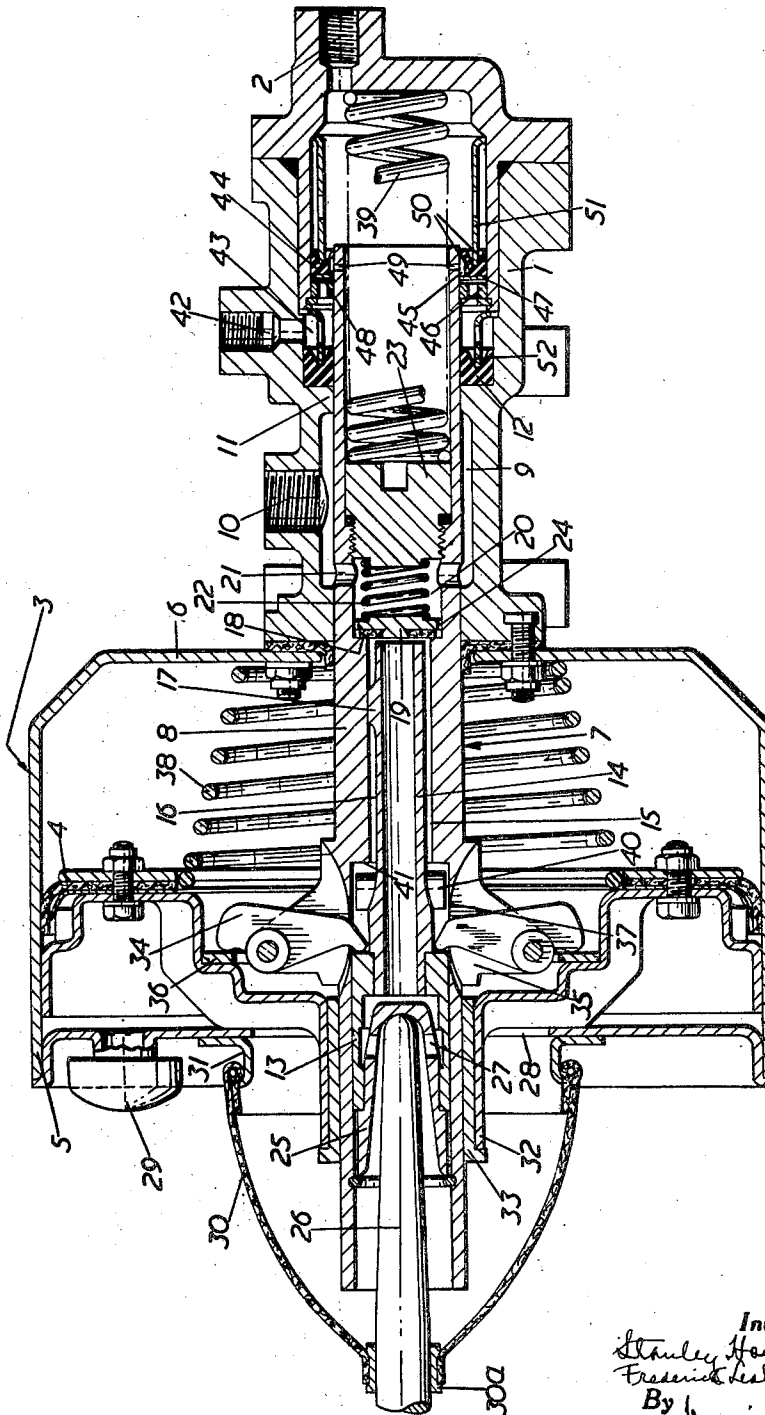


July 30, 1957

S. H. EDGE ET AL
SERVO BRAKING APPARATUS
Filed July 14, 1954

2,800,770



Inventor
Stanley Howard Edge
Frederick Leslie Root
By *Harris & Pottman*
Attorneys

1

2,800,770

SERVO BRAKING APPARATUS

Stanley Howard Edge and Frederick Leslie Beet, Lincoln, England, assignors to Clayton Dewandre Company Limited, Lincoln, England, a British company

Application July 14, 1954, Serial No. 443,394

Claims priority, application Great Britain July 20, 1953

4 Claims. (Cl. 60—54.6)

This invention relates to servo-assisted brake-operating mechanisms for road-vehicles and particularly to such mechanisms of the kind wherein the output of a vacuum or compressed-air servo device employing a piston or diaphragm as the pressure-responsive operating member is transmitted hydraulically to the brake-actuating cylinders of the road wheels of the vehicle.

The object of the invention is to provide an improved and simplified mechanism of the above kind which is of compact construction and which is designed to facilitate manual operation of the brakes in the event of the servo device becoming inoperable.

According to the invention there is provided a servo-assisted brake-operating mechanism of the kind described including a vacuum or compressed-air servo device controlled by a pedal or like actuated valve means and mounted at one end of and in alignment with an hydraulic cylinder which is adapted to be connected to the brake-actuating cylinders, and means extending through said servo device into the hydraulic cylinder and adapted to operate therein as a displacement device, said means being operable to transmit to the liquid in the hydraulic cylinder effort produced by the servo device and manual effort applied to the pedal or like actuator, but being movable independently of the operating member of the servo device so that, in the event of the latter being in an inoperable condition, manual effort can be transmitted by said means to the liquid in the hydraulic cylinder without any obstruction or interference from said operating member of the servo device.

Reference will now be made to the accompanying drawing which illustrates in sectional elevation a preferred embodiment of the invention in its inoperable condition.

In the embodiment illustrated in the drawing, the servo-assisted brake-operating mechanism includes an hydraulic cylinder 1 formed at one end (hereinafter regarded as the forward end of the mechanism) with an outlet port 2 which is adapted to be connected with the brake-actuating cylinders of the road wheels of the vehicle. At the other end of the hydraulic cylinder there is arranged a vacuum servo device 3 consisting of a piston 4 mounted within a cylinder 5 to the forward end wall 6 of which the hydraulic cylinder 1 is coaxially fixed.

Extending concentrically through the servo cylinder into the hydraulic cylinder and slidably supported thereby is a displacement device 7. This device includes an elongated, hollow, cylindrical outer component 8 whose forward end portion projects into the interior of the hydraulic cylinder 1 through a chamber 9 formed at the rear thereof. This chamber is provided with a port 10 which is adapted to be connected by a conduit (not shown) with a source of vacuum. The chamber is separated from the interior of the hydraulic cylinder by a wall or partition 11 formed with a central aperture through which the component 8 is slidably guided. A sealing gland 12 is arranged against the forward face of

2

the wall 11 so as to ensure that no liquid escapes along the outer surface of said component.

Within the component 8 there is mounted an inner component formed in two parts 13 and 14. The rear part 13 is of hollow cylindrical form and is slidably supported in the rear portion of the outer component 8, and the forward part 14 is of tubular form and projects coaxially from the front end of the rear part through a portion 15 of reduced internal diameter formed in the central part of the outer component 8. The forward part 14 of the inner component extends with clearance through the reduced portion 15 of the outer component to leave an annular passage 16 between its outer surface and the inner surface of said reduced portion. The part 14 is slidably guided in the reduced portion 15 by means of one or more external projections 17. The shoulder at the forward end of said reduced portion forms an annular valve seat 18 for a disc valve element 19 which is mounted in a valve chamber 20 formed in the outer component 8 at the forward end of the reduced portion thereof. This valve chamber is provided with ports 21 opening into the vacuum chamber 9. The valve element 19 is biased onto its seat by a coil spring 22 held in compression between the valve element and a slotted plug 23 which is screwed into the forward end portion of the outer component 8 to form the valve chamber 20 and to seal off the interior of the displacement device from the interior of the hydraulic cylinder 1. The disc valve element is guided in its opening and closing movement by the wall of the valve chamber and is formed with peripheral recesses 24 to permit the passage of air past the valve element when it is unseated.

In the rear part 13 of the inner component there is fitted a cup-shaped member 25 which forms a socket for engagement by the end of a rod 26 connected with the brake pedal of the vehicle. This cup-shaped member is formed with ports 27 through which the interior of said inner component is at all times open to atmosphere via the rear end of the outer component, a central opening 28 in the rear end wall of the servo cylinder, and the space within the cylinder to the rear of the piston 4, which space is in constant communication with atmosphere through a breather 29 in the rear end wall of the cylinder. A flexible gaiter 30 is preferably provided to prevent dust or dirt entering the mechanism, the gaiter being fixed at one end to a ferrule 30a slidably mounted on the rod 26, and at the other end to an annular member 31 attached to the rear end wall of the servo cylinder.

In its central portion the servo piston is formed with a rearwardly projecting sleeve 32 within which is fitted a sealing sleeve 33 which in turn fits on the outer component 8 of the displacement device. This sealing sleeve permits axial movement of said outer component independently of the servo piston whilst maintaining a fluid-tight seal between the two.

Forwardly of the servo piston the displacement device carries a reaction device by means of which a progressive control of the servo output is established; that is to say, it ensures that the effort produced by the servo piston, which effort is dependent upon the degree of vacuum to which the piston is subjected, is proportional to the manual effort applied to the pedal. The reaction device consists of a number of beams 34 which lie in substantially radial planes with respect to the displacement device and the servo piston and each of which is pivotally mounted intermediate its ends upon a radial arm 35 fixed to or formed integrally with the outer component of the displacement device. The outer ends of the beams engage a ring 36 which bears against the forward face of the servo piston, and their inner ends project through openings 37 in the outer component of the displacement device for engagement by the forward end face of the rear part 13 of the inner component.

3

When the mechanism is in its inoperative condition, as shown in the drawing, the inner component occupies a rearward position wherein the front end of its forward part 14 is disengaged from the disc valve element 19 which consequently remains seated on the annular valve seat 18. In this condition, the space within the servo cylinder forward of the piston is open to atmosphere via the openings 37, the annular passage 16, the interior of the inner component of the displacement device, the ports 27 in the cup-shaped member 25, the rear end of the outer component of the displacement device, the opening 28 in the rear end wall of the servo cylinder, the space to the rear of the servo piston, and the breather 29. Thus, with both of its sides under atmospheric pressure, the servo piston remains at rest.

When the operator depresses the brake pedal his effort is transmitted through the rod 26 to the inner component of the displacement device, which component is thereby advanced firstly to engage the disc valve element 19 and so cut off the forward space of the servo cylinder from atmosphere, and thereafter to unseat the disc valve element so that said space is placed in communication with the source of vacuum via the valve chamber 20, the ports 21 and the vacuum chamber 9. The resulting pressure differential in the servo cylinder advances the servo piston whose movement is transmitted through the reaction beams 34 and their supporting arms 35 to the outer component of the displacement device so as to advance said component further into the hydraulic cylinder. The resulting displacement of liquid from this cylinder causes the operation of the brakes. Return springs 38 and 39 are provided for the servo piston and the displacement device respectively.

As the output effort of the servo piston is transmitted to the outer component of the displacement device through the reaction beams, this effort reacts through the beams against the inner component of the displacement device and, therefore, against the manual effort applied to the brake pedal, thus giving the operator a "feel" of the degree to which his own effort is being power-assisted. The reaction is proportionate to the servo output, being governed by the ratio between the two arms of each beam either side of its fulcrum. Since the reaction is proportionate the relation between the input and output efforts is proportionate also. For example, when the effort produced by the servo piston exceeds the manual input effort the inner component of the displacement device is moved rearwardly by the inner ends of the beams and allows the disc valve element 19 to be seated and thus cut off the forward space of the servo cylinder from vacuum. If the input effort is maintained constant at this point the valve element will assume a lapped condition in which it is in engagement with the valve seat 18 and is in turn engaged by the forward end of the inner component of the displacement device. If, on the other hand, the input effort is reduced, said inner component will be moved further in the rearward direction with the result that its forward end will become disengaged from the disc valve element and admit atmosphere to the forward space of the servo cylinder. This space will remain open to atmosphere until the balance between input and output is restored, when the valve element will again resume its lapped condition. Thus the proportion between the manual input effort and the output effort produced by the servo is maintained to give a progressive control of the servo output.

If the manual input effort exceeds the maximum reactive force that can be exerted by the servo piston through the beams, which is when the servo piston is subjected to full vacuum, the inner component of the displacement device is advanced to a point where a number of external projections 40 on its forward part 13 abut a shoulder 41 formed on the inner surface of the outer component 8 at the rear end of the reduced portion 15 thereof. The disc valve element 19 controlling the ap-

4

plication of vacuum to the servo piston is then fully opened. Thereafter, any increase in the input effort will not produce a corresponding increase in the servo assistance, and the manual effort will be transmitted through the displacement device to the liquid in the hydraulic cylinder 1, thus being added to the effort produced by the servo piston.

In the event of the servo device being inoperative in any way, such as, for example, if no vacuum is available, the manual effort is transmitted directly to the liquid in the hydraulic cylinder by the displacement device without any obstruction or interference from the servo piston, such as, for example, the "cushioning" effect which might otherwise be caused by the piston being moved in the servo cylinder when no vacuum is being applied. This is made possible by the fact that the displacement device extends slidably through the servo piston and is thus movable independently thereof.

For replenishing the liquid in the hydraulic cylinder a reservoir (not shown) is provided. The reservoir communicates via a port 42 in the wall of the cylinder with an annular space 43 formed between the sealing gland 12 and an annular recuperative seal 44 surrounding the forward end of the outer component 8 of the displacement device. In its inner periphery the seal is formed with an annular recess 45 which opens rearwardly towards the annular space 43. The seal is backed by a perforated annular washer 46 between which and the seal there is interposed an annular shim 47 formed with radial grooves or ribs 48 to permit liquid passing through the perforations in the washer 46 to reach the annular recess 45 in the seal. In the forward end of the outer component 8 of the displacement device there is formed a number of radial ports 49 which, when said outer component is in its fully retracted position, register with the annular recess 45 to permit replenishment of the hydraulic cylinder with liquid from the reservoir via the annular space 43. When the outer component of the displacement device is advanced into the interior of the hydraulic cylinder during the operation of the mechanism, the radial ports 49 are moved forwardly of the seal 44 and the latter prevents any liquid escaping back into the annular space 43.

In order to improve its sealing qualities the seal 44 is formed on its forward face with two concentric lips 50 which are adapted to be pressed into sealing contact with the inner surface of the cylinder and the outer surface of the outer component of the displacement device respectively by pressure created within the interior of the cylinder.

The seal is held in place by a perforated sleeve 51 one end of which bears against the forward end of the cylinder and the other end of which engages in the annular recess between the two concentric lips 50 of the seal. A similar sleeve 52 is provided for holding the sealing gland 12 in place.

We claim:

1. A servo-assisted brake-operating mechanism comprising a hydraulic brake master cylinder having means for connecting it to the brakes; a differential fluid-pressure energized servo-device mounted at one end of the hydraulic cylinder and in alignment therewith, an assembly extending movably through the servo-device in axial alignment therewith and with the hydraulic cylinder and comprising a hollow outer member having a closed end extending into the hydraulic cylinder and reciprocable therein to displace hydraulic fluid therefrom to the brakes, and a hollow manually operable inner member mounted coaxially within the outer member and reciprocable axially therein and having means engageable with the outer member to transmit movement thereto in hydraulic fluid displacing direction, the outer member having a valve seat therein and the inner member having an open end located adjacent to said valve seat, means operative in response to relative axial movement between said inner and outer members for controlling the operation

5

of the servo-device including a valve within the outer member and positioned for engagement with said valve seat of the outer member or with the open end of the inner member, and means connecting the servo-device to said outer member for operation thereof and engageable with the inner member for transmitting thereto reaction of the servo-device.

2. A servo-assisted brake-operating mechanism, comprising a hydraulic master cylinder having means for connecting it to the brakes for transmitting hydraulic pressure thereto, a servo-device having a differential fluid pressure energized operating element mounted at one end of the hydraulic cylinder and in alignment therewith, an assembly extending through the operating element of the servo-device in axial alignment therewith and with the hydraulic cylinder and comprising a hollow outer member having a closed end forming a ram extending into the hydraulic cylinder and reciprocable therein to displace hydraulic fluid therefrom to the brakes and provided with an axial bore having means of communication with one side of the operating element of the servo-device, and a hollow manually operable inner member movable axially within the outer member and having means thereon engageable with the outer member to move it in hydraulic fluid displacing direction, said inner member being open at one end to provide communication between the interior of the inner member and the bore of the outer member, and the outer member having a valve seat therein located in proximity to said open end of the inner member, means operative in response to relative axial movement between said members for controlling the operation of the operating element of the servo-device including a valve having a spring acting to engage it with said valve seat and said valve being engageable by said open end of the inner member to interrupt communication between the interior of the inner member and the

6

bore of the outer member and to disengage said valve from said valve seat, and means for connecting the operating element of the servo-device to said outer member for operation thereof in hydraulic fluid displacing direction and for transmitting reaction from the servo-device to said manually operable inner member.

3. A servo-assisted brake-operated mechanism as defined in claim 2, wherein said hydraulic cylinder is formed with an annular space for replenishing said cylinder with hydraulic fluid, and including an annular recuperative seal fixed within said hydraulic cylinder and surrounding the outer member of said assembly, the inner periphery of said seal being formed with an annular recess which communicates with said annular space, and wherein the outer member of said assembly is provided with a port which registers with said annular recess in said seal when said outer member is retracted to thereby provide communication for the passage of hydraulic fluid from said annular space to the interior of the hydraulic cylinder and which port is beyond said seal when said outer member is advanced to thereby prevent back flow of hydraulic fluid to said annular space.

4. A servo-assisted brake-operating mechanism as defined in claim 3, wherein said seal is formed in one face with two concentric lips which are pressed into sealing contact with the inner surface of said hydraulic cylinder and the outer surface of the outer member of said assembly by the pressure of hydraulic fluid in said cylinder.

References Cited in the file of this patent

UNITED STATES PATENTS

2,130,799	Hofstetter	Sept. 20, 1938
2,458,803	Stelzer	Jan. 11, 1949
2,532,960	Stelzer	Dec. 5, 1950