it will be seen that the aforesaid divider plate(s) 7 and end plates 8 and 9 are all provided with O-rings seals 14 that prevent leakage of hydraulic fluid out of the synchronizer 5. The end plates 8 and 9 are provided both with O ring seals 23a and wear rings or bearings 24a. Likewise, the divider plates 7 are provided with opposed O ring seals 23a and wear rings 24a. Also in the divider plates 7 are vent passageways 16 located at their entry between the opposed O ring seals 23a, and two L-shaped hydraulic fluid passages 15 and 15a.

Still looking at FIG. 2 of the drawings it will be seen that this invention contains a longitudinally slidable piston rod 17 that consists of a plurality of tubes 18 which are mounted end-wise on the rod 19 whose ends are provided with threads on which are placed washers 20 and nuts 21 that hold the aforesaid tubes 18 in place after the plurality of pistons 22 have been placed in position on the piston rod, as is clearly shown in FIG. 2. External 23 and internal 14a O-ring seals of the pistons 22 provide the necessary sealing of this part of the synchronizer. Each piston 22 is provided with a plurality of piston wear rings 24 and each piston 22 has a radially disposed vent opening 25 between the O ring seals 23. A vent opening 26 is located in the outer end of one of the aforesaid tubes 18 of the piston rod 17, to allow atmospheric pressure between the opposed O rings seals 14a.

The construction of this invention has now been described in detail and its method of securement in the hydraulic system of a piece of machinery or other hydraulically operated mechanisms will now be given along with its method of operation.

Directing ones attention again to FIG. 1 of the accompanying drawings it will now be seen that this invention is connected between the plurality of hydraulic cylinders 27 and the hydraulic fluid supply line 28 which of course is connected to a hydraulic fluid supply tank 29 and a pump 30. A tube or pipe 31 connects each of the aforesaid hydraulic cylinders 27 with the aforesaid hydraulic fluid passage 15 in the divider plates 7 with the exception of the last one of the hydraulic cylinders. This last cylinder has its tube or pipe 31 connected to aforesaid hydraulic fluid passage 11 that is in the aforesaid end plate 9 of this invention. It should be noted at this time that the piston rods 34 of all of the aforesaid hydraulic cylinders 27 are connected to various loads 35 on the outer end thereof. The load of each piston is of course different from that of the other loads, as will be fully understood by those experienced in the art.

The piston rod 17 of the synchronizer 5 moves, solely because of changes in hydraulic fluid energy, back and forth as is indicated by the arrowed line in FIGS. 1 and 2 of the accompanying drawings. When this is done it is obvious from examination of FIG. 2 that the hydraulic fluid being pumped under pressure in the synchronizer 5 through the aforesaid hydraulic fluid supply line 28 will be supplied in the same volume to all of the aforesaid hydraulic cylinders that are connected to the synchronizer. This action will obviously result in all of the pistons of the often mentioned hydraulic cylinders traveling in exact unison, which is the basic object of this invention.

From the foregoing, and an examination of the accompanying drawings, it will be seen by those experi-

enced in the art that this invention accomplishes all of the objects of the synchronizer when the device is connected in the hydraulic system of a machine or other hydraulically operated mechanisms, in the manner illustrated in FIG. 1 of the drawings.

This invention is subject to any and all changes in detail design and/or modifications that one may care to make in so long as the changes and/or modifications fall within the scope and intent of the appended claims.

What I now claim as new is:

1. A synchronizer for a fluid power system to supply like quantities of fluid to multiple working fluid actuators utilizing the energy of another separate source of fluid under pressure comprising a housing comprising a plurality of hollow cylindrical members arranged coaxially, a pair of end plates having portions fitted within and closing the outer ends of the outermost ones of said cylindrical members to form an enclosed cylindrical space; divider means extending transversely across said space to divide said space into a plurality of equal volume working chambers corresponding in number to the number of said fluid actuators, said divider means having oppositely facing annular shoulders adapted to support and receive the ends of adjacent ones of said cylindrical members; said end plates and said divider means having portions extending radially outwardly beyond said cylindrical members, tie rods connecting said end plates and said divider means together at said projecting portions, a piston rod extending through said end plates and said divider means, a plurality of pistons carried by said piston rod, one piston being disposed in each of said working chambers, means connecting the

space at one side of each of said pistons to said separate source of fluid, said piston rod projecting at each end beyond said end plates in all positions of said pistons, and means connecting the space at the opposite side of each of said pistons to one of said fluid actuators, whereby upon the application of pressure to said working chambers from said separate source, each of said pistons is caused to move the same distance, displacing equal amounts of fluid to said fluid actuators from the spaces at the opposite sides of said pistons.

2. The synchronizer according to claim 1 wherein the piston rod has a hollow interior portion vented to atmosphere through a portion of the piston rod which extends beyond one of said end plates.

3. The synchronizer according to claim 1 wherein said piston rod is formed by a plurality of hollow cylindrical sections, each section having an end portion fitting into one side of one of said pistons, a retainer rod extending through said piston rod from end to end thereof; and means in the outer ends of said retainer rod effective to retain said piston rod sections in assembled relation with said pistons.

4. The synchronizer according to claim 1 together with spaced seals carried by said divider means for engagement with said piston rod, and means venting the space between said seals.

5. The synchronizer according to claim 2 together with spaced seals carried by said pistons for engagement with said cylindrical members, and means connecting the space between said seals to the interior of said piston rod.

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