July 27, 1965 G. K. FARMERY ETAL 3,196,618

FLUID PRESSURE-OPERATED BRAKING APPARATUS

Filed March 12, 1964 2 Sheets-Sheet 1

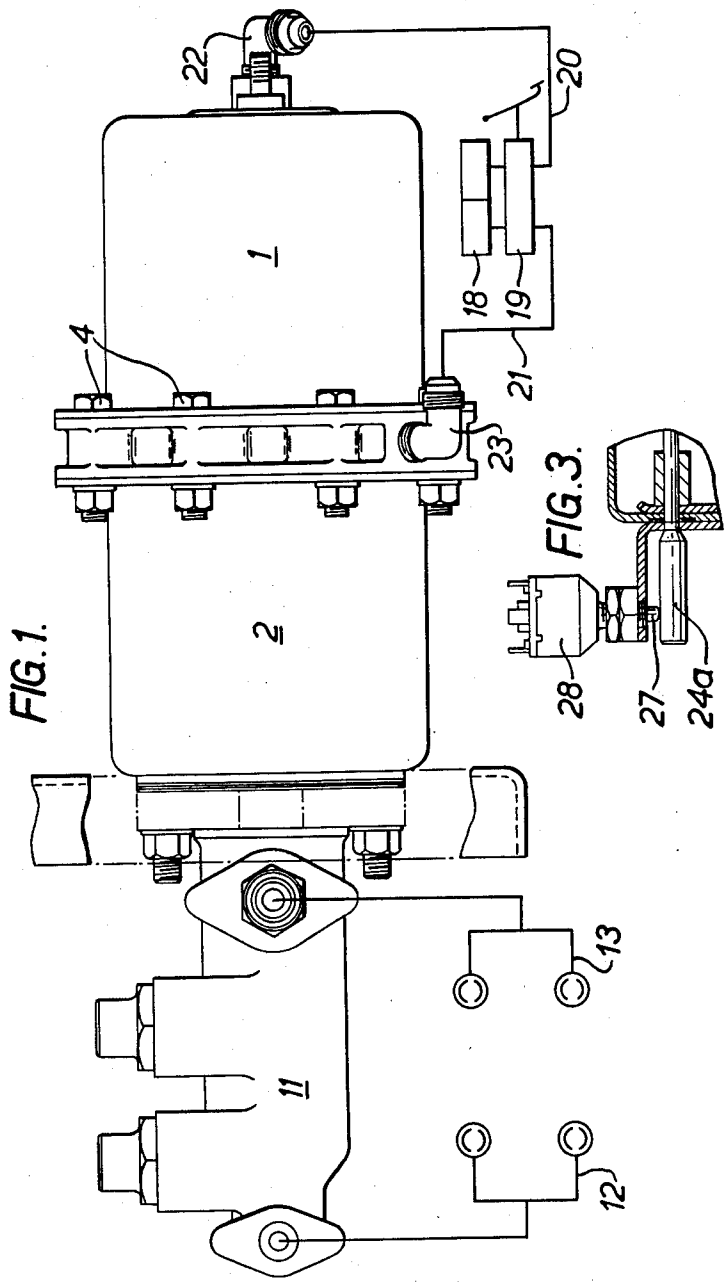

FIG. 1.

FIG. 3.

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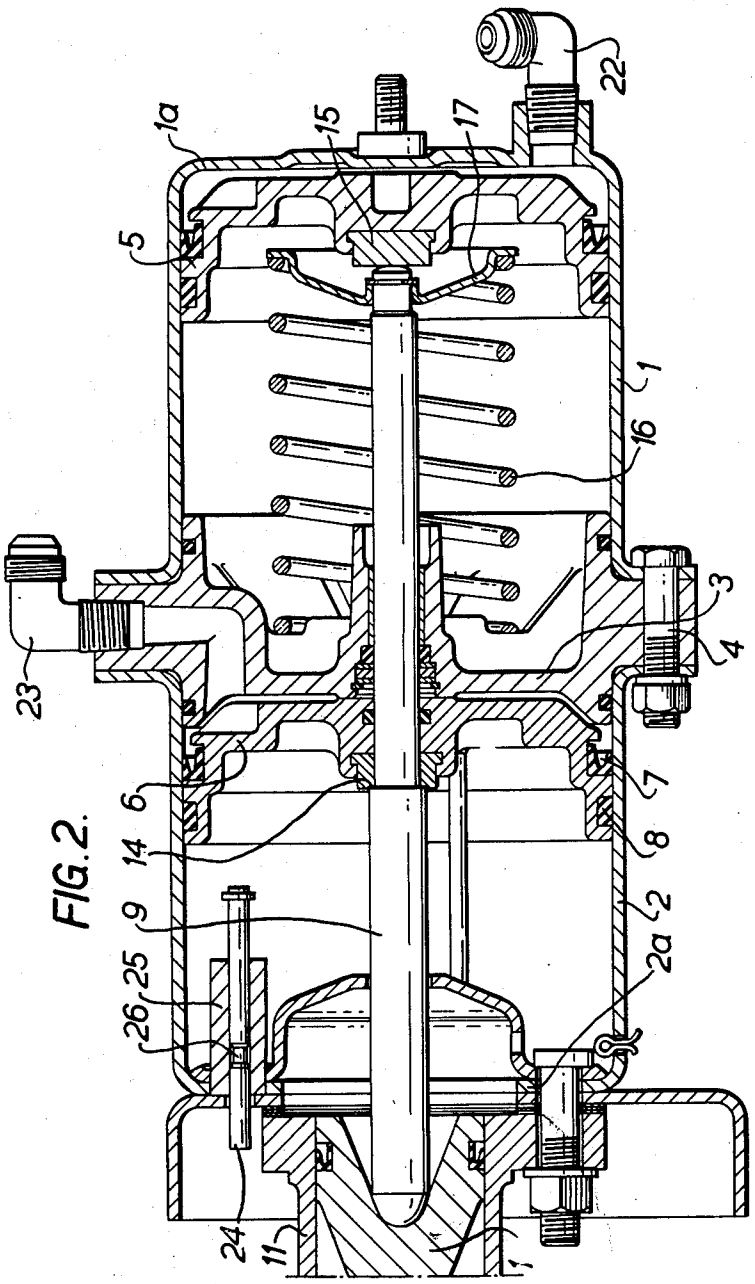

FIG. 2.

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FLUID PRESSURE-OPERATED BRAKING APPARATUS

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7 Claims. (Cl. 60—54.6)

This invention relates to fluid pressure-operated braking apparatus and more particularly to safety braking apparatus of the kind in which a common valve means controls the operation of a dual air pressure or vacuum-operated actuator or servo unit the output of which is transmitted hydraulically to two independent sets of brakes. The present invention provides an improved apparatus of this character having the features of approximate equal air or vacuum usage in the two actuator cylinders and balanced pressures in the two sections of the hydraulic system at all times whilst maintaining a high degree of safety against a complete failure.

According to the invention the improved apparatus comprises an actuator unit consisting of a pair of coaxial cylinders arranged end to end, a piston in each cylinder and an operating rod extending coaxially of the cylinder assembly and having operative connection with a tandem master cylinder the outputs of which are transmitted independently and respectively to the two sets of brakes to be actuated, and means for supplying compressed air or vacuum to the two actuator cylinders from independent sources and under control of common-actuated valve means, the operating rod being spring-loaded to the inoperative position and the pistons having merely abutting engagement with surfaces on the rod such that they are capable of independent movement and their combined thrust is normally transmitted to the master cylinder, whilst a failure in either air pressure or vacuum section results in one piston only moving the operating rod to actuate the master cylinder with reduced thrust.

Reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention and in which:

FIG. 1 is a diagrammatic view of the complete braking system,

FIG. 2 is an axial section through the actuator unit to an enlarged scale and

FIG. 3 is a fragmentary view showing an alternative form of travel indicator.

As shown, the actuator unit is formed by arranging two cylinders **1**, **2**, each formed with an integral end wall **1***a*, **2***a*, respectively, in axial alignment and with their open ends in close juxtaposition, and interconnecting the cylinders by a double-flanged disc or plate which spigots into the ends of the cylinders and constitutes a transverse wall **3** separating the two cylinder spaces. Pistons **5** and **6** are of substantially the same size as shown in FIGURE 2. Bolts or equivalent means **4** are used for securing the assembly together. Disposed within each cylinder is a piston **5**, **6** which may be of any suitable type but is preferably of dished form as shown to include a stepped skirt seating a ring seal **7** and a lubricant-impregnated felt or like ring **8**. Located coaxially of the cylinder assembly is an operating rod **9** which passes with sealed fit through an opening in the transverse wall **3**, said rod extending at one end through the end wall **2***a* of the actuator and having operative connection with the main piston **10** of a tandem master cylinder **11** supported on said end wall and providing independent actuation of a front braking system **12** and a rear braking system **13** in known manner. The pistons have merely abutting engagement with the operating rod, said rod having an inner end portion of reduced

diameter and piston **6** being engaged by the shoulder **14** separating the two rod portions whilst the extreme inner end of the rod abuts the piston **5**. Preferably the pistons are fitted with abutment pads **15** where they engage the operating rod. A coiled compression spring **16** is interposed between the transverse wall and a bearer plate **17** on the inner end of the operating rod and urges the rod and the pistons towards the inoperative or "brakes off" position shown in FIG. 1.

The actuator described is adapted to be operated by air pressure, that is, by a system comprising a divided reservoir **18**, or two separate reservoirs, preferably charged from a common compressor through non-return valves, said reservoirs being connected respectively and through a dual brake valve **19**, and conduits **20**, **21** to the equivalent ends of the two actuator cylinders. The air supply connections **22**, **23** are provided on the integral cylinder end wall **1***a* and on the transverse wall **3** respectively.

Thus under normal conditions and upon operation of the brake valve, air is delivered to the two cylinders, the pistons of which are displaced in unison against the action of the loading spring and transmit their joint thrust through the operating rod to the master cylinder, air usage in the two parts of the system being approximately equal. If either part of the air system fails, the other part will continue to function, actuating the master cylinder with a reduced thrust, but the piston of the inoperative part of the system will not be moved and thus will not apply an undesirable load on the operative section of the actuator.

The present construction also lends itself to the provision of a travel indicator operable by one of the actuator pistons and adapted to provide an indication or warning of a predetermined amount of wear on the brake shoes. In FIG. 2 there is shown a visual type indicator comprising a sight rod **24** supported for sliding movement in a sleeve **25** fixed to the end wall **2***a* of cylinder **2**, the rod being progressively displaced in the sleeve by the movements of the piston **6** and said rod including a coloured ring or similar marking **26** which, when it becomes visible exteriorly of the cylinder, gives warning that the brake shoes need adjustment. FIG. 3 illustrates an alternative indicator of the electrical type, this device comprising as before a displaceable rod **24***a* engageable by piston **6**, the rod in this instance including an outer end portion of larger diameter upon which rides the plunger **27** of a plunger-operated switch **28**, the arrangement being such that, when the plunger rides on to the rod portion of smaller diameter, the switch closes the circuit to an electrical buzzer, warning light or equivalent device in the driver's cab.

We claim:

1. In a fluid pressure brake operating apparatus, an actuator unit comprising two coaxial cylinders, a piston slidably mounted in each cylinder, an operating rod slidably mounted on the axis of said cylinders and having one end in separable abutment with one of said pistons disposed within one of said cylinders, return spring means biasing said rod into abutment with said one piston, the other of said pistons disposed in the other of said cylinders being centrally apertured to pass said rod and the other end of said rod projecting through said other cylinder for operative connection with the master cylinder of a vehicle braking system, means providing a separable unidirectional motion transmitting connection between said rod and said other piston, and means for simultaneously independently applying a fluid pressure differential to both of said pistons for displacing them in brake actuating direction for displacing said rod toward said master cylinder connection, said one piston abutting said rod and said other piston being coupled in motion transmitting association with said rod by said unidirectional connec-

tion when said pistons are displaced in said brake actuating directon, whereby by virtue of its separable connections with said pistons said rod may be displaced in brake actuating direction by either of said pistons alone or both together acting in tandem and spring biased displacement of said rod in the opposite direction displaces both of said pistons in said opposite direction.

2. In the brake operating apparatus defined in claim 1, said cylinders having a common wall between them wherein said rod has a sliding seal fit.

3. In the brake operating apparatus defined in claim 2, said spring means being a compression spring in said one cylinder and extending between said common wall and said rod.

4. In the brake operating apparatus defined in claim 1, said rod having a reduced diameter portion passing slidably through said other piston and forming a shoulder in separable abutment with said rod at said unidirectional motion transmitting connection.

5. In the fluid pressure brake operating apparatus defined in claim 1, said pistons being of substantially the same size.

6. In the fluid pressure brake apparatus defined in claim 1, means for indicating brake lining wear comprising an

indicator member movably mounted on one of said cylinders to be engaged and operated during brake actuating displacement of the piston in said cylinder.

7. In the fluid pressure brake apparatus defined in claim 2, means providing a fluid pressure inlet to said one cylinder in the end wall of said cylinder remote from said common wall, and means providing a fluid pressure inlet for the other cylinder through said common wall.

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