

Aug. 27, 1946.

H. A. ARNOLD

2,406,485

HOSE PUMP

Filed May 5, 1944

2 Sheets-Sheet 1

FIG. 2.

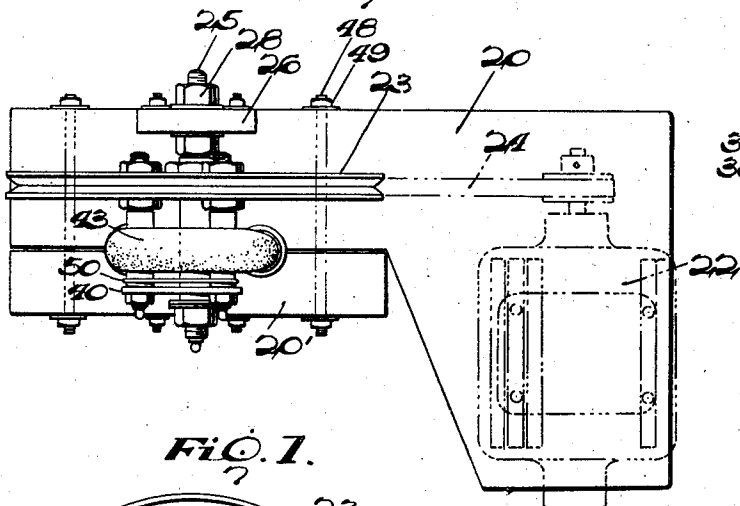


FIG. 4.

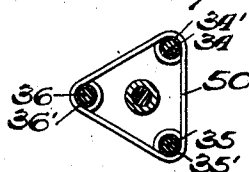


FIG. 1.

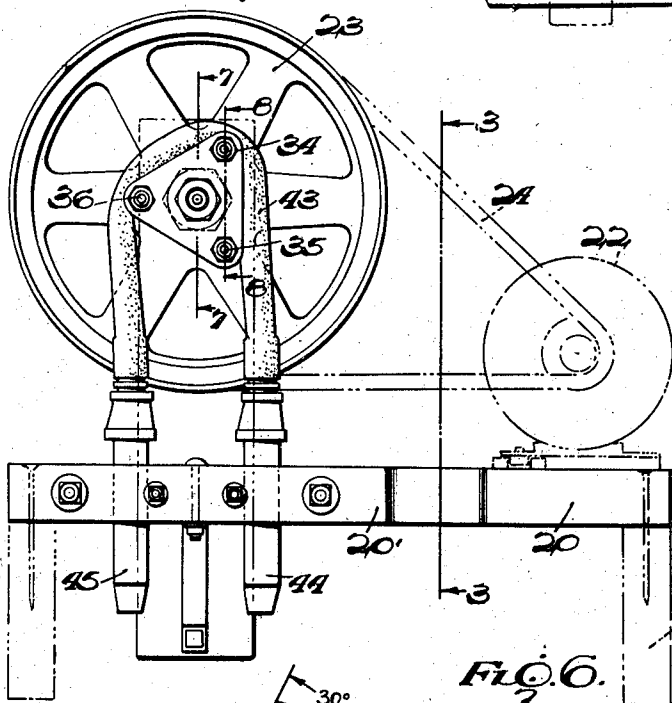


FIG. 3.

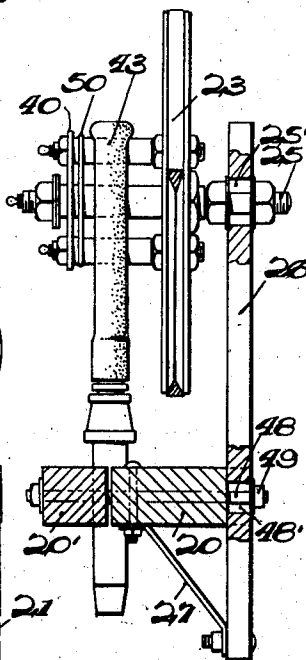


FIG. 6.

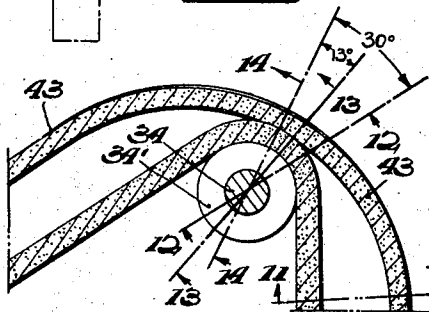


FIG. 5.

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2 Sheets-Sheet 2

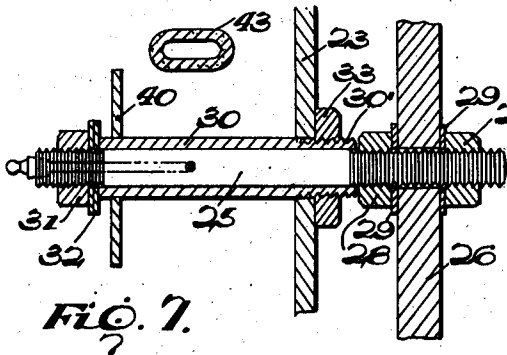


FIG. 7.

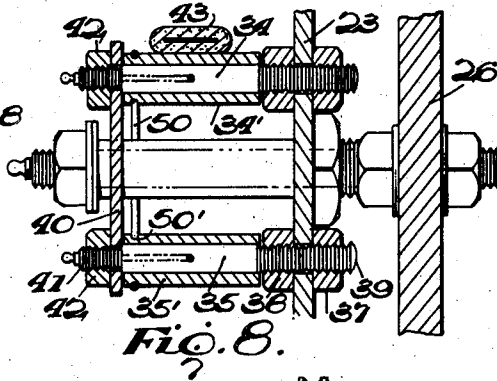


FIG. 8.

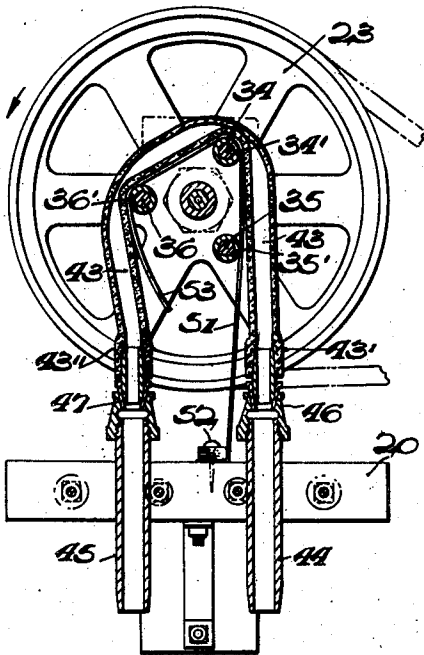


FIG. 9.

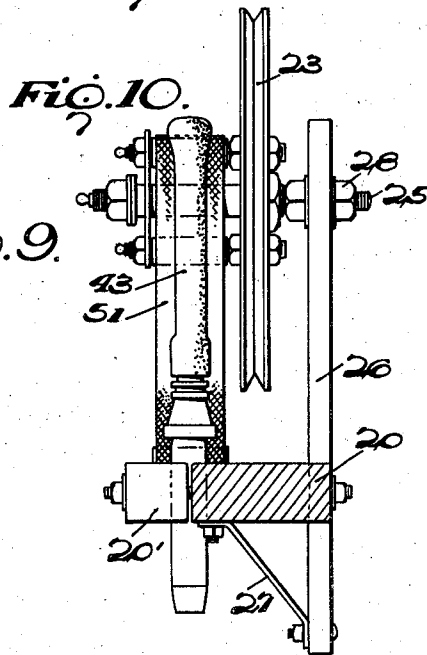


FIG. 10.

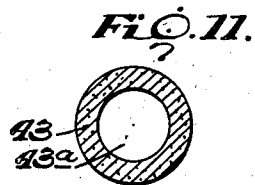


FIG. 11.

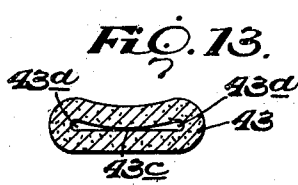


FIG. 13.

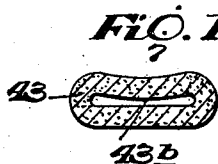


FIG. 12.

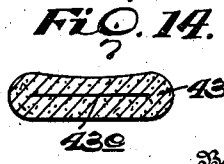


FIG. 14.

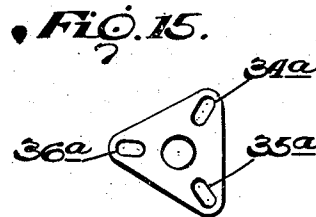


FIG. 15.

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UNITED STATES PATENT OFFICE

2,406,485

HOSE PUMP

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Application May 5, 1944, Serial No. 534,274

7 Claims. (Cl. 103—149)

1

The present invention relates to pumps comprising a flexible hose and rotating members or rollers engaging and compressing the hose to exhaust successive charges of liquid or gases therefrom. Such pumps are highly desirable in their simplicity and cheapness but in the past have been objectionable, among other things, because of lack of efficiency and durability and because of creepage and wear of the hose.

The objects of the present invention, among others, are to provide a hose pump that avoids all of these objections and has maximum efficiency and durability for pumping both viscous materials and gases. These desired results are secured by a preliminary stretching or tensioning of the hose over the rotating members or rollers, and this preliminary stretching or tensioning of the hose insures a complete but successive closing or sealing of the opening therein when the rotating members or rollers progressively compress the hose. This effective closing or sealing enables the desired suction or pressure within reasonable limits to be obtained.

Other objects are to provide a pump of simple construction that may be economically manufactured and readily assembled, one which requires no by-pass valve to relieve against excess pressure, one whose operation is not adversely affected by the drying or caking of small amounts of viscous fluids such as molasses, one which is not adversely affected by corrosive materials such as phosphoric acid, one which does not expose wearing or mechanical moving parts such as pistons, valves, and impellers to sticky viscous or corrosive fluids, one that is as readily cleaned as a piece of hose, tubing or pipe, one that has practically a 100 per cent volumetric displacement efficiency for pumping gases or producing a high vacuum, and one that is adapted for pumping liquids with high vapor pressures or for pumping vaporous chemical compounds such as ammonia hydroxide.

The invention will be better understood by reference to the accompanying drawings wherein

Fig. 1 is an elevation of the novel pump;

Fig. 2 is a corresponding plan view;

Fig. 3 is an end elevation view partly in section on the line 3—3 of Fig. 1;

Fig. 4 is a detail of the rotating members or rollers and a band for insuring the same speed of rotation thereof;

Fig. 5 is a detail corresponding to Fig. 1;

Fig. 6 is a cross sectional view of a modified form of hose;

2

Fig. 7 is a sectional view on the line 7—7 of Fig. 1 looking in the direction of the arrows;

Fig. 8 is a sectional view on the line 8—8 of Fig. 1 looking in the direction of the arrows;

Fig. 9 is a detail similar to Fig. 1, with a band interposed between the rotating members or rollers and the hose;

Fig. 10 is an end elevation corresponding to Fig. 9;

Fig. 11 is a cross sectional view on the line 11—11 of Fig. 5 looking in the direction of the arrows;

Fig. 12 is a cross sectional view on the line 12—12 of Fig. 5 looking in the direction of the arrows;

Fig. 13 is a cross sectional view on the line 13—13 of Fig. 5 looking in the direction of the arrows;

Fig. 14 is a cross sectional view through the hose on the line 14—14 of Fig. 5 looking in the direction of the arrows; and

Fig. 15 is a detail.

Referring to the drawings, wherein like reference numerals indicate like parts, 20 indicates a conventional base supported by legs 21 for a motor 22 which drives a rotor or carrier, here shown as a pulley 23, through a belt 24.

The pulley 23 is mounted on a shaft 25 that is carried by an upright 26 suitably fixed to the base 20 as by brackets 27. As here shown (Fig. 7) the shaft 25 is secured to the upright 26 by means of nuts 28 and washers 29. The shaft 25 carries a sleeve 30 which rotates thereon and is positioned on said shaft by a nut 31 and washers 32. The sleeve 30 carries the rotor or pulley 23 which is held in position by a nut 33 engaging a screw threaded portion 30' of said sleeve 30.

The pulley 23 carries a plurality of pintles 34, 35 and 36. Each of these pintles is secured to the sprocket by nuts 37 and 38 (Fig. 8) engaging a screw threaded portion 39 of the pintle. The other ends of each of these pintles project through and are carried by a plate 40 mounted on the sleeve 30. The ends of the pintles projecting through the plate 40 are preferably screw threaded at 41 and carry nuts 42 that engage with plate 40 to hold the pintles 34, 35 and 36 in fixed position. The pintles 34, 35 and 36 carry the sleeves 34', 35' and 36'.

The hose 43 is looped over the rotating members or sleeves 34', 35' and 36' and stretched or tensioned to the extent desired for a particular pumping pressure. As herein shown, the end 43' of the hose is adjustably connected to a pipe fitting 44 on the suction side of the pump and the

3

end 43" of the hose is connected to a pipe fitting 45 on the discharge side of the hose. The extremities of the hose are secured to the pipe fittings 44 and 45 by suitable screw threaded couplings 46 and 47 so that the desired stretching or tensioning of the hose can be secured by manipulation of these couplings. The pipe fittings 44 and 45 are clamped in position between base 20 and base member 20' by means of bolts 48 and nuts 49.

Instead of providing couplings 46 and 47 for the stretching and extension of the hose 43, it will be understood that the extremities of the hose may be fixedly secured to a suction source and discharge means and the pintles 34, 35 and 36 adjusted radially along slots 34a, 35a and 36a (Fig. 15) in the plate 40 and similar slots (not shown) in the pulley 23, the pintles being clamped in the desired position of adjustment by any suitable or conventional means. Further this stretching or extension can be effected by moving the pipe fittings 44 and 45 downwardly, or by an adjustment of the support 26 which is permitted by slot 48' therein (Fig. 3) or an adjustment of shaft 25 in slot 25'.

For purposes of illustration the rotation of the pulley 23 carrying the pintles and sleeves over which the hose 43 is looped and stretched is counterclockwise. Unless some provision were made to insure that the several sleeves carried by the pintles rotated in unison and at the same speed each sleeve leaving the position 36 would stop rotating due to friction in the bearing. As the sleeve reached the position of sleeve 35 and contacted the hose it would suddenly be forced to rotate, and the friction between the sleeve and the hose would wear a notch and finally a hole at that point although the remainder of the hose would be practically free of wear. To avoid this contingency means are provided in the form of an elastic band 50 (Figs. 4 and 8) which is carried in a groove 50' in the outer end of each of the sleeves 34', 35' and 36'. This band provides a drive between the sleeves and keeps all of them turning at the same speed although one may not be in contact with the hose. This provision eliminates localized wear on the hose.

A further expedient for preventing localized wear on the hose is to interpose between the rotating members or sleeves and the hose a band 51 (Figs. 9 and 10) which prevents any contact between the rotating members and the hose. This band could be continuous like band 50 or one end of the band could be fastened to the support 20 by a nail or fixture 52 leaving the other end 53 of the band free.

The operation of the device will be readily understood by reference to Fig. 5 and Figs. 11, 12, 13 and 14. The stretched hose 43 which may be the standard milking machine hose, such as De Laval, having a $\frac{1}{4}$ inch wall thickness with a $\frac{7}{8}$ inch inside diameter or De Laval No. .0166 and I. H. C. 12274CA $\frac{7}{8}$ inch inside diameter and $\frac{1}{2}$ inch outside diameter is looped and stretched over the rotating members or sleeves to the extent desired for a particular suction lift and pressure. When so stretched and positioned the hose will have the cross sectional configuration shown in Fig. 11 at all points except at and adjacent the position of the roller 34 in Fig. 5 where it will have cross sections shown in Figs. 12, 13 and 14. In Fig. 11 the opening 43a of the hose is round and undistorted. In Fig. 12 the opening 43b has been elongated and flattened by the roller, this cross section being at a

4

point about 30° from line 14-14, Fig. 5. In Fig. 13 the walls of the hose have contacted at 43c while at the marginal extremities 43d there is no contact, this cross section being at a point about 13° from the line 14-14, Fig. 5. In Fig. 14 is shown the point of maximum compression and in this figure there is shown at 43e a complete closing or sealing of the opening of the hose. This condition of complete sealing is facilitated and insured by the preliminary stretching or tensioning of the hose over the rotating members. The completeness of the sealing has a direct influence on the efficiency of the suction lift and pressure. As shown a hose of the proper wall thickness, elasticity and flexibility is fully rounded in all parts except at or adjacent the position of the rollers as shown in Fig. 5. Thus each roller imparts a stripping action on the hose, forcing the liquid or gas in the hose to move ahead of the progressive but continuous closing action of the roller on the hose. The ability of the hose to round itself after the passing of the roller creates a partial vacuum in back of the roller or allows additional fluid or gas to fill up the hose by displacement. Thus the movement of the liquid through the hose is continuous at a velocity equal to the peripheral speed of the rollers.

I have found that the opening in the hose can be more readily closed or sealed if it is provided with longitudinal notches or channels 54 as shown in Fig. 6 in which event, however, the hose should be reinforced at 54' opposite the notched interior wall so that the hose will round out again after the passage of the compressing roller and thereby counteract the collapsing effects of high outside or low inside atmospheric pressure.

I have also found that this provision of a preliminary stretching or tensioning of the hose and looping the same over the rotating members increases the by-pass effects of the hose by facilitating transverse expansion outwardly in all directions in the presence of excess pressure, and it is a manifest advantage that the present hose pump eliminates the usual by-pass valves and conduits.

A hose pump embodying the present invention is not only simple in construction, easy to assemble and disassemble, but cheap to manufacture. It can be adjusted by a preliminary stretching or tensioning of the hose over the rotating members to pump any pressure within limits without adversely affecting the suction lift or the closing or sealing of the opening in the hose. It can be used to pump heavy viscous materials, such as molasses, or to pump gases. It is an effective vacuum pump and therefore is "self-priming." Milk at 93° F. was boiled under vacuum created by this hose pump and wild onion flavors, unless exceptionally strong, were removed from the milk. It is not affected adversely by corrosive acids, such as phosphoric acid, nor is it affected by the drying and caking of small amounts of molasses; and it does not clog with dirt or sludge. The pumps with more than one hose of varying sizes depending on the relative capacities desired, have been used as metering, proportioning and mixing devices for substances such as molasses and acids for legume silage and as metering and proportioning devices on liquid fertilizer distributors.

While I have disclosed herein the best embodiment of the inventive idea known to me, it is to be understood that the invention is susceptible of other mechanical embodiments within the limits of the appended claims, and it is to be partic-

5

ularly noted that while I have herein shown three rotating members that act to support and successively compress the hose, additional rotating members may be employed depending on the length and number of the suction strokes desired.

What is claimed is:

1. A pump comprising a hose stretched beyond its normal length, and a plurality of members operable one after another to keep the hose stretched and compress it for performance of the pumping operation.

2. A pump comprising a hose stretched beyond its normal length and connected to a source of fluid and a discharge element, a rotating support, and a plurality of members carried thereby, said members being rotated into and out of engagement with the hose and operable one after another to keep it stretched and effect the pumping operation, said hose being transversely expansible outwardly in all directions to relieve any excess pressure produced therein.

3. A pump comprising a tensioned hose, a movable support, a plurality of rollers rotatably mounted on said support and movable thereby into and out of engagement with the hose to effect the pumping operation, and a connection between said rollers to cause all of them to rotate on their own axes at the same speed.

4. A pump comprising a hose adjustably connected to a source of fluid and a discharge element, and a rotating member provided with a plurality of rollers over one of which the hose is initially stretched and tensioned to the desired degree to produce the desired pump pressure, said rollers being operable one after another to keep

6

the hose stretched and tensioned at said desired degree and to compress said hose for performance of the pumping operation.

5. A pump comprising a hose adjustably connected to a source of fluid and a discharge element, and a movable element provided with a plurality of rollers over one of which the hose is stretched and tensioned to the desired degree to produce the desired pump pressure, said rollers being operable by said member one after another to keep the hose stretched and tensioned and to compress it for performance of the pumping operation, said hose being expanded outwardly in all directions upon production of excess fluid pressure therein to thereby afford a by-pass effect and eliminate the necessity for by-pass valves and conduits.

6. In a pump of the type comprising a rotor provided radially of its axis of rotation with spaced hose compressing elements, a hose arranged to be compressed by said elements and provided interiorly thereof along its length with a notch or channel enabling the opening in the hose to be completely closed when said hose is compressed by said elements.

7. A pump element comprising a hose provided interiorly thereof along its length with oppositely disposed notches or channels enabling the opening in the hose to be completely closed by compression and resilient reinforcements on the outside of the hose opposite the notched interior wall insuring a more uniform wall resiliency and strength for normal opening or expansion of the hose to its initial shape and producing an elliptically shaped hose.

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