

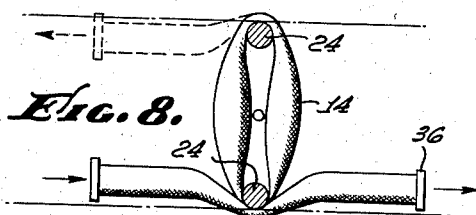
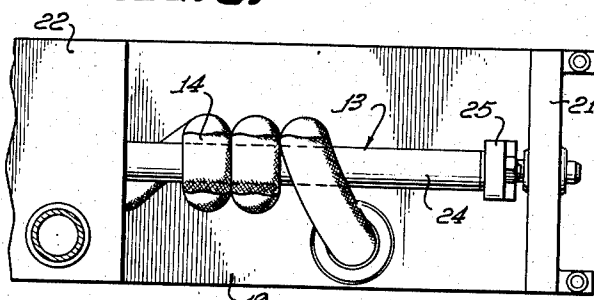
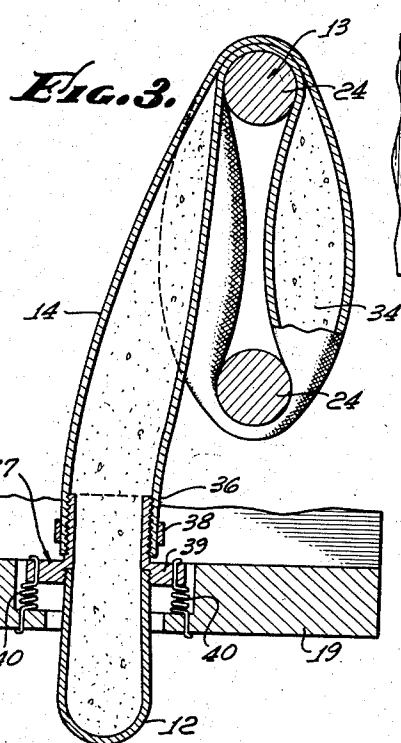
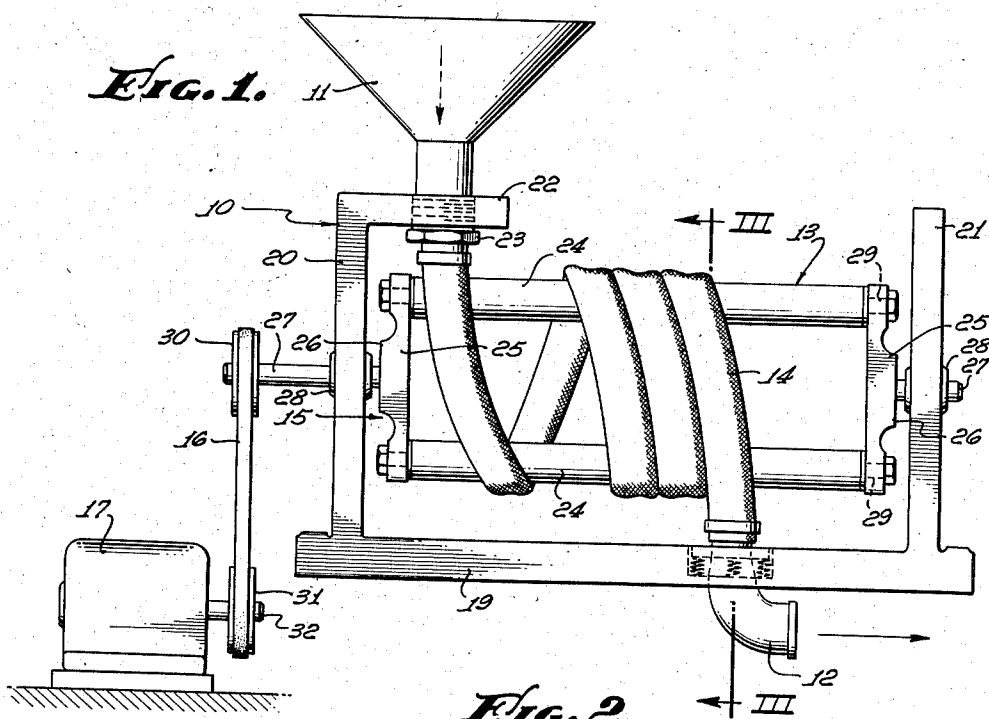
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W. K. VOGEL ET AL
SPIRAL TYPE PUMP MEANS

2,885,967

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4.

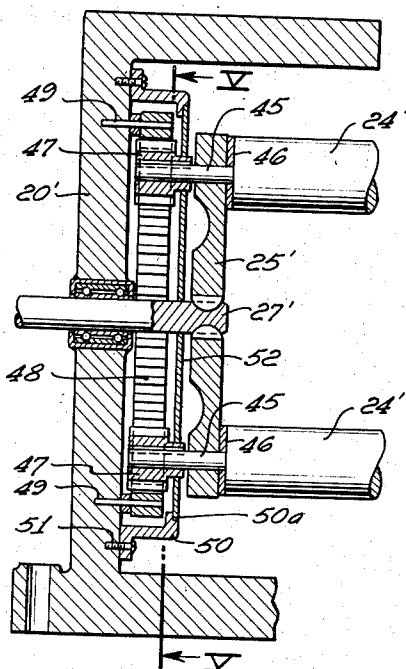


Fig. 5.

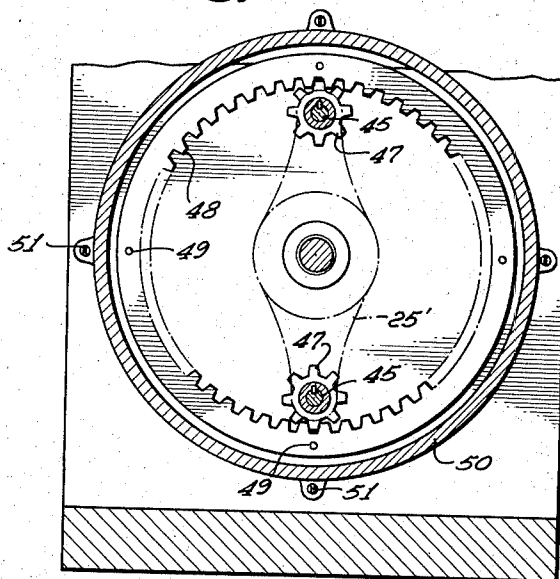


Fig. 6.

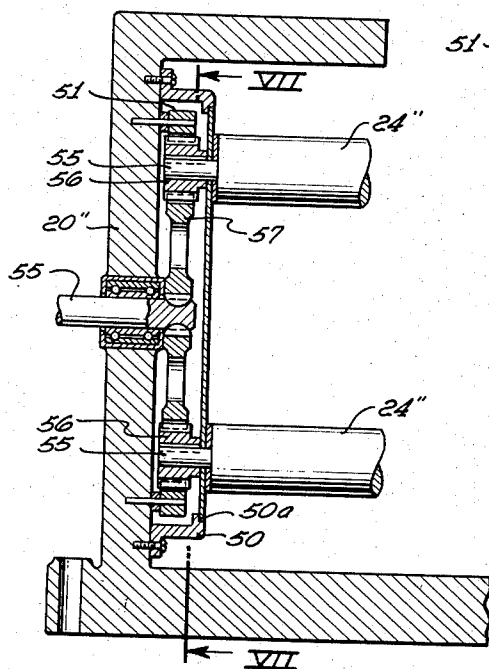
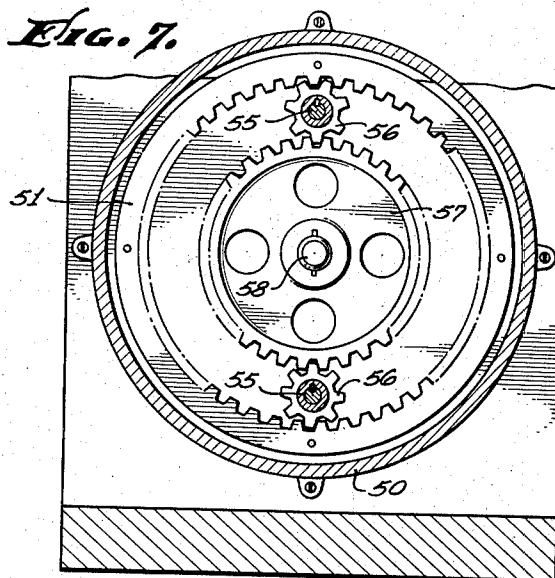


Fig. 7.



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2,885,967

SPIRAL TYPE PUMP MEANS

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12 Claims. (Cl. 103—149)

This invention relates to a positive displacement pump means for viscous materials such as semi-fluid or pasty heterogeneous mixtures, for example: plaster, stucco, cement, mortars, concrete, and the like. More particularly, the invention relates to a pump means embodying the principle of progressively squeezing or flattening a flexible conduit or hose means in order to obtain positive pumping action.

Prior proposed pump means embodying this principle of operation have usually included a hose or flexible tube wrapped in a circle or a part circle within a rigid backing wall having a corresponding circular surface. With the hose positioned against the circular wall surface, a rotatable pressure member was rotated about the center of the circularly wrapped hose to apply pressure against inner wall surfaces of the hose so as to pinch or close the passageway in the hose. Such prior proposed pumping means were obviously limited in the quantity of material which could be pumped at a selected rate and in the amount of pressure available. Furthermore, when pumping abrasive materials, pressing of the hose walls together and against a rigid backing wall caused extreme wear of hose wall surfaces.

This invention contemplates a novel pump means which includes progressively squeezing a fluid conduit means in such a manner that a rigid backing wall is not employed to pinch the hose. The invention contemplates the arrangement of a fluid conduit means in a spiral fashion. Within the spiral is positioned a pair of pressure roller members which are spaced apart a sufficient distance so that the fluid conduit means is tensioned or tightly drawn over and around the pair of roller members and internal wall surfaces of the hose are drawn together opposite pressure contacts of the roller members. In such a spiral arrangement fluid carrying pump chambers or pockets are provided in portions of the conduit means extending between the roller members, said roller members being spaced apart a sufficient distance so that the conduit means will round out or approximately assume its normal shape in cross-section. The spiral arrangement permits any selected member of pump chambers which may be progressively advanced as the pair of roller members are rotated, the walls of the hose being essentially squeezed together by the roller members.

The primary object of this invention is to disclose and provide a novel positive displacement pump utilizing a flexible fluid conduit means.

An object of this invention is to disclose and provide a pump means of novel construction which does not require precision parts, which is self compensating for manufacturing tolerances and for wear and which does not require special tooling or techniques for manufacture.

Another object of this invention is to design a pump means which does not employ valves and in which the material being pumped is not engaged by sliding or rotating parts.

A further object of this invention is to design and provide a pump means in which a continuous steady flow of

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pasty material may be provided through a single conduit means and in which pressure requirements may be readily met by selective arrangement of the single conduit means.

A still further object of this invention is to disclose a pump means in which a single fluid conduit member for pumping fluid is the principal part of the pump means subject to wear and is readily and inexpensively replaceable.

Still another object of this invention is to disclose and provide a positive pump means which is rugged, trouble-free, and inexpensive to manufacture.

A more specific object of this invention is to disclose a pump means for semi-fluid pasty materials including a compressible bendable fluid conduit member arranged in a spiral fashion and a pair of pressure roller members disposed within the spirally arranged conduit member in spaced relation sufficient to tension the conduit member to cause lateral distortion of the spiral arrangement and to squeeze walls thereof into closed relation at the roller members to form pumping chambers, said pair of roller members being rotated about the axis of the spiral of the conduit member to continuously progressively advance said pumping chambers.

A further object of this invention is to provide a pump means in which a single conduit member, substantially rigid or non-stretchable in an axial direction and relatively soft and flexible in a radial direction, is wrapped in tension about two or more rollers for forming spaced chambers for fluid.

These and other objects of this invention will be readily apparent from the following description and drawings in which exemplary embodiments of the invention are shown.

In the drawings:

Fig. 1 is a side elevation of a pump means embodying this invention.

Fig. 2 is a fragmentary top view of the pump means shown in Fig. 1.

Fig. 3 is a transverse sectional view taken in the plane indicated by line III—III of Fig. 1.

Fig. 4 is a fragmentary sectional view taken in a vertical plane bisecting one end of a pump means embodying a modification of this invention and illustrating positive means for driving pressure roller members.

Fig. 5 is a fragmentary sectional view taken in the plane indicated by line V—V of Fig. 4.

Fig. 6 is a fragmentary sectional view taken in a vertical plane bisecting a pump means showing a different modification of this invention, showing another positive drive means for pressure roller members.

Fig. 7 is a transverse sectional view taken in the plane indicated by line VII—VII of Fig. 6.

Fig. 8 is a schematic view of a pump embodying this invention showing location of inlet and outlet ends of a hose member.

In the exemplary pump means shown in Figs. 1 to 3, a frame means 10 may be provided with a material intake hopper 11 of funnel shape and a discharge outlet 12 to which may be attached suitable pipe or hose means for conveying pumped material. Mounted for rotation on frame means 10 may be a conduit flattening or pressure applying means generally indicated at 13. Arranged under tension in a spiral fashion around pressure means 13 and interconnecting the intake hopper 11 and the discharge outlet 12 may be a single flexible hose member or fluid conduit means 14. The pressure means 13 may be supported from the frame means by mounting means indicated generally at 15, said mounting means being connected to a drive pulley belt 16 and a power means such as electrical motor 17 in well known manner.

The frame means 10 may comprise a base plate 19 provided with upstanding end walls 20 and 21. End wall

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20 may be provided with a top inturned horizontal flange 22 supporting a conduit fitting 23 for connecting intake hopper 11 to one end of flexible conduit means 14. Conduit fitting 23 and the connection of hopper 11 to conduit means 14 is spaced to one side of the longitudinal center line of frame means 10 and beyond the sweep of pressure means 13.

Pressure or conduit flattening means 13 is positioned between end walls 20 and 21 and may comprise a pair of cylindrical pressure, roller members 24 arranged in spaced parallel relation. Each roller member 24 may be made of suitable metal material, may be of uniform diameter, and may be provided with a smooth external cylindrical surface. The diameter of each roller member 24 and the spacing apart thereof is related to the conduit means 14 as later described.

Mounting means 15 for rotation of said roller members in an orbital path about a common axis may include at each end a spider member 25 having a central hub 26 in which may be mounted an outwardly extending stub axle 27 which projects into bearing means 28 provided in the adjacent associated wall 20, 21. In each end of spider member 25 is mounted an end of a roller member 24. In this example, the end of member 24 is freely rotatably carried thereby and may comprise an axial reduced end portion 29 extending through a bore in the end of spider member 25. Suitable antifriction bearing means (not shown) support end portion 29.

One stub axle 27 may be extended outwardly from end wall 20 and provided with a pulley wheel 30 providing a connection to pulley belt 16 which is connected at its other end to a pulley wheel 31 carried by motor shaft 32. It is understood other means may be provided for driving axle 27 to cause rotation of pressure means 13.

Flexible conduit means 15 may comprise a single elongated hose member made of any suitable flexible compressible, bendable, resilient rubber composition, synthetic composition, or plastic material. Preferably the hose member is limitedly longitudinally stretchable. The material of hose member should be live and springy so that it will tend to quickly return to substantially its normal cross-sectional shape.

The inlet end of conduit means 14 may be connected to fitting 23 in well known manner and in this example is fixed to fitting 23 so as to hold the inlet end of the conduit means stationary. The conduit means is wrapped in a spiral fashion for a selected number of turns around the outside of pressure roller members 24 under sufficient tension so as to compress and flatten walls of the conduit means against members 24 at areas of engagement of the inner wall portions of the conduit means with members 24. Under tension the conduit inner wall portions laterally flatten and conform to the curvature of the roller members 24 at the engagement areas, while at the same time the outer conduit wall portions are laterally flattened and drawn toward the roller members 24. As seen in Fig. 3 such flattening of the walls of the conduit means against the curved surfaces of the pressure roller members 24 tightly closes the passageway of the conduit means and provides between the spaced roller members 24 pumping chambers or pockets 34 for material being pumped. In the example, approximately two and one half turns of the fluid conduit means are made and five of such pumping chambers or pockets 34 are formed. Such pumping chambers may be considered as pump stages and pressure requirements may be met by varying the number of pumping chambers by increasing or decreasing the number of spiral turns.

Outlet end 36 of said fluid conduit means is provided with an end fitting 37 which may be secured by a clamping ring 38. The fitting 37 may include an end flange 39 which provides an internal connection to discharge outlet 12. End flange 39 may be connected to base plate 19 of the frame means by a plurality of circumferentially arranged tension springs 40. The springs 40 permit lim-

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ited longitudinal movement of the outlet end 39 of the fluid conduit means while maintaining tension on the fluid conduit means. In some installations it may be desirable to hold outlet end 39 in stationary or fixed relation to the frame means.

The relationships between the diameter of pressure roller 24, the diameter of the fluid conduit means 14 and the spacing apart of the pressure roller members 24 are important. The diameter of each pressure roller member 24 should be at least equal to the inside diameter of the fluid conduit means so that the hose may round out into approximately normal circular section between the roller members to provide a fluid chamber 34 of maximum size and so that inner wall portions of the several turns of the hose will not interferingly contact each other to limit the normal tendency of the hose member to round out. The roller members 24 should be as small in diameter as possible to conserve space but should also be large enough to avoid damage to the hose member at engagement areas when pressure is applied to the hose. Normally, the spacing apart of the roller members 24 should be from 3 to 5 times the diameter of the hose to facilitate forming the fluid pumping chambers 34. Under such relationships a plurality of pumping chambers 34 for fluid will be readily provided in the spirally wrapped conduit means.

Means for maintaining the fluid conduit means under selected tension to maintain the closed flattened areas of the fluid conduit means to prevent leakage between chambers as the pressure means 13 is rotated includes securing of inlet and outlet ends of the fluid conduit means outside of the orbital path of the pair of roller members 24 and in particular relation with respect to each other and with respect to the axis of rotation of the pressure means 13. With the ends of the conduit means in such relation, as described hereinafter, to the pressure means 13, tension in the conduit means will be substantially constant and uniform throughout rotation of the pump means. Slight changes in tension during rotation may be compensated for by the elastic characteristics of the hose material and by spring loading one or both ends of the conduit means.

Accurate location of the conduit ends may be determined by mathematical formulae taking into consideration the radius of roller member 24, the radial spacing of roller members 24 from the axis of rotation of pressure means 13, conduit wall thickness and the conduit length between the conduit ends. Two exemplary arrangements of the location of the conduit ends are described (Fig. 8).

In one arrangement, the secured conduit ends, as viewed from the end of the pump means, not only lie outside of the orbital path of roller members 24 but may lie slightly above a horizontal plane tangential to the bottom roller when the rollers 24 are disposed vertically one above the other and when the secured conduit ends are spaced a relatively great distance from the orbital path. When the secured conduit ends approach the orbital path, their location should also approach the said horizontal plane. In this arrangement, the conduit ends may be said to be disposed in virtually 360° relation.

In another arrangement, one secured conduit end may lie above the other conduit end with the axis of the conduit ends lying in the same slightly inward relation to parallel horizontal planes tangential to top and bottom rollers 24 when disposed vertically one above the other. These conduit ends may be said to be disposed in virtually 180° relation.

In operation, pressure means 13 is rotated at selected speed about the mounting means 15. As roller members 24 move in a circular orbital path, each roller member moves in rolling contact along the inner wall portions of the spirally wrapped fluid conduit means 14. Since the fluid conduit means 14 is tensioned to provide

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flattened areas of engagement at the contact of roller members with the fluid conduit means, such flattened areas are continuously advanced in the direction of the spiral. Thus pumping chambers 34 are continuously progressively advanced toward the discharge outlet. Fluid such as plaster introduced into the fluid conduit means through hopper 11 is thus moved in chambers 34 to discharge outlet 12. The quantity of material pumped by the pump means of this invention thus is dependent upon the speed of rotation of the pressure roller members 24 and the pressure developed is dependent upon the number of pumping chambers 34 (that is the number of turns of the spirally wrapped hose).

It will also be noted that in the embodiment in Figs. 1-3, the pressure roller members 24 are freely rotatable. As the pair are moved about their common axis of rotation, the surfaces of the roller members rollingly contact the inner wall portions of the spirally arranged flexible conduit means. To reduce wear on the inner wall portions of the spirally arranged conduit means it is desirable that the diameter of the pressure roller members 24 be at least equal to the inner diameter of the flexible conduit means as mentioned above.

In Figs. 4 to 7 inclusive there are shown different modifications of mounting means 15 for the pressure roller members 24. In these modifications pressure roller members are positively driven in rotation about their axes so as to rotate the roller members against the inner wall portions of the conduit means and thus facilitate movement of pumping chambers 34. Mounting means at only one end is shown since the other mounting means at the opposite end of the pump means is substantially the same.

In the modification shown in Figs. 4 and 5, pressure roller members 24' may be provided with outwardly extending stub axles 45 carrying washers 46 and extending through the associated end of spider member 25'. Keyed to the end of each axle 45 may be a spur gear 47, said spur gear having meshed engagement with an internal ring gear 48 secured to end wall 20' and held against rotation by means of a plurality of pins 49. An annular flanged cover member 50 may be secured to end wall 20' as by screw bolts 51. A rotatable cover plate 52, carried by the spider member 25' and circumferentially supported in recess 50a on cover member 50, protects gears 47 and 48 against dust and dirt. Spider member is carried by stub axle 27' which may be connected to a drive means, said stub axle being anti-frictionally mounted in the end wall of the frame means as in the prior embodiment.

It will thus be apparent that as spider members 25' are rotated about the axis of axle 27' the pressure roller members 24' are positively rotated by meshed engagement of the gears 47 with the stationary internal ring gear 48. Thus the pressure roller members 24' rollingly contact the inner wall portions of the flexible conduit means so as to progressively advance pumping chambers in a facile manner with reduction of wear on the conduit means.

In Figs. 6 and 7 each pressure roller member 24'' similarly includes stub axle 55 having keyed thereto a spur gear 56. The spur gears 56 are provided meshed engagement with an internal annular ring gear 57 fixed to end wall 20'' as in the prior modification. In Figs. 6 and 7 however, the spider members 25' is replaced with a pinion gear 57 which has meshed engagement with each spur gear 56. The pinion gear 57 may be carried by a stub axle 58 which may be driven by motor means as in the first embodiment. It will be apparent that a planetary gear means is provided in the modification of Fig. 6 wherein spur gears 56 act as planetary gears and the driving pinion gear acts as a sun gear. Thus as the gear 57 is positively rotated the gears 56 are positively driven at a selected gear ratio in order to positively rotate pressure members 24''.

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It should be noted that the conduit member is relatively soft and flexible in a radial direction and relatively unyielding in a longitudinal direction. Thus when the conduit member is wrapped in a selected number of turns about two or more pressure rollers the softness in a radial direction collapses the walls thereof and provides the spaced chambers for fluid. Maintenance of tension in the conduit member is utilized to retain the spaced chambers. Such wrapping of the conduit about the roller members provides a symmetrical arrangement which may include roller members circumaxially spaced about an axis of rotation at 180°, 120° or 90°.

Those skilled in the art will readily understand the simplicity and ease with which the conduit member may be changed or replaced and the cost advantage of minimizing "down" time on machines with which the pump means is used. The conduit member drawn into the laterally distorted spiral arrangement does not require close manufacturing tolerances for positive operation; and accurate alignment of the pressure roller members is not necessary. It will be understood that the pressure roller members may be arranged in other than parallel relation and that their spacing may converge or diverge in the direction of progressive movement of the fluid pumping chambers.

All changes and modifications coming within the scope of the appended claims are embraced thereby.

We claim:

1. A positive displacement pump means for viscous materials comprising, the combination of: a frame means including a base provided with upstanding end walls; a pair of parallel, spaced apart, cylindrical members extending between said end walls; means mounting said cylindrical members in said end walls for rotation of the cylindrical members about a common axis lying therebetween; compressible, bendable, virtually longitudinally non-stretchable conduit means provided with an inlet and an outlet connected respectively to the frame means adjacent the end walls, said conduit means being spirally wrapped for a selected number of turns about said cylindrical members under tension sufficient to compress and flatten walls of said conduit means at said cylindrical members to provide spaced separate chambers for fluid disposed between said cylindrical members; and means connected to said cylindrical member mounting means for rotating said cylindrical members about said common axis to progressively advance said chambers along the conduit.

2. A pump means as stated in claim 1 wherein said mounting means for said cylindrical members includes gear means for driving each cylindrical member in rotation about its axis.

3. A claim as stated in claim 1 including yieldable tension means for said fluid conduit means at the connection of said outlet to the frame means.

4. A pump means for semi-fluid materials comprising in combination: a frame means having upstanding end walls; at least two roller members in spaced relation extending between said end walls; means mounting said roller members for rotation about an axis lying between said roller members; a compressible, virtually longitudinally non-stretchable, bendable conduit member having an inlet and an outlet connected to the frame means, said conduit member being spirally wrapped about said roller members under tension sufficient to compress said conduit member at its contact with each roller member for closing chambers for fluid; and means connected to said roller members mounting means to rotate said roller members about said axis of rotation.

5. In a pump means for viscous fluids, the combination of: a compressible, virtually longitudinally non-stretchable, bendable fluid conduit member provided with an inlet and an outlet restrained against axial movement, said conduit member being arranged in spiral fashion; means including pressure members positioned

in spaced relation within said spirally arranged conduit member, the spacing apart of said pressure members being sufficient to compress together walls of said conduit member at each pressure member to close at spaced areas the passageway provided by the conduit member and to provide spaced chambers for fluid; and means operatively connected to said pressure members to rotate said pressure members in spaced relation about an axis parallel to the axis of the spirally arranged conduit member.

6. A pump means as stated in claim 5 wherein said pressure members are cylindrical and the diameter of each pressure member is at least equal to the inside diameter of the fluid conduit member.

7. A pump means as stated in claim 5 wherein the spacing apart of the pressure members is greater than three times the inside diameter of the conduit member.

8. A pump means as stated in claim 5 wherein yieldable tension means is provided at one end of said conduit member.

9. A pump means for semi-fluid pasty materials comprising the combination of: a helically arranged continuous conduit means of laterally resilient elastic, virtually longitudinally non-stretchable material; pressure applying means disposed within and in spaced relation to the axis of the helically arranged conduit means for tensioning said conduit means to laterally distort the helical arrangement and to close the passageway in the conduit means opposite said pressure applying means and to define chambers for fluid between said pressure applying means; and means operatively connected to said pressure applying means for rotating said pressure applying means about said axis of the helical conduit means for causing said chambers to progressively advance along the conduit means.

10. A pump means comprising: a laterally distorted continuous conduit member of laterally elastic resilient, virtually longitudinally non-stretchable material arranged in a selected number of turns about an axis; and pressure

means rotatable about said axis and flattening said conduit means at laterally distorted diametrically opposed portions of the conduit means and defining spaced chambers for fluid in said conduit means between said flattened portions.

11. A positive displacement pump means for semi-fluid pasty materials comprising, in combination: a flexible longitudinally non-stretchable hose member having a selected inner diameter; means to form in said hose member a plurality of progressively traveling pump chambers of virtually uniform capacity, said means including a pair of parallel freely rotatable pressure rollers spaced apart a distance greater than three times the inner diameter of the hose member, each roller having a diameter at least equal to said inner diameter; said hose member being spirally wrapped around said pair of pressure rollers to laterally collapse the walls of the hose member at said rollers; means connecting said pressure rollers for rotating said pair of rollers about an axis; and means holding inlet and outlet ends of said hose member in spaced relation to the orbital path of the pair of rollers.

12. A pump as stated in claim 11, wherein said means holding inlet and outlet ends of said hose member are spaced proximate to and inwardly of parallel planes externally tangent to said pair of rollers when a plane passing through the axes of the rollers is disposed substantially normal to an axis of one of the hose ends at the holding means.

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