

[54] **HYDRAULIC DRIVING SYSTEM**
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[58] **Field of Search** **91/191, 178, 189, 91/447**

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[57] **ABSTRACT**

There is provided a hydraulic driving system having two independent driving cycles and comprising two double-acting piston-cylinder assemblies, each of the pistons of which have a specific starting position and is arranged to move from said position through the medium of an interlocking means only when the other piston occupies its starting position.

4 Claims, 2 Drawing Figures

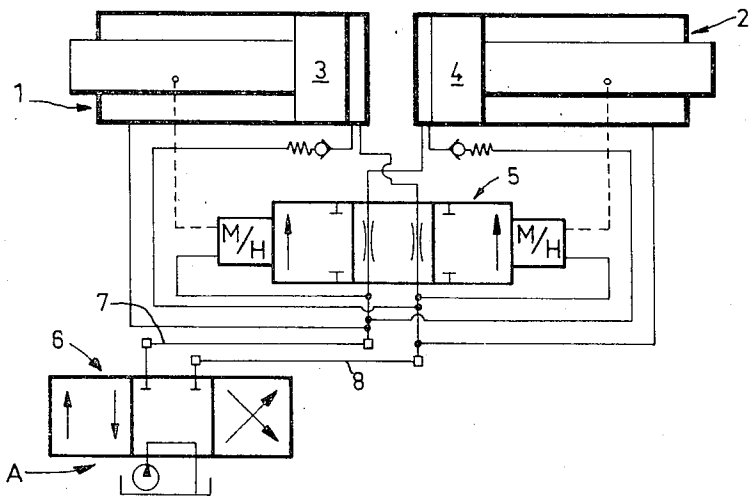


FIG. 1

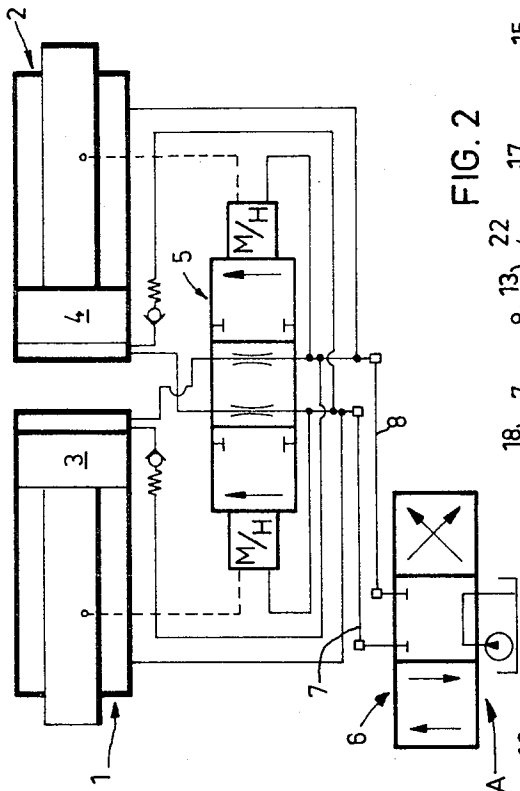
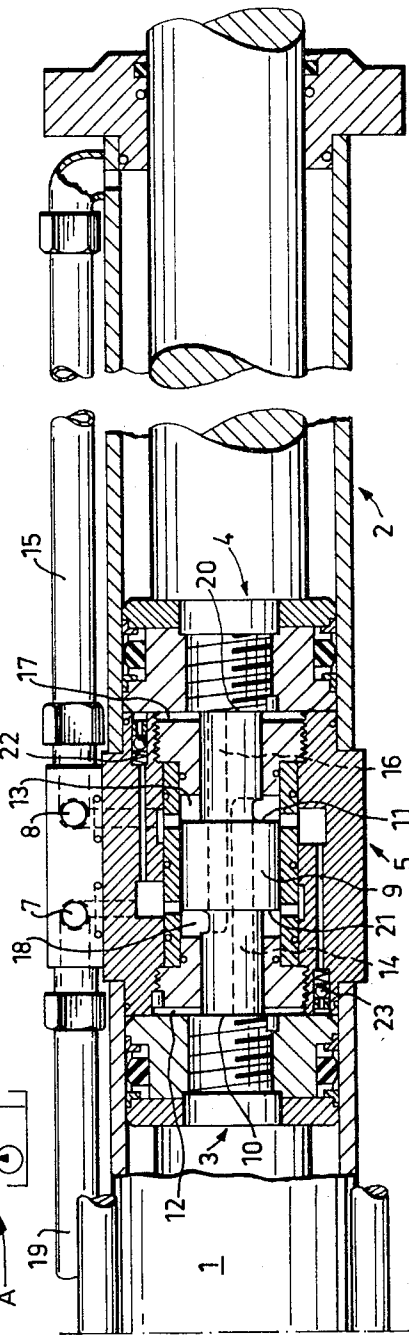


FIG. 2



HYDRAULIC DRIVING SYSTEM

The present invention relates to a hydraulic driving system having two driving cycles which are independent of each other, the system comprising two double-acting piston-cylinder assemblies, each of the pistons of which have a specific starting position. The system according to the present invention is mainly characterized by an interlocking device so constructed that the piston of one of the piston-cylinder assemblies is movable from its starting position only when the piston of the other piston-cylinder assembly occupies its starting position.

A hydraulic driving system constructed in accordance with the invention can be used as a driving means for machines, apparatus etc. which carry out two separate, cyclic operations, of which one cycle may start only when the device associated with the second cycle has reached its starting position. For example, the system is suitable for use with side-tipping loader buckets or excavator scoops of the type which tip towards both sides. When applied to such buckets the system of the present invention can be used in a number of different ways. For example, it can either be used solely for laterally tipping the buckets or solely to operate the locking means which retain the buckets in position during the different tipping movements, and can also be used to provide both the actual tipping movements and for operating the bucket position locking means.

The system of the present invention affords considerable advantages over known, multi-purpose hydraulic driving systems. For example, the system of the present invention is much more compact than the driving system described in my Swedish Pat. No. 317 030, this system comprising one piston-cylinder assembly having a common piston rod which projects out from both sides of the assembly, and despite its compactness is more robust than the known system and has short and strong piston rods, thereby reducing to some extent its volume, which in turn enables it to be installed within a smaller space than the known system, a feature which is highly significant with respect, for example, to loader buckets and excavator scoops, with which a robust driving system which requires but a small installation space is always desirable.

The U.S. Pat. No. 3 419 171 describes a hydraulic driving system for lateral and front tipping loaders. This known system is provided with two single-acting cylinders provided with spring loaded pistons. The disadvantage with this system is that too much force is required to overcome the inherent strength of the springs and that the system is bulky and requires a relatively large installation space. These disadvantages are eliminated with the system of the present invention, which also locks one piston while the other works, a feature which is not found in the known system.

The system of the present invention also affords advantages of the aforementioned type when compared with the hydraulic driving system known from the French Pat. No. 1 366 024, in which are installed spring-loaded pistons, and thus no double-acting piston-cylinder assemblies, and with which system the movements of the two pistons can only be locked in a manner such that one piston is unable to move while the other is moving and thus the pistons are not capable of being locked normally in their starting positions.

The invention will now be described in more detail with reference to the accompanying drawing, in which FIG. 1 illustrates diagrammatically an embodiment of the invention, and FIG. 2 shows the embodiment shown in FIG. 1 in a more detailed, practical illustration.

As will be seen from the drawing, a hydraulic driving system according to the invention includes two double-acting piston-cylinder assemblies 1, 2 having pistons 3, 4. Each of the pistons has a specific starting position and each of the pistons is capable of being moved through the medium of an interlocking means 5 in a direction from its starting position only when the other piston is located in its starting position.

The actual interlocking means 5 comprises at least one hydraulic means and is controlled both mechanically and hydraulically. The system in its entirety is capable of being operated solely by three different control pulses sent from an operating means 6, for example in the form of a four-path hydraulic valve of known design, the control pulses being transmitted to the system through two hydraulic connecting lines 7, 8. The system is connected to a hydraulic driving circuit, indicated in the drawing by the reference A, via the operating means 6.

It will be evident from FIG. 2, which illustrates the two piston-cylinder assemblies 1, 2 connected to form a single unit with the interlocking means therebetween as a common end wall piece, that the interlocking means 5 need only be provided with one single moving element, namely a sliding piston 9. The piston 9 is provided on its end surface facing the piston-cylinder assembly 1, to the left of the Figure, with a pressure surface 10 which is exposed to a chamber 12 located between the interlocking means 5, which also serves as an end wall piece, and the piston 3 in the piston-cylinder assembly 1 and which communicates with an annular chamber 13 located in the interlocking means 5 through a channel 14 disposed in the sliding piston 9. The sliding piston 9 is also provided with an annular pressure surface 11 which is acted upon in a direction opposite to the pressure surface 10 and arranged on a cylindrical collar portion located on the centre portion of the sliding piston, the area of the annular pressure surface 11 being greater than the area of the pressure surface 10 facing the piston-cylinder assembly 1.

The hydraulic line 8 extending from the operating means 6 is connected to the annular chamber 13 and also communicates, via the channel 14 in the slide piston 9, with the chamber 12 between the piston 3 of the piston-cylinder assembly 1 and the interlocking means 5, which also serves as an endwall piece. Furthermore, the hydraulic line 8 is connected with the chamber within the outer end of the piston-cylinder assembly 2, shown to the right of the drawing, through a constantly open line 15.

As will be seen from FIG. 2, the interlocking means 5 is symmetrical, and hence the sliding piston 9 also includes a second channel 16 which corresponds to the channel 14 and which extends between a chamber 17 located between the other end of the interlocking means 5 and the piston 4 of the piston-cylinder assembly 2, and a second annular chamber 18 at the other end of the cylindrical collar portion of the sliding piston 9. The hydraulic line 7 is connected with the second annular chamber 18 and communicates, via the second channel 16 in the sliding piston 9, with the chamber 17 located between the piston 4 of the piston-cylinder as-

sembly 2 and the interlocking means 5. The hydraulic line 7 also communicates with the space within the outer end of the piston-cylinder assembly 1, via a constantly open line 19. Arranged in the space between the piston 4 and the interlocking means 5 and in the second annular chamber 18 at the other end of the cylindrical collar portion of the sliding piston 9 are pressure surfaces 20 and 21 respectively, the area of the pressure surface located in the last mentioned space being greater than that located in the first mentioned space. In short, it can be said that the four pressure surfaces 10, 11, 20, 21 are arranged in opposed relationship on the ends of the sliding piston and on the ends of the cylindrical collar portion located thereon, the areas of the surfaces 10, 20 arranged on the ends of the piston being equal but smaller than the areas of annular surfaces 11, 21 located on the ends of the collar portion, the area of the surfaces 11, 21 also being equal but greater than the area of the surfaces 10, 20 located on the ends of the piston. The pressure surfaces 11, 21 of larger area communicate through their respective channels 14, 16 in the sliding piston 9 with the opposed pressure surfaces of smaller area arranged on the opposite end of the sliding piston. The cylindrical collar on the sliding piston 9 serves as a valve means during movement of the piston for controlling the flow of pressure medium to and from the two annular chambers 13 and 18.

The mode of operation of the illustrated embodiment of the system according to the invention will be evident from the following.

In the drawing, the pistons 3, 4 of the two piston-cylinder assemblies 1, 2 are shown occupying their inner end positions, which comprise the starting positions for the working cycle of the pistons. The hydraulic pistons 3, 4 act mechanically against each end of the sliding piston 9 to maintain it in a central position. In this position the connection from one of the hydraulic lines 8 to the chamber 12 at one end of the sliding piston 9, having the associated pressure surface 10, and to the annular chamber 13 at the opposite end of the collar and having the pressure surface 11, is open but presents a constricted through-flow area, while the connection to the space within the outer end of the piston-cylinder assembly 2 is fully open. At the same time, the connection from the second hydraulic line 7 to the two corresponding chambers 17, 18 and the pressure surfaces 20, 21 located on the opposite ends of the sliding piston and the collar, respectively, is also open but presents a restricted through-flow area while the connection to the space within the outer end of the opposing piston-cylinder assembly 1 is fully open.

Subsequent to setting the operating means 6, pressure medium is supplied through the hydraulic line 8 at the same time as pressure medium is removed through the hydraulic line 7, and the piston 4 in the piston-cylinder assembly 2 is actuated by the supplied pressure medium in a manner to hold the piston in its starting position. As a result of the constricted through-flow area of the fluid inlet at the ends of the cylindrical collar on the sliding piston 9, which collar also acts as a valve means, there is a restricted supply of pressure medium to the annular chamber 13 and from there to the chamber 12 between the piston 3 of the piston-cylinder assembly 1 and the interlocking means 5, via the channel 14 in the sliding piston 9. This restricted supply of pressure medium to the chamber 12 causes the piston 3 in the piston-cylinder assembly 1 to move outwardly

from its inner end position, the sliding piston 9 moving in the same direction until it reaches a stop position determined by its cylindrical collar as a result of the fact that the pressure surface 11 arranged on the collar and acted upon by the pressure prevailing in the annular chamber 13 is of greater area than the pressure surface 10 arranged on the opposite end of the sliding piston and actuated by a pressure of equal magnitude prevailing in the chamber 12. As a result of this movement of the sliding piston, the connection from the hydraulic line 8 to the chamber 12 located between the piston 3 of the piston-cylinder assembly 1 and the interlocking means 5 is fully opened, whereby the piston 3 moves at full speed upon continued outward movement. At the same time, because of the collar on the sliding piston 9, the connection between the second hydraulic line 7 and the chamber 17 between the piston 4 and piston-cylinder 2 and the interlocking means 5 is fully closed, thereby ensuring that the piston 4 does not make a working stroke.

In order to return the piston 3 of the piston-cylinder assembly 1 to its starting position, the supply of pressure medium is switched, by means of the operating means 6, from the hydraulic line 8 to the hydraulic line 7, whereupon pressure medium is drained through the hydraulic line 8 under the action of the supply of pressure medium through the constantly open connection 19, while pressure medium is fed to the second hydraulic line 7 and to the space within the outer end of the piston-cylinder assembly 1, this supply of pressure medium forcing the piston 3 in the piston-cylinder assembly 1 towards its starting position and towards the interlocking means 5. Since the pressure surfaces 10 and 11 are now subjected to the pressure prevailing in the hydraulic line 8 serving to drain the pressure medium, the sliding piston 9 is maintained in its left stop position as seen in the drawing, i.e., is displaced in a direction towards the still operating left hand piston-cylinder 1. Thus, the connection is closed between the hydraulic line 7, through which the pressure medium is now being supplied, and the piston 4 of the right hand piston-cylinder assembly 2. Thus, the piston-cylinder assembly 2 is also inactive during the return stroke of the piston-cylinder assembly 1, since the interlocking means 5 prevents the piston 4 from moving from its starting position.

Subsequent to the aforescribed movement of the piston 3, the interlocking means 5 is re-set to its starting position by moving the sliding piston 9 mechanically from its left hand stopping position, as seen in the drawing, to its centre position, by the piston 3 as said piston, during its return stroke, moves through the last part of its travel towards its original starting position.

When the sliding piston 9 has reached its central position, either the piston 3 of the piston-cylinder assembly 1 or the piston 4 of the piston-cylinder assembly 2 can be caused to effect a working stroke, by supplying pressure medium to either of the hydraulic lines 7, 8 by means of the operating means 6.

It will be evident from the foregoing, that neither of the two pistons 3, 4 are able to move from their starting position when the other piston has left its starting position. Thus, when one piston-cylinder assembly 1, 2 is active and its piston 3, 4 is in motion, the other piston-cylinder assembly is inoperative and its piston is locked in its starting position.

In the exemplary embodiment of the system according to the invention, as illustrated in FIG. 2, the throttling effect which the cylindrical collar of the sliding piston 9 has on the flow of pressure medium has two purposes, firstly, the constricted flow of pressure medium causes the system to operate slowly around the starting positions of the pistons, and secondly it shortens the length of movement required by the sliding piston to close the inactive piston-cylinder assembly 1,2 at that moment.

The illustrated system is also provided with non-return valves 22,23 which serve to take up a portion of the return flow of pressure medium over the sliding piston 9 and to permit that of the pistons 3,4 of the piston-cylinder assemblies 1,2, which is inactive at the moment, to move through a slight distance from its starting position and towards the interlocking means 5 serving as a common end wall piece for the piston-cylinder assemblies, this movement being insufficient to influence locking of the piston.

As will be evident from the foregoing, each of the pistons 3,4 of the two piston-cylinder assemblies is arranged to remain in or to adopt its starting position in response to a guide pulse which causes the other piston to move from its starting position. Each of the pistons are also arranged to remain in their respective starting positions in response to a guide pulse which causes the other piston to move toward its starting position.

The invention is not restricted to the described and illustrated embodiment but can be modified within the scope of the following claims.

What I claim is:

1. A hydraulic driving system having two independent driving cycles comprising a first and a second double-acting piston-cylinder assembly, the piston of each assembly having a specific starting position, and an interlocking valve means between said assemblies for controlling movement of said pistons so that one piston may be moved from its starting position only when the

other piston is maintained at its starting position, said valve means including a first and a second hydraulic inlet and a sliding piston controlling said inlets, means for selectively supplying hydraulic pressure to said inlets, said sliding piston being at a neutral position when the first and second pistons are at their starting positions and being movable from its neutral position in one direction to a first position when subject to hydraulic pressure through the first inlet so as to close the second inlet and to admit hydraulic pressure to said first piston to move it from its starting position, means for simultaneously supplying hydraulic pressure to the outer end of the second piston to maintain it in its starting position, and means for supplying hydraulic pressure to the outer end of the first piston when at the outer end of its cylinder when desired to return said first piston to its starting position, said sliding valve remaining in its first position until said first piston has returned to its starting position and returns said sliding piston to its neutral position, the same functions occurring in opposed relation when hydraulic pressure is supplied to said second inlet.

2. A hydraulic driving system as claimed in claim 1 wherein said sliding piston is provided with two sets of opposed pressure surfaces of unequal area, one set of said surfaces being subject to the hydraulic pressure supplied through one of said inlets to move the sliding valve from its neutral position.

3. A hydraulic driving system as claimed in claim 2 wherein said sliding valve is provided with two channels therethrough, each channel affording communication between the surfaces of unequal area of one set.

4. A hydraulic driving system as claimed in claim 1 wherein the cylinders of said assemblies are disposed co-axially on opposed sides of said interlocking valve means and secured thereto and said pistons, when in their starting positions, abut said sliding piston when the latter is in its neutral position.

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