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J. W. LUDOWICI

2,692,618

DIAPHRAGMED PISTON AND CYLINDER CONSTRUCTION

Filed Sept. 19, 1951

2 Sheets-Sheet 1

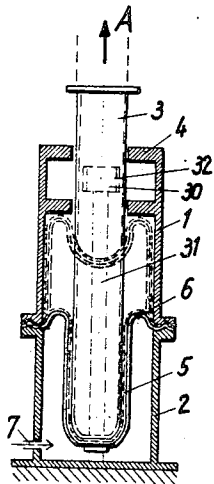


Fig. 1

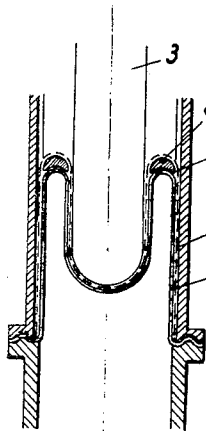


Fig. 2

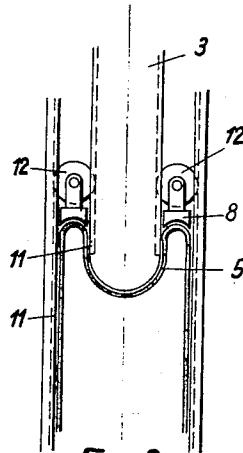


Fig. 3

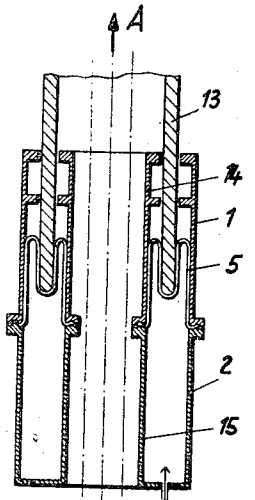


Fig. 4

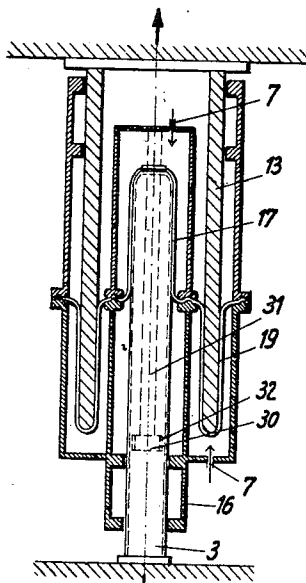


Fig. 5

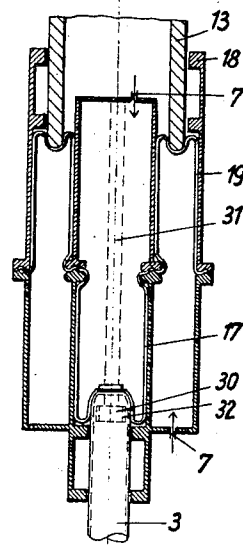


Fig. 6

Inventor
Johann W. Ludowici
By
Young, Emery & Thompson
Attys.

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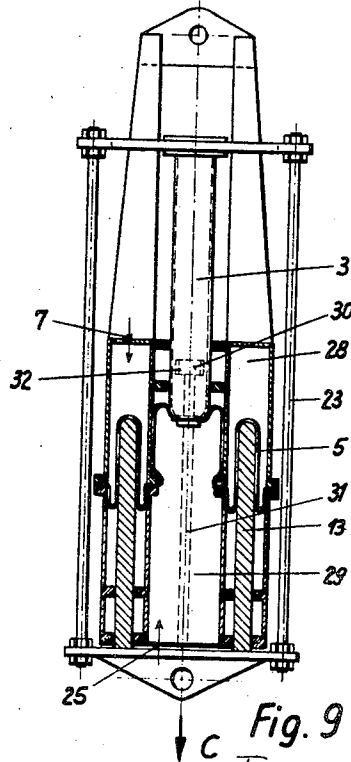
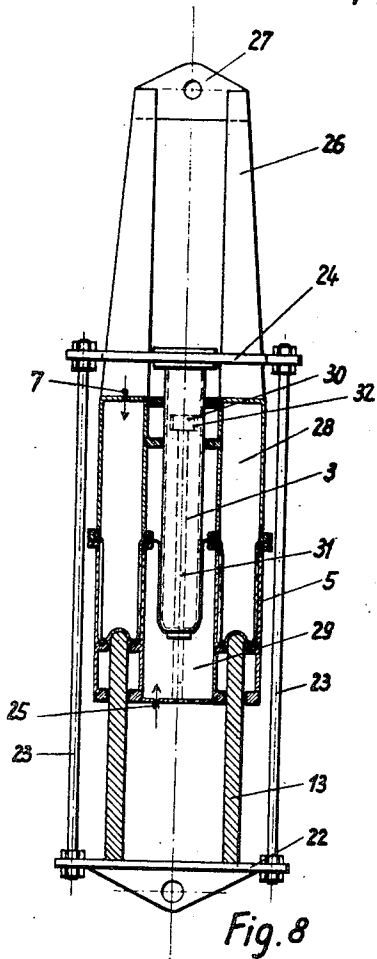
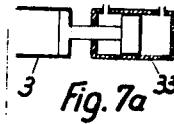
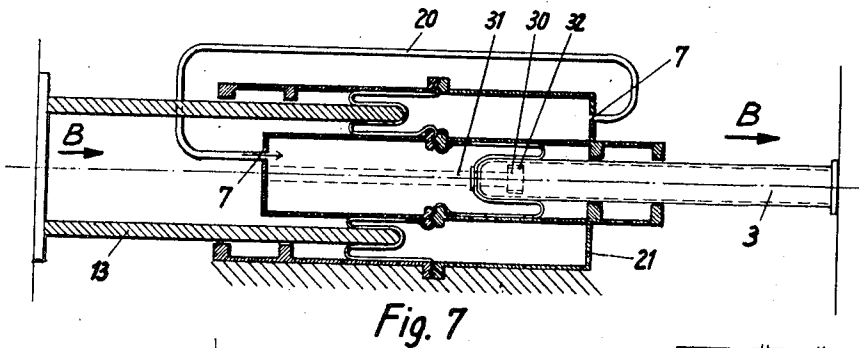
J. W. LUDOWICI

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DIAPHRAGMED PISTON AND CYLINDER CONSTRUCTION

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2 Sheets-Sheet 2



Inventor
Johann W. Ludowici
By Young, Evers + Thompson
Attys.

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DIAPHRAGMED PISTON AND CYLINDER
CONSTRUCTIONJohann Wilhelm Ludowici, Jockgrim, Pfalz,
Germany

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5 Claims. (Cl. 137—781)

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The present invention has for its object to provide an engine which is suitable for big output and rough service, e. g. the working of elevators for building machinery, which can be constructed in a simple manner and which requires the least possible attendance. For such purposes, the usual piston engines are less suitable, since not only must they be constructed with the utmost precision involving high costs, but also they are very sensitive to dust, sand and metal scrapings.

The engine as per the present invention makes use of a novel pneumatic principle for moving a piston in a cylinder whereby an elastic diaphragm which can be turned upside-down undertakes the separation of the two discharge chambers in the cylinder as well as the movement of the piston in the cylinder during the working stroke. Between the piston and the inside barrel of the cylinder can remain a relatively large intermediate space which is filled out by the upside-down part of the elastic diaphragm and the compressed air.

Endurance tests carried out with such engines proved that neither the elastic diaphragm nor the piston and cylinder showed any disadvantageous alterations after 20,000 working strokes and that such engines having a relatively large piston stroke are capable of lifting quickly weights up to 10 tons and more. Such outputs, however, cannot be achieved at all with piston engines so far known or only by employing very large construction costs inapplicable for simple building machinery.

Some forms of executions of pneumatic engines as per the present invention are shown in the drawings by way of example in which Figs. 1 to 7, 8 and 9 are longitudinal sectional views and in which Figs. 1 to 4 show separate modified structures, Figs. 5 to 7 show a further modification in two different positions, Fig. 7a is a sectional view of a detail, and Figs. 8 and 9 show a still further modification in two different positions.

Fig. 1 shows in cross-section a cylinder consisting of two halves 1 and 2 in which a piston 3 is moved up and down in the direction of the arrow A. The cover 4 of the upper cylinder-part serves as guide for the piston. Between the parts 1 and 2 of the cylinder is stretched the open end of a diaphragm 5 of elastic material, the closed part of which wraps itself over the end of the piston 3 and which can be fastened there. During the downward movement of the piston the upside-down part of the diaphragm 5 rolls itself off the cylinder barrel 1 and the piston skirt until the turnover-point 6 has reached the position as

shown in Fig. 1 which represents the lower dead-point position of the piston.

If now, at supply 7, compressed air is blown into the lower part 2 of the cylinder, the diaphragm 5 rolls itself into a position as shown by the dotted line, whereas the piston carries out its working stroke.

The piston 3 is executed as a hollow piston and carries in its interior a shaft 31 for a damping piston 30. The shaft is carried air-tightly through a lower opening of the piston 3 and the diaphragm 5 and is rigidly fixed to the bottom of cylinder 2. The interior of piston 3 contains a pressure liquid which during the upward movement of the piston 3 emanates through the small openings 32 of the stationary damping piston 30. Thereby, the hydraulic damping of the piston movement is being achieved which however, need not indispensably be provided in the engine but is built-in only when required. Depending on the size of the openings 32 a stronger or weaker damping can be achieved. It is also within the range of the present invention to make the openings 32 adjustable in order to regulate the damping. Identical or similar damping devices may also be provided in the further examples of execution.

The elastic diaphragm 5 can be provided with a textile tissue stiffening woven in or applied on in order to avoid any stretching. Tests have proved that at pressures of 15 atm. and several thousand strokes there appeared no deformations nor signs of fatigue of the diaphragm 5. In order to resist still higher pressures, a supporting ring 8 can be inserted into the cylinder as per Fig. 2, against which the turning point 6 of the diaphragm 5 can prop up itself. It is furthermore very advantageous to carry steel or textile bands 9, laid in grooves 10 of the cylinder barrel, over the supporting ring 8 and the bottom of the piston which will then, just like the diaphragm 5, roll off during the movement of the piston 3. In this construction, the compression-pressure is taken up by the steelbands 9 and the supporting ring 8. The supporting ring moves up and down at half the speed of the piston. For an improved guiding of the supporting ring 8, rollers 12 (Fig. 3) can be connected with it which roll off in rack and pinion guides 11 and which lift and lower the ring 8 at the correct speed.

A special characteristic of the invention consists in the fact that the most varied technical executions are possible with similar construction parts without costly fine treatment of packing or guide surfaces being necessary. Thus, for ex-

ample, a construction is shown in Fig. 4 in which a shaft can be carried through the center of the cylinder 1, 2. Such a construction can, in the building of motorcars, be applied for instance to the operating organs for clutches or to brake cylinders concentrically ordered round a wheel axle or to shock absorbers. A ring piston moves in the hollow space between two cylinders 1, 2 and 14, 15. Between the cylinder parts an elastic double diaphragm has been stretched which moves in a similar manner as in Fig. 1 and thereby drives upward the ring piston 13.

Fig. 5 shows a multistage arrangement of pistons with long stroke in an inserted position; Fig. 6 shows the same arrangement in the drawback position. No. 3 is the designation of a piston which is executed as in Fig. 1. This piston is being guided in a cylinder neck 16 and is operated by the elastic diaphragm 17, whereas the ring piston 13 is being guided in the upper part 18 of the neck of the cylinder. The elastic diaphragm 19 which may be executed in one piece together with diaphragm 17 operates the ring piston 13 in opposite direction to piston 3.

Fig. 7 shows the same arrangement of the pistons, the supplies 7 for the pressure liquid, however, being connected by a piping 20. Cylinder 21, in this case, is arranged stationary, thereby creating a "pneumatic transformer," i. e. a device with which a transmission from a higher to a lower speed and vice versa can be achieved, if one of the two pistons 3 or 13 is pressed in. If, for instance, the piston 13 is moved in the direction of arrow B, also the piston 3 is being pressed into the direction B, the way or stroke of piston 3, however, becoming longer in the ratio of the effective areas of the two pistons. Such arrangements are of great importance in cases where with simple means and without change of direction a transmission from a higher to a lower speed or vice versa has to be achieved.

Figs. 8 and 9 show a double-acting stroke or operating arrangement, for instance for building machinery. A ring piston is firmly coupled with an inner piston 3 over the hoop 22, the connecting rods 23 and the yoke 24, the piston projecting into the outer cylinder part, the piston 3 into the inner cylinder part. Both pistons are being operated by the diaphragm 5 doubly turned upside-down. The cylinder is fitted with shoulders 26, connected by a cross-section 27. If now the pressure liquid supply (Fig. 9) is opened, an over-pressure will be created in the chamber 28 forcing the ring piston 13 to yield in the lower direction (arrow C). On account of the rigid connection 22, 23, 24 also the inner piston 3 is being moved in the same direction C and thereby presses the pressure-liquid from the chamber 29 through the opening 25. The procedure of insertion from the position of Fig. 8 is effected by condensation in chamber 29 and expulsion of the pressure liquid from chamber 28.

Such arrangement is therefore double-acting and can, according to the differences of pressures in the chambers 28 and 29, take up the tasks of a differential piston.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A pneumatic engine especially for elevators

comprising a working cylinder having pressure chambers, an elastic diaphragm separating the pressure chambers and secured at approximately the middle of the cylinder relative to the length thereof, a hollow piston having a diameter smaller than the diameter of the cylinder and in contact with the diaphragm at the inner end of the piston, with the other end projecting out of one end of the cylinder, means for admitting compressed air into the other end of the cylinder, and a damping piston extending into the hollow of the first-mentioned piston.

2. A pneumatic engine according to claim 1, in which a supporting ring is provided in the cylinder around the first-mentioned piston and in contact with the diaphragm.

3. A pneumatic engine according to claim 1, in which a supporting ring is provided in the cylinder around the first-mentioned piston and in contact with the diaphragm, said ring having a plurality of rollers contacting said first-mentioned piston and cylinder to guide the ring in the space between said first-mentioned piston and cylinder.

4. A pneumatic engine according to claim 1, in which the cylinder is in the form of a double-walled member with a space between the two walls in which the diaphragm is secured and into which the piston projects in contact with the diaphragm.

5. A pneumatic engine especially for elevators comprising a working cylinder having pressure chambers, an elastic diaphragm separating the pressure chambers and secured at approximately the middle of the cylinder relative to the length thereof, a hollow piston having a diameter smaller than the diameter of the cylinder and in contact with the diaphragm at the inner end of the piston, with the other end projecting out of one end of the cylinder, means for admitting compressed air into the other end of the cylinder, a damping piston extending into the hollow of the first-mentioned piston, and a second working cylinder surrounding the first-mentioned cylinder and having a piston with a cooperating diaphragm integral with the first-mentioned diaphragm with the last-mentioned piston in contact with the second-mentioned diaphragm at the inner end of the last-mentioned piston with the outer end projecting out of one end of its cylinder, said second-mentioned diaphragm being secured in its cylinder at approximately the middle of said second cylinder relative to the length thereof.

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