United States Patent

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[54] **FLUID PRESSURE ACTUATED MOTORS**
4 Claims, 2 Drawing Figs.

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[50] Field of Search 92/64, 63, 49, 61, 62, 107, 165; 188/182.02

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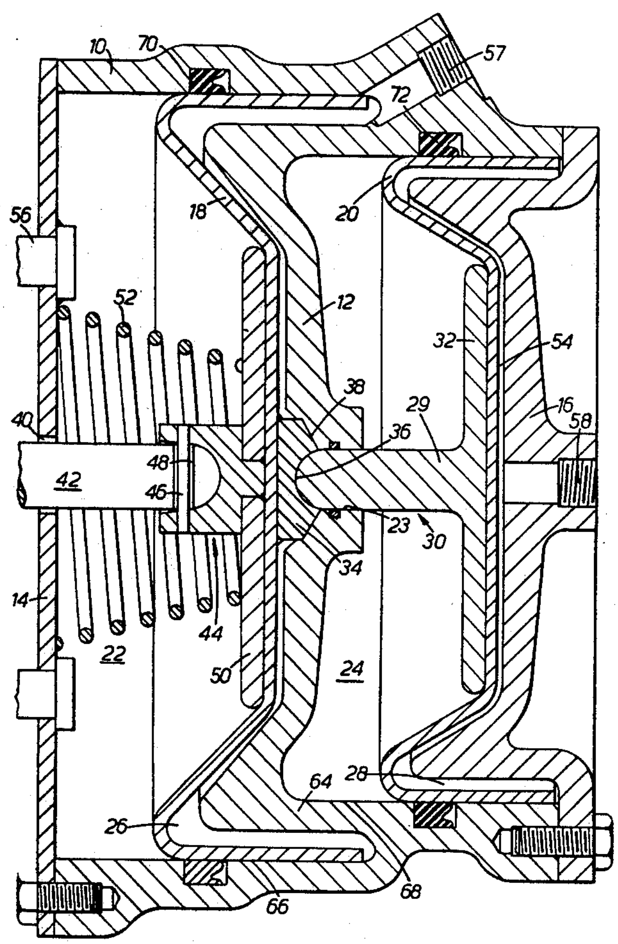
ABSTRACT: In a fluid pressure motor having at least two pistons working in separate cylinder spaces and coupled together in tandem, the cylinder space in which one piston works overlaps axially with the cylinder space in which an adjacent piston works. In the construction described and illustrated there are two pistons each formed as a metal pressing and including an annular skirt which throughout the working stroke of the piston is in engagement with a stationary seal carried by the wall of the cylinder in which that piston works; each piston is of dished form towards one end of its cylinder and the wall at that end of the cylinder is complementarily shaped; the opposite end wall of one cylinder provides an abutment for a coil compression spring which bears against the piston in that cylinder and is accommodated within the dished recess of the piston.



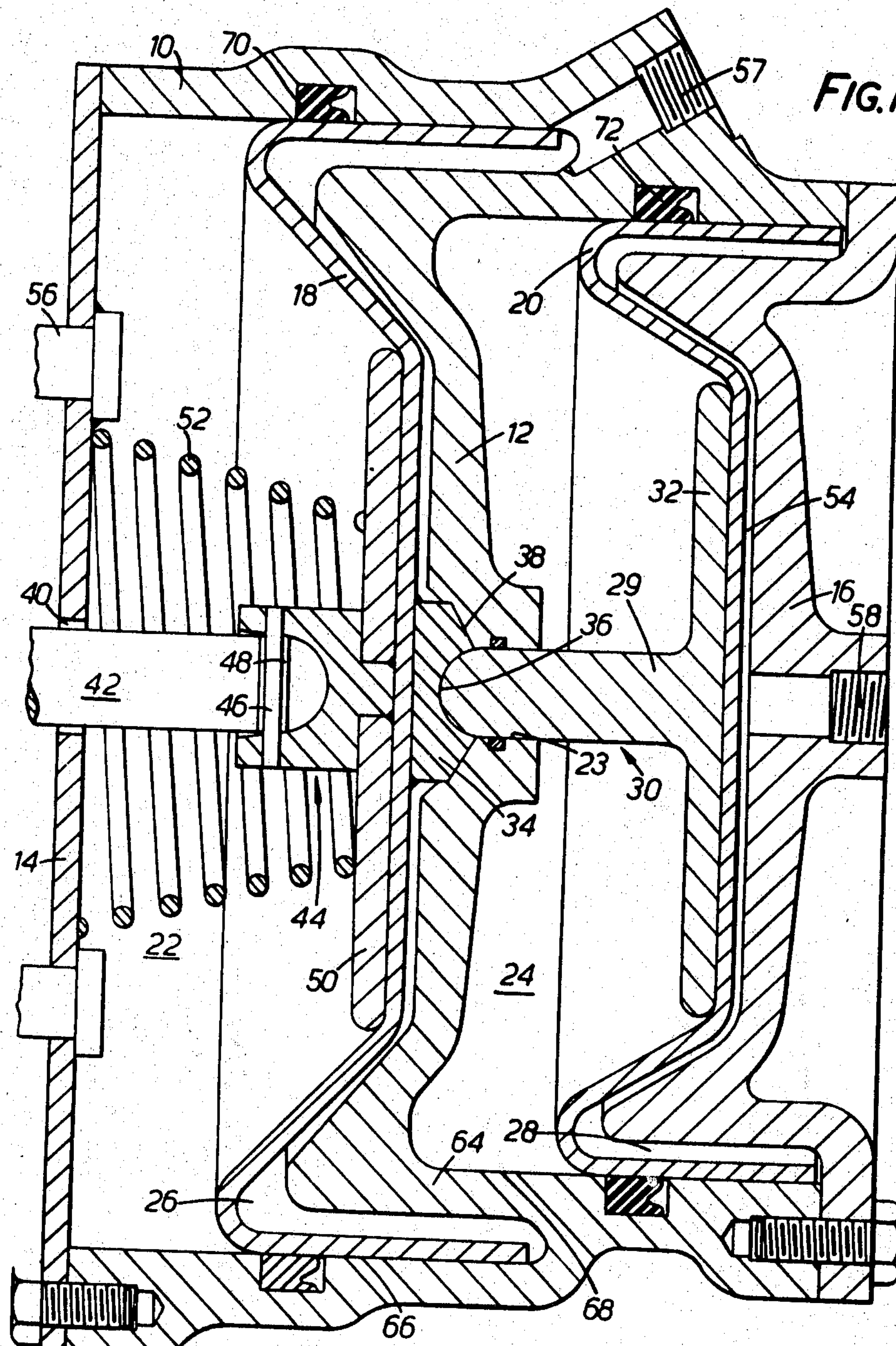

10
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FIG. 1.

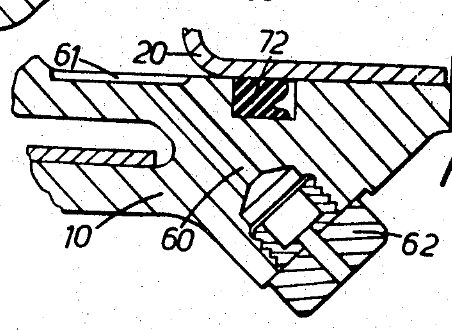
61
20
72
10
60
62

FIG. 2.

FLUID PRESSURE ACTUATED MOTORS

This invention relates to fluid pressure actuated motors of the type having two (or more) pistons working in separate cylinder spaces and mechanically interconnected in tandem to apply their working outputs to a common output member. A motor of this type has the advantage over a conventional single piston motor that the overall diameter can be considerably reduced for a given output at a given applied fluid pressure.

In accordance with the present invention the cylinder space in which one piston of such a motor works overlaps axially with the cylinder space in which an adjacent piston works, thus allowing the overall axial length of the motor to be reduced.

In a preferred form of motor in accordance with the invention one (at least) of the pistons is formed as a metal pressing and includes a peripheral skirt which throughout the working stroke of the piston is in engagement with a stationary seal carried by the wall of the cylinder in which that piston works, this skirt (when the piston is at one end of its stroke) surrounding at least part of the length of the cylinder space in which an adjacent piston works.

These and other features and advantages of the invention are exemplified in the constructional form of the invention which will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is an axial cross section of a motor in accordance with the invention; and

FIG. 2 is a scrap cross section taken in another axial plane to illustrate a detail.

The motor unit comprises a generally cylindrical, open ended body portion **10**, having a central-dividing wall **12** which, together with a pair of cylinder-end closures **14** and **16**, forms a forward and a rear motor compartment or cylinder space. A pair of pressed steel pistons **18** and **20** are located one in each of the motor compartments to divide the compartments into atmospheric chambers **22** and **24** in front of the respective pistons and pressure chambers **26** and **28** to the rear of the respective pistons.

The dividing wall **12** has a central aperture **23** which sealingly and slidably receives the forward end of a stem **29** forming part of a pressure member **30**, which is housed within the chamber **24** and has an enlarged disc-shaped rear end portion **32**, which is in abutting engagement with the piston **20**. A thrust pad **34** is welded to the back face of the piston **18** and is provided with complementary abutment surfaces for the part-spherical end **36** of the stem **29** and for a frustoconical seating **38** machined into the front end of the dividing wall **12** around the aperture **23**.

The end wall **14** has a central aperture **40** which receives with substantial clearance a push rod **42**, whose rear end rests in a spherical seating on a force transmitting element **44**, to which it is connected by a pin **46** passing through a diametrical hole **48** adjacent the push rod end. The element **44** includes an enlarged disc-shaped rear end portion **50** which abuts the piston **18**. A piston return coil spring **52**, located between the end closure **14** and the element **44**, acts to urge the piston **18** against the abutment **38** and the piston **20** against a rubber or like buffer **54**, on the front face of the end closure **16**. The motor is adapted for attachment, e.g. to a vehicle frame, by a set of mounting bolts **56** carried by the end closure **14**.

Fluid under pressure is introduced into the pressure chamber **26** by way of a radial port **57** in the body portion **10**, and to the pressure chamber **28** through an axial port **58** in the end closure **16**.

The chamber **24** is connected to atmosphere by means of a plurality of port means, each of the general form shown in FIG. 2 and comprising a radial port **60** communicating with an axial port **61**. At its outer end, the port **60** is provided with an apertured end cap **62** for carrying an air filter element (not shown). The chamber **22** is connected to atmosphere through the aperture **40**.

To minimise the overall length of the motor, the respective cylinders and pistons are so constructed and arranged that the rear part of the forward cylinder space (constituted by chambers **22** and **26**) axially overlaps the forward part of the rear cylinder space (constituted by chambers **24** and **28**). As shown in the drawing, the piston **18** is of larger diameter than the piston **20**, and the dividing wall **12** has a peripheral skirt **64**, the interior surface **68** of which forms the forward part of the rear cylinder space. The outer surface of the skirt **64** is spaced from the interior surface **66** of the forward pressure chamber **26**, sufficiently to facilitate machining of the surface **66** and to receive a rearwardly extending skirt on the forward piston **18**. The pistons **18** and **20** are sealed by respective piston seals **70** and **72** mounted in the body **10**.

Both pistons **18** and **20** are formed as metal pressings which are each dished rearwardly so as to have a flat central portion or web, located axially between the forward and rear extremities of the piston. The piston return spring **52** is located within the dished part of piston **18**, so that when the piston is fully forward, the spring is accommodated wholly within the piston **18** and does not interfere with the working stroke of the piston **18**.

The rear walls **12** and **16** of the pressure chambers **26** and **28** are shaped to conform substantially to the adjacent pistons, so as to reduce as far sa practically possible the minimum volume of the chambers **26** and **28** when the motor is in its unactuated condition, as drawn. This arrangement reduces to a minimum any delay between the introduction of fluid pressure into the chambers **26** and **28** and initial forward displacement of the pistons.

In operation, the delivery of pressurized fluid such as compressed air to the chambers **26** and **28** produces a pressure difference across the pistons **18** and **20**, which move in opposition to the return spring **52** and displace the push rod **42** outwardly through the end closure **14**, during which stage air in the chambers **22** and **24** is exhausted to atmosphere through the opening **40** and ports **60** and **61** respectively. The push rod (which may, for example be connected to a brake-applying mechanism) transmits a force which is equal to the sum of the force outputs of the two pistons.

When the pressure in chambers **26** and **28** is relieved, the pistons are returned to their rest position under the action of the return spring **52**, atmospheric air being drawn back into the chambers **22** and **24**.

The motor unit may advantageously be used in conjunction with a dual brake system in which the inlets **56** and **58** are each connected to separate pressure sources such that failure of one source of supply will not cause a complete failure.

If the supply to the rear cylinder fails, the forward piston **18** can move forwardly on its own, leaving the rear piston behind (since the pistons make abutting engagement only and are not secured to each other); if the supply to the forward cylinder fails, the rear piston can move forwardly, pushing the forward piston ahead of it.

The motor has been described as being operated by superatmospheric air pressure, but could obviously be modified so as to be vacuum operated (either air or vacuum suspended) or hydraulically operated. A motor in accordance with the invention could also be used in conjunction with arrangements other than braking systems.

I claim:

1. A fluid pressure motor comprising a body defining first and second coaxial cylinder spaces separated from one another by a dividing wall so shaped that the first cylinder space located on one side of said wall includes an annular end portion which encircles the adjacent end portion of the second cylinder space located on the other side of said wall and spaced radially inward from said first cylinder space, first and second pistons respectively working in said cylinder spaces, each piston dividing its cylinder space into two fluid chambers, said first piston including a peripheral annular skirt engageable in said annular end portion, said second piston engaging the dividing wall in a second end portion formed by said wall so that said second end portion is radially inwardly arranged with respect to said first annular portion and means

extending slidably and sealedly through said dividing wall to couple said pistons together in tandem.

2. A fluid pressure motor as defined in claim 1 and further comprising a stationary annular seal carried by said body in said first cylinder space and making sealing engagement with the periphery of said first piston, the axial length of said first piston exceeding its working stroke.

3. A fluid pressure motor as defined in claim 1 in which at least one piston is formed as a metal pressing which is dished, a compression spring which urges the piston towards one end of its stroke being accommodated within the dishing when the piston is at the other end of its stroke.

4. A fluid pressure motor as defined in claim 1 in which at least one piston is formed as a metal pressing which is dished, one end wall of the cylinder space in which that piston works being complementarily shaped so as to reduce as far as possible the minimum volume of the chamber formed between the piston and that end wall.