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VIBRATOR MOTOR

Filed May 27, 1960

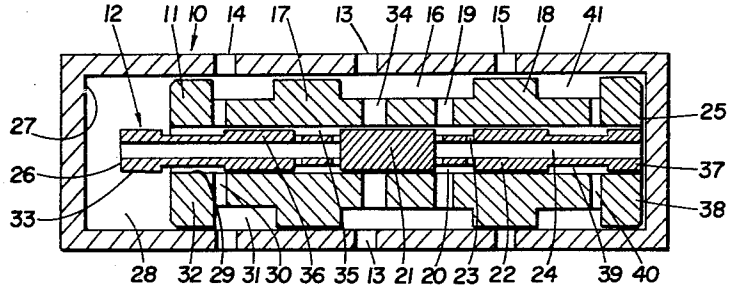


FIG. 1

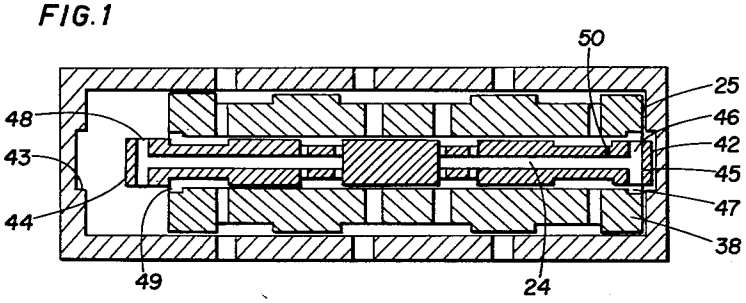


FIG. 2

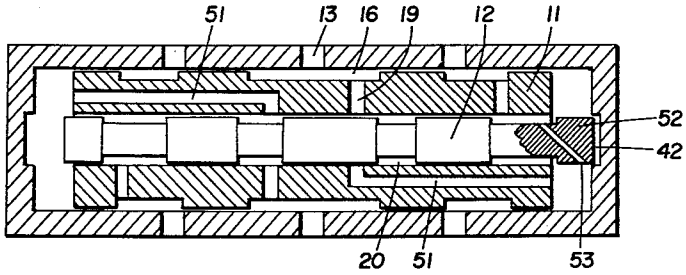


FIG. 3

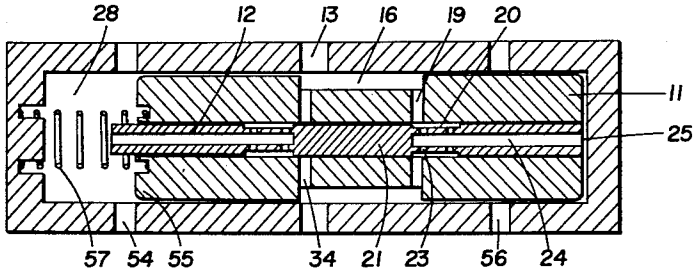


FIG. 4

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VIBRATOR MOTOR

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This application relates to fluid operated converters and particularly to vibrator motors.

The application of vibrators industry and for a variety of uses is well known. The production of a vibrator having good operating characteristics, together with features such as simplicity of construction combined with physical compactness and high energy yield for fluid consumed, is however, a matter of relative difficulty. Known vibrators suffer from the disadvantage of having a relatively low efficiency, moreover, in the case of a small unit designed to provide a given power output, the problem of efficiency of the unit is accentuated.

It is amongst the objects of this invention to provide a double acting vibrator of improved efficiency.

It is also amongst the objects to provide a vibrator having good power to weight characteristics.

It is further amongst the objects to provide a vibrator motor having two basic moving parts.

Further objects and advantages will become apparent from a consideration of the following description and drawings in which:

FIGURE 1 shows a cross-sectional view of the vibrator of the invention;

FIGURE 2 shows a cross-sectional view of a vibrator motor similar to FIGURE 1 but embodying gas cushioning features;

FIGURE 3 shows a cross-sectional view of a vibrator motor employing a solid valve; and

FIGURE 4 shows a further embodiment of the vibrator motor.

Referring now to the drawings and particularly to FIGURE 1, there is shown a vibrator motor having a cylinder **10**, piston **11** and valve **12**. Inlet port or ports **13** are provided through side wall of cylinder **10**. Similar exhaust ports **14** and **15** are also provided in the side wall of cylinder **10**. Gas under pressure is introduced into the cylinder by inlet port **13** to the annulus **16** on the central portion of piston **11** between lands **17** and **18**. The gas flows from annulus **16** through transfer passage **19** to annulus **20** on valve **12** between lands **21** and **22**. From annulus **20** the gas passes through ports **23** to passage **24**, in valve **12**, from thence it flows to space **25**, which may be zero on starting at the end of cylinder **10**. As the gas flows from inlet port **13** to space **25** the valve and piston are caused to move to the left; the valve and piston travel substantially together until the end **26** of valve **12** abuts against the end wall **27** of cylinder **10**. Whilst the valve **12** and piston **11** are travelling to the left gas from chamber **28** at the left hand end of the cylinder **10** is free to exhaust through central bore **29** of piston **11**, transfer passage **30** and annulus **31** which latter is formed between land **17** and the end **32** of piston **11**.

When the end **26** of piston **12** abuts the end wall **27** the valve ceases to move and piston **11** continues to travel to the left. Gas from chamber **28** may still be exhausted by outlet port **14** in the manner described until the entrance to bore **29** of piston **11** is blocked by the overlapping of piston end **32** with the land **33** of valve **12**. At this stage, further exhaust from chamber **28** is cut off and the trapped gas remaining forms a cushion for the piston. As the piston **11** continues to travel to the left, the inlet transfer port **19** is closed off by land **21** on valve **12** thus terminating the feed of gas from inlet port

13 to end chamber **25**, at the same time inlet transfer passage **34** is being opened to annulus **35** formed between lands **21** and **36** on valve **12**. As the piston **11** and valve **12** assume a position where inlet gas may proceed from inlet port **13** via inlet transfer passage **34** to annulus **35**, the right hand end **37** on valve **12** will project beyond right hand end **38** of piston **11**, thereby allowing gas which will now be occupying end chamber **25**, to flow out via annulus **39**, outlet transfer passage **40** and annulus **41** to outlet port **15** which will already have been uncovered by the movement to the left of piston **11**. At this stage the valve and piston will have assumed a position similar to that shown in FIGURE 1 but at the opposite end of cylinder **10**. The reverse stroke is similar in nature to that just described. In this embodiment of the invention valve **12** is uncushioned but cushioning for the valve may simply be provided in the manner illustrated in FIGURE 2.

Referring now to FIGURE 2, it will be seen that recessed portions **42** and **43** corresponding in size to the ends **33** and **37** of valve **12**, are provided in the end walls of cylinder **10**. The ends of valve **12** are formed by solid portions **44** and **45**, and in order to provide for the flow of gas through passage **24** to end chamber **25**, additional valve ports **46** are provided. The end **38** of piston **11** is also provided with an annular groove **47**; similar ports **48** and groove **49** are provided at the other end of the system. It will be seen that as the solid valve end **45** enters the space **42**, a quantity of gas will be trapped and form a cushion for the valve.

When the gas supply is removed and the motor stopped, there is a tendency for both the valve and the piston to creep towards a central position due to the expansion of the remaining gas trapped at the ends. It has been found that by providing a bleed **50** at one end, this motion can be biased one way and an off centre position will then be assumed which facilitates subsequent starting.

In the embodiment shown in FIGURE 3, provision is made for a solid valve piece **12**. In this case central bore **24** of the valve is replaced by means of passage **51** through piston **11**. Inlet transfer port **19** remains in the same form and in the same position as does annulus **20**. Gas entering through inlet port **13** merely proceeds via annulus **16**, inlet transfer passage **19**, annulus **20** and passage **51** to end space **25**. In this embodiment the valve **12** is cushioned in a similar manner by virtue of the end **52** entering recessed portion **42**. The bleed **53** serves the same purpose as bleed **50** in FIGURE 2. It will be noticed that for convenience of balance, passage **51** is arranged on the opposite side of the left hand end of piston **11**.

Reference is now made to the embodiment shown in FIGURE 4. In this embodiment it will be noticed that the piston **11** is of a simplified form as is valve **12**. This arrangement is particularly suitable for small applications. In this case, gas enters inlet port **13** and proceeds via annulus **16** through inlet transfer passage **19** to annulus **20**; from thence it flows through ports **23** and along passage **24** to end space **25** in a manner similar to that described with regard to the embodiment shown in FIGURE 1. As the piston **11** and valve **12** move to the left, gas is exhausted from space **28** via exhaust port **54**. As movement to the left proceeds the end **55** of piston **11** closes exhaust port **54**, trapping a volume of low pressure gas in chamber **28** which when compressed forms a cushion for the piston. As soon as the end of valve **12** comes in contact with the end of cylinder **10**, the inlet transfer passage **19** is closed off by means of central land **21** on valve **12**. At the same time the inlet transfer passage **34** is opened and the gas trapped in end chamber **25** is vented to atmosphere via exhaust port **56**.

In order to ensure starting in all attitudes, a light spring

57 may be incorporated to provide the piston 11 with an off centre characteristic.

It is contemplated and has been found that the invention as described works most satisfactorily when all parts are assembled with sufficient tolerance to provide a close running fit. At the same time, the invention has the advantage of performing efficiently with larger tolerances. This feature presents a considerable advantage to the invention in industrial application with respect to factors such as wear and maintenance, in that the life of the apparatus is extended and maintenance requirements are reduced. The piston and valve may be formed of any materials suitable to the requirements predicated by the circumstances under which the invention is to be used.

Whilst the above description has given details of certain modifications, it will be apparent that further variations and modifications may be made without departing from the scope of the following claims.

What we claim is:

1. A fluid operated vibrator motor comprising: a cylinder member having closed ends; a double acting piston member axially slidable within said cylinder member; an axially disposed bore through said piston member; a valve member slidable within said bore, said valve member being of a length greater than said piston member; inlet and outlet port means in said cylinder, lands on said piston member adapted to block said outlet port means upon relative movement of said piston; transfer passages in said piston member communicating with said bore; land means on said valve member positioned to block and open said transfer passages upon relative movement of said piston and valve members by virtue of the engagement of the end of said valve member with the end of said cylinder towards the end of each stroke of said piston, whereby fluid reversal is effected in the motor.

2. A fluid operated vibrator motor comprising: a cylinder member having closed ends; a double acting piston member reciprocable within said cylinder; a valvepiece within said piston member, said valvepiece being axially relatively movable with respect to said piston member, and being of a length greater than said piston member thereby to protrude beyond the end thereof; fluid conduit passage means allowing passage of fluid by said valvepiece to either end of said piston member into the chamber formed between the end thereof and the end of the cylinder thereby to effect movement of said piston member and valvepiece; fluid inlet and outlet port means in the walls of said cylinder; transfer passage means in said piston communicating between said inlet port means and said valvepiece; and land means on said piston member and on said valvepiece positioned to communicate fluid first towards one end chamber of the system, thereby moving said piston member and valvepiece in the opposite direction, the fluid being communicated to the opposite end chamber upon relative movement of said valvepiece and said piston member, said movement being effected by the contact between the end of said cylinder and the end of said valvepiece projecting beyond said piston member.

3. A fluid operated converter comprising: a cylinder member having closed ends; a double acting piston member reciprocably slidable within said cylinder, the ends of said piston member forming chambers at either end of said cylinder; inlet port means disposed in the side of said cylinder; outlet port means communicable with each said end chamber; land means on said piston for alternately blocking one of said outlet port means upon relative movement of said piston member and cylinder; a valve guide bore in said piston, a valvepiece within said valve guide bore and relatively axially slidable with respect to said piston, said valvepiece being of a length greater than said piston; inlet transfer passages communicating between said inlet port means and said valve guide bore; a fluid conduit means extending to each end chamber and communicable with said inlet transfer passages; and land means on said valvepiece slidable to open and close off said communication between said inlet transfer passages and one of said fluid conduit means upon relative movement of said valvepiece and said piston member, whereby fluid flow is directed sequentially from said inlet first to one end chamber and then to the other upon reversal by virtue of the relative movement of said valvepiece and said piston member.

4. A fluid operated vibrator comprising: a cylinder member having closed ends; a double acting piston member reciprocable within said cylinder member; inlet port means centrally disposed in the cylinder wall; first and second outlet port means disposed on either side of said inlet port between the centre of the cylinder and the ends thereof in spaced apart relationship to said inlet port means; a central portion of reduced diameter on said piston member, said portion being of a length sufficient to be communicable with said inlet port means for all positions of said piston; a central valve guide bore coaxial with said piston; a valve member slidable within said bore, said valve member having a length greater than the piston member; inlet transfer passages disposed towards each end of said recessed portion on said piston member and communicable with said valve guide bore; land means centrally on said valve member for closing said transfer passages upon relative movement of said piston and valve member; fluid passages communicating between each end of the piston member and the central portion of said valve guide bore thereby to permit flow of fluid from the inlet port means to one end of the cylinder when a transfer passage is open; and land means on said piston to sequentially open and close the outlet ports upon reciprocation of said piston member in said cylinder.

5. A fluid operated vibrator motor comprising: a cylinder member having closed ends; a piston member reciprocable within said cylinder; inlet port means centrally disposed in the cylinder wall; outlet port means disposed in the cylinder wall between said inlet port means and the ends of said cylinder; spaced apart land means on said piston for closing said outlet ports sequentially upon reciprocation of said piston thereby to permit exhaust from one end only of said cylinder at a time; a central valvepiece coaxial with said piston and slidably disposed therein; at least two fluid inlet conduit passages permanently communicating with said inlet port means and communicable with said central valvepiece; land means on said valvepiece for closing said passages sequentially; and conduit means extending to the end of each piston whereby fluid may be directed sequentially from the inlet port to one end of the cylinder at a time.

6. A fluid operated vibrator motor comprising; a cylinder member having closed ends; a piston member reciprocable within said cylinder; inlet port means centrally disposed in the cylinder wall; outlet port means disposed in the cylinder wall between said inlet port means and the ends of said cylinder; spaced apart land means on said piston for closing said outlet ports sequentially upon reciprocation of said piston thereby to permit exhaust from one end only of said cylinder at a time; a central bore extending through said piston; a central valvepiece coaxial with said piston and slidably disposed in said central bore; at least two fluid inlet conduit passages permanently communicating with said inlet port means and communicable with said central valve-piece; central land means on said valvepiece for closing said passages sequentially; conduit means extending to each end of the piston whereby fluid may be directed sequentially from the inlet port to one end of the cylinder at a time; end lands on said valvepiece movable into and out of the ends of said central bore upon relative movement of said piston and valvepiece thereby to open and close communication between said bore and the cylinder at the ends of the piston; and outlet passages communicable between the central bore adjacent each end thereof and said outlet ports whereby upon relative movement of said valvepiece and said piston exhaust is sequen-

tially permitted past the respective end lands on said valvepiece from one end of said cylinder at a time.

7. A vibrator motor as claimed in claim 6 including recessed portions at each end of the cylinder, said recessed portions being of a diameter to receive the end of the valvepiece at each end of the stroke; and solid end walls on each end of the valvepiece whereby the entry of said solid end wall of said valvepiece into the recessed portion entraps a quantity of gas in said recessed portion thereby to provide gas cushioning at the end of each valve stroke.

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