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CLUTCH AND BRAKE CONTROLS FOR INCHING VEHICLE

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FIG. 1

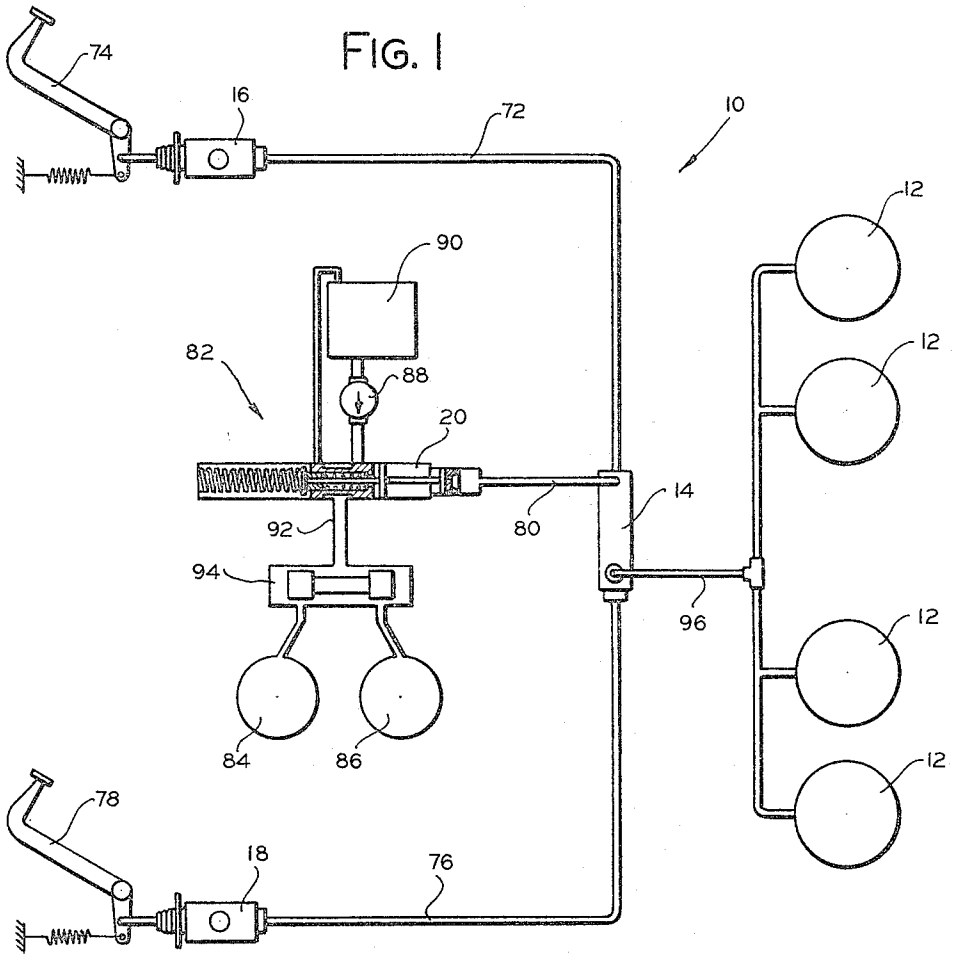
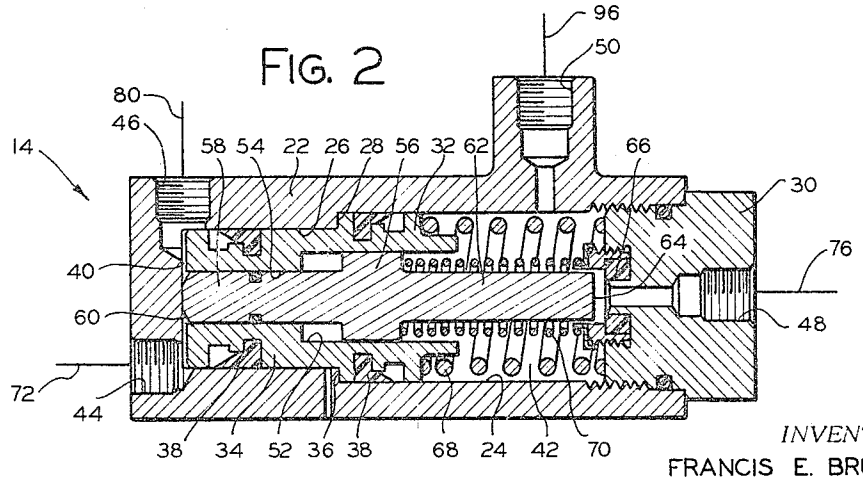


FIG. 2



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CLUTCH AND BRAKE CONTROLS FOR INCHING VEHICLE

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This invention relates to braking and inching systems, and more particularly to systems having an operator controlled actuator for applying the vehicle brakes only and a separate operator controlled actuator for disengaging the drive train and applying the brakes.

In fork lift trucks it is often desirable to operate the engine at a high speed so that the lift fork or like material engaging device can be elevated rapidly. It is desirable in such circumstances to be able to "inch" the vehicle forwardly or rearwardly, as desired, to make possible its accurate positioning and the handling of material. In fork lift trucks having transmissions of the type including fluid actuated clutches it is common practice to allow the clutch to slip to the extent necessary to reduce the power transmitting capacity thereof and at the same time engage the brakes to the extent necessary. A system of this type is disclosed in U.S. Patent No. 3,143,127 issued Aug. 4, 1964, in the name of Barry L. Frost.

In a system as just described it is inherent that the drive train is partially or fully disengaged before the vehicle brakes are applied. It is sometimes desirable to be able to apply the vehicle brakes without disengaging the drive train, for example, when the lift truck is on a ramp, or similar inclined surface. Consequently, inching and braking systems have been developed which permit disengagement of the drive train and brake application or only brake application without disengagement of the drive train. An example of such a system is shown in U.S. Patent No. 2,883,015 issued Apr. 21, 1959, in the name of Charles S. Schroeder. One of the shortcomings of a system such as disclosed in the aforementioned Schroeder patent is that it is difficult to keep both foot pedals properly adjusted as the linings on the brake shoes wear.

A principal object of my invention is to provide an improved dual pedal inching and braking system.

In carrying out my invention is a preferred embodiment thereof I provide a valve with a bore therein which is divided into two chambers by a pair of pistons, one telescoped inside the other. First and second ports communicate with one chamber and third and fourth ports communicate with the other chamber. The first and third ports are each connected to separate piston and cylinder fluid actuators. The second port is connected to means for disengaging a power-shifted transmission and the fourth port is connected to the brakes. When one of the actuators is operated to supply pressurized fluid to the first port, the means for disengaging the transmission is actuated and one of the pistons is operated to block communication between the third port and the chamber with which it communicates. Also, the other piston is actuated to force fluid out of the chamber through the fourth port to apply the brakes. When the other actuator is operated pressure fluid is supplied through the fourth ports and the associated chamber to apply the brakes.

The above and other objects, features and advantages of my invention will be more readily understood by persons skilled in the art when the following detailed description is taken in conjunction with the accompanying drawing wherein:

FIGURE 1 shows a dual pedal inching and braking system according to my invention and

FIGURE 2 is a cross section of a valve embodied in my invention.

Referring now to the drawing, the reference numeral 10 denotes generally a braking and inching system which a plurality of brakes 12, a valve 14, a piston and cylinder actuator 16 for generating pressurized fluid, a piston and cylinder actuator 18 for generating pressurized fluid and means 20 for disengaging the associated drive train.

Valve 14 includes an elongated body 22 with a longitudinally extending step bore 24 therein which has a reduced diameter portion 26 that forms a shoulder 28. The open end of bore 24 is closed by threaded plug 30.

Slidably disposed in bore 24 is a step piston 32 which has a reduced diameter portion 34 that forms a shoulder 36. Shoulder 36 cooperates with shoulder 28 to limit the leftward movement of piston 32 in bore 24. A pair of fluid pressure seals 38 are disposed in grooves in piston 32. Piston 32 defines with bore 24 and plug 30 a pair of fluid chambers 40 and 42. Communicating with chamber 40 is a pair of ports 44 and 46. Similarly, another pair of ports 48 and 50 communicate with chamber 42.

A step bore 52 which includes a reduced diameter portion 54 extends longitudinally between the ends of piston 32. Slidably disposed in bore 52 is a piston 56 having a reduced diameter portion 58 with a chamfered end 60 and a reduced diameter portion 62 with a flat end 64. Flat end 64 cooperates with an adjacent resilient ring 66 mounted on plug 30 to form a seal as will be explained shortly.

Piston 32 is biased toward the left, as viewed in FIGURE 2, by means of a compression spring 68 which is disposed in chamber 42. Also, piston 56 is biased toward the left by a compression spring 70 which is disposed in chamber 42. Spring 70 has a substantially lower spring rate than spring 68 so that considerably less force is required to move piston 56 toward the right against the bias of spring 70 than is required to move piston 32 toward the right against the bias of spring 68.

Actuator 16 is connected to port 44 by means of a fluid conduit 72. Also connected to actuator 16 is a foot operated pedal 74 which when depressed causes actuator 16 to supply pressurized fluid to chamber 40 via conduit 72 and port 44. Actuator 18 is connected to port 48 by means of a conduit 76 and also is connected to an operator controlled foot pedal 78 so that when pedal 78 is depressed actuator 18 supplies pressurized fluid through conduit 76 and port 48 to chamber 42.

Connected to port 46 and hence chamber 40 is a conduit 80 which is connected at the other end thereof to inching valve 20. Inching valve 20 is disposed in a fluid circuit 82 for supplying pressurized fluid to the fluid actuated forward and reverse clutches 84 and 86 of a power-shifted transmission. Fluid circuit 82 also includes a pump 88 which draws fluid from a reservoir 90 and supplies fluid under pressure to inching valve 20 which regulates the pressure of fluid supplied via conduit 92 to a direction control valve 94 that distributes the pressurized fluid either to forward clutch 84 or reverse clutch 86. As the pressure of fluid supplied to valve 20 via conduit 80 increase valve 20 is actuated to reduce the pressure of fluid supplied to whichever one of the clutches 84 and 86 is engaged. As the pressure of fluid being supplied to the engaged clutch decreases the power transmitting capacity of the engaged clutch will decrease until the clutch is completely disengaged and no longer has any capacity to transmit power. A more detailed description of the struc-

ture and operation of inching valve **20** will be found in the above-mentioned U.S. Patent No. 3,143,127.

Connected to port **50** and hence chamber **52** is fluid circuitry **96** which communicates pressurized fluid to the various brakes **12** which may be either shoe brakes or disc brakes, for example.

In order to enable persons skilled in the art to better understand my invention, I will now explain the operation of it. It will be assumed that my inching and braking system is embodied in a fork lift truck having a power-shifted gear transmission which includes fluid actuated forward and reverse clutches. It will further be assumed that the truck is conditioned for forward drive and that the operator wishes to mancuver the truck while elevating a load carried by the fork lift. In order to accomplish this the operator depresses foot pedal **74**, thereby supplying pressurized fluid to chamber **40**. The pressurized fluid supplied to chamber **40** acts against end **60** of piston **56** and causes it to move to the right against the bias of spring **70** so that end **64** is brought into fluid sealing abutment with seal **66**, thereby blocking fluid communication between port **48** and chamber **42**. Also, pressurized fluid supplied to chamber **40** is directed to inching valve **20** via conduit **80** and causes inching valve **20** to operate to reduce the pressure of fluid supplied to forward clutch **84**, causing clutch **84** to slip. As pedal **74** is depressed further the pressure of fluid supplied to chamber **40** is increased, thereby actuating inching valve **20** to further decrease the pressure of fluid supplied to forward clutch **84**. When the pressure of fluid being supplied to clutch **84** is reduced sufficiently clutch **84** will be completely disengaged. As the pressure of fluid being supplied to chamber **40** increases the force acting on the reduced diameter portion **34** of piston **32** will be increased until piston **32** is moved toward the right against the bias of spring **68**, thereby forcing fluid out of chamber **42** with the result that brakes **12** are applied with increasing force as piston **32** moves further toward the right. Preferably, the application of brakes **12** is timed to begin as clutch **84**, for example, is substantially fully disengaged. However, this timing can be varied by changing the rate of spring **68**, for example, to have the brake application begin slightly sooner relative to clutch disengagement or delay brake application even further after clutch disengagement.

Should the operator of the truck desire to brake the truck for a normal stop or bring the truck to a stop while on an incline, it is desirable to maintain the full effect of the drive train in order to take advantage of engine braking, for example. Therefore, the operator can in such circumstances depress pedal **78** which causes actuator **18** to supply pressurized fluid to chamber **42** and hence to brakes **12** via port **50** and fluid circuitry **96**, causing them to be applied.

While I have disclosed a single preferred embodiment of my invention in the above-detailed description, it will be understood that this description is for illustrative purposes and should not be construed as limiting the scope of my invention. Various modifications and changes to my invention which are nonetheless within the spirit and scope of my invention may occur to persons skilled in the art, and so the limits of my invention should be determined from the following claims.

I claim:

1. A valve comprising an elongated body, a longitudinally extending bore in the said body, a first piston slidably disposed in the said bore for longitudinal movement and defining with the said bore first and second longitudinally spaced apart chambers, first and second ports commmunicating with the said first chamber, third and fourth ports communicating with the said second chamber, spring means for biasing the said first piston toward the said first chamber, a second bore extending longitudinally through the said first piston, a second piston slidably disposed in the said second bore and actuatable longitudinally to a position blocking communication of the said third port with the said second chamber, and spring means for biasing the said second piston toward the said first chamber so that when pressurized fluid is supplied to the said first chamber the said second piston is actuated to block communication of the said third port with the said second chamber and then the said first piston is actuated to force fluid out of the said second chamber through the said fourth port.

2. For use with a vehicle having fluid actuated brakes and a drive train including a clutch, an inching and braking system comprising a valve with an elongated body, a longitudinally extending bore in the said body, a first piston slidably disposed in the said bore for longitudinal movement and defining with the said bore first and second longitudinally spaced apart chambers, first and second ports communicating with the said first chamber, third and fourth ports communicating with the said second chamber, spring means for biasing the said first piston toward the said first chamber, a second bore extending longitudnially through the said first piston, a second piston slidably disposed in the said second bore and actuatable longitudinally to a position blocking communication of the said third port with the said second chamber, and spring means for biasing the said second piston toward the said first chamber so that when pressurized fluid is supplied to the said first chamber the said second piston is actuated to block communication of the said third port with the said second chamber and then the said first piston is actuated to force fluid out of the said second chamber through the said fourth port, first operator controlled fluid pressure generating means connected to the said first port, second operator controlled fluid pressure generating means connected to the said third port, fluid actuated means connected to the said second port for decreasing the power transmitting capaicity of the clutch, and conduit mean connecting the brakes with the said fourth port so that actuation of the said first generating means first decreases the power transmitting capacity of the clutch and then applies the brakes and actuation of the said second generating means applies the brakes only.

3. For use with a vehicle having fluid actuated brakes and a drive train including a clutch, an inching and braking system comprising a valve with first, second, third and fourth ports, the said valve being operable when pressurized fluid is supplied to the said first port to direct fluid from the said first port to the said second port, block fluid communication between the said third and fourth ports and force fluid out through the said fourth port and operable when pressurized fluid is supplied to the said third port to direct fluid from the said third port to the said fourth port, first operator controlled fluid pressure generating means connected to the said first port, second operator controlled fluid pressure generating means connected to the said third port, fluid actuated means connected to the said second port for decreasing the power transmitting capacity of the clutch, and conduit means connecting the brakes with the said fourth port so that actuation of the said first generating means first decreases the power transmitting capacity of the clutch and then applies the brakes and actuation of the said second generating means applies the brakes only.

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