Jan. 20, 1959 W. H. KREAMER 2,869,473

METERING PUMP

Filed March 15, 1954

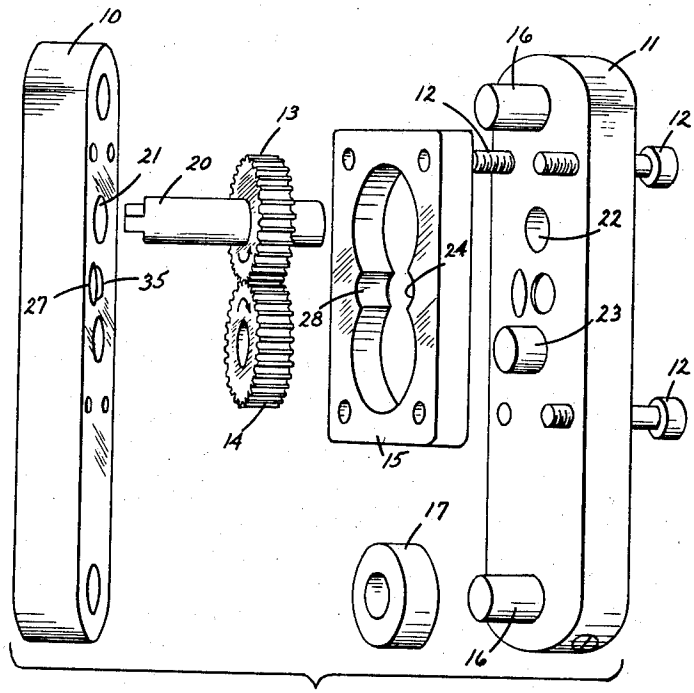


Fig. 1

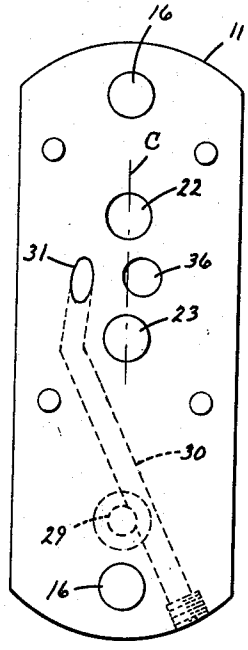


Fig. 2

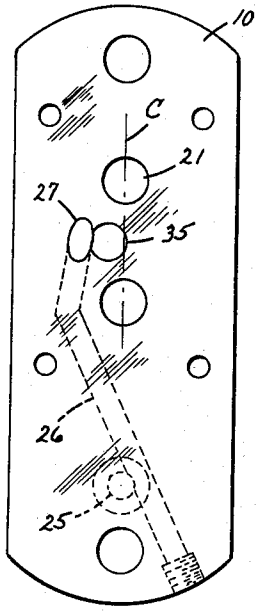


Fig. 3

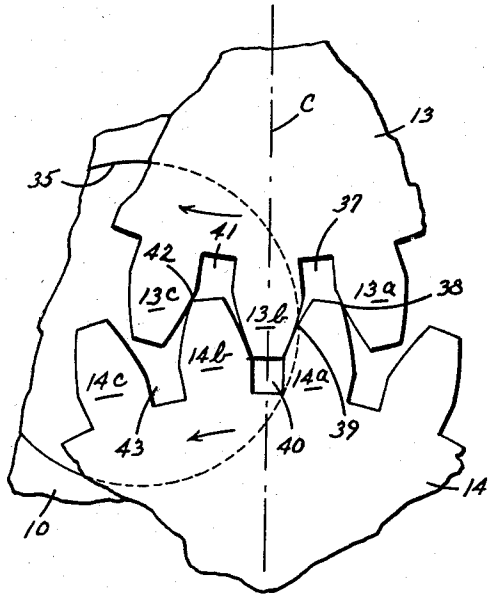


Fig. 4

United States Patent Office 2,869,473 Patented Jan. 20, 1959

2,869,473

METERING PUMP

William H. Kreamer, Roanoke, Va., assignor to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

Application March 15, 1954, Serial No. 416,269

1 Claim. (Cl. 103—126)

This invention relates to gear type liquid pumps and, more particularly, to a precision gear pump used for metering liquids.

I have found that pumps of the type used to meter viscose and other similar fluids from which synthetic textile sheets, films or filaments are spun sometimes cause bubbles in the metered fluid stream. These bubbles are highly undesirable since they result in broken filaments. Efforts to eliminate the bubbles in metering pumps of this type have included the expedients of supplying the viscose to the pump under varying degrees of pressure and also the provision of various relief grooves and ports in the pump plates. All previous designs for such pumps with which I am familiar have proceeded on the theory that it was necessary to provide a pressure relief groove on the delivery side of the pump in order to permit fluid trapped between the incipiently meshing teeth of the gears to be discharged through the relief passages and thence into the delivery chamber. Such relief grooves are well-known in the art and have extended in the direction of gear travel towards the centerline of the gears to a point at which the gear teeth are nearly fully meshed. This insures that substantially all of the liquid trapped between meshing teeth has been forced out of the teeth which in turn prevents rough running of the pump.

On the intake side of the pump, it has been proposed to use one or more suction relief grooves which connect the intake chamber and/or port with the disengaging gear teeth before they are completely unmeshed. Otherwise, the disengaging teeth tend to create a vacuum or low pressure area before any of the intake fluid is delivered to the chamber which increases in volume as the teeth disengage. Heretofore, such suction relief grooves have not extended beyond the centerline to the pressure side of the pump because the effective seal created at the centerline would be thereby reduced or destroyed.

I have found that it is possible to eliminate the pressure relief groove and also to eliminate the possible formation of bubbles in the liquid by moving the suction relief groove beyond the centerline of the pump so that the suction or intake chamber of the pump is in communication with the chambers formed in the gear teeth at a point which is the same or slightly after the point at which these chambers between the teeth are closed. The invention also includes the provision of enlarged chambers for liquid trapped between the gear teeth. These enlarged chambers cooperate with the location of the suction relief grooves in reducing the percentage of volume change which occurs in the teeth chambers. Heretofore, the teeth of metering pump gears have been so accurately made that practically full scavenging of the teeth chambers is accomplished at the centerline. In other words, practically no liquid is carried past the seal.

A principal object therefore of the present invention is to provide, in a metering gear type pump, a relief groove

or channel which extends beyond the centerline of the gears towards the delivery side of the pump.

A further object of the invention is to provide a passage which communicates between the intake chamber of a gear pump and the chambers formed between teeth of the meshing gears at a point on the pressure side of the pump at or just after cut-off occurs between the teeth chambers and the delivery chamber.

A further object of the invention is to provide undercut teeth in a gear type pump in which the intake chamber is in fluid communication with the undercut chambers on the gears on the pressure side of the pump.

Further objects will be apparent from the specification and drawings in which:

Figure 1 is an exploded view of a gear type metering pump constructed in accordance with the present invention;

Figure 2 is a face view of one of the pump plates shown in Figure 1;

Figure 3 is a face view of the other of the pump plates shown in Figure 1; and

Figure 4 is a highly enlarged fragmentary detail showing the location of the suction relief groove with respect to the meshing teeth and the centerline.

The invention comprises essentially the provision of a relief groove or passage extending from a point beyond the centerline of the pump gears to provide limited fluid communication between such point and the intake chamber. In addition to such a groove or grooves, the teeth of the gears are shaped to permit a substantial amount of trapped liquid to be carried past the centerline of the pump.

Referring now more particularly to the drawings, a gear pump constructed in accordance with the present invention and intended for use as a metering pump for liquid viscose and similar materials has a front side plate 10 and a rear side plate 11. These two plates are securely clamped together when the pump is assembled by means of machine screws 12, 12. The space between the plates when assembled is partially filled by the driving pump gear 13 and the idler pump gear 14 which turn in the housing plate 15. Guide pins 16, 16 and spacing collars 17 on each pin provide the desired alignment and structural rigidity for the pump assembly. The shaft 20 which is connected to and drives gear 13 extends through an aperture 21 in front plate 10 and an aligned aperture 22 in rear plate 11. Idler gear 14 is journaled on a pin or post 23 mounted in plate 11. The gears 13 and 14 turn, in the present instance, as shown by the arrows in Figure 1 so that the intake chamber is partially bounded by the concave cut-away face 24 in the plate 15. Fluid intake to the chamber is provided through the customary orifice 25 in plate 10 which communicates with a drilled passage 26 and intake port 27. The discharge chamber is partially defined by the concave face 28 on the opposite side of housing plate 15. Fluid is discharged from the pump through an orifice 29 which connects with the discharge chamber through a drilled passage 30 and discharge port 31. The structure described above is substantially conventional in pumps of this type and therefore forms no part of the present invention.

It will be especially noted that the intake chamber (not shown as would appear with the pump assembled, but hereinafter designated by numeral 24) is, in effect, enlarged by reason of notches or grooves 35 and 36 in plates 10 and 11 respectively. Notch 35 overlaps the intake port 27 to provide direct fluid communication therebetween. Notch 36 in the opposite plate provides direct fluid communication with the chamber 24 only. In the preferred embodiment, I provide notches or grooves in both plates 10 and 11. However, this may not be

strictly necessary depending upon the viscosity of the fluid pumped, the pressure on the intake or supply fluid, and the depth and size of the passages. It will be noted, however, that particularly the groove **35**, which is in communication with the intake port **27**, extends beyond the centerline C of the gears as shown clearly in Figures 3 and 4. This, in a sense, introduces intake fluid to the discharge side of the pump as defined by the centerline between gears **13** and **14**. Notch **36** likewise extends somewhat beyond the centerline as shown in Figure 2. The reason for this location of either or both of the notches **35** and **36** will be more apparent in connection with the description of Figure 4. In addition to the provision and location of the grooves **35** and **36**, I undercut the teeth of both gears to provide chambers or passages for the entrapped liquid as the gears fully mesh. The advantages of these passages in the gears or between the gear teeth are believed to be in the substantial decrease percentagewise of the compression present in the volume of fluid carried past the seal or centerline of the gears. Furthermore, these passages assist in eliminating the release of air bubbles in a fluid such as viscose by acting as miniature expansion chambers.

Referring now more particularly to Figure 4, it will be seen that tooth **14***a* has just sealed the liquid in chamber **37** between teeth **13***a* and **13***b*. This is by reason of the line contact at **38** between teeth **13***a* and **14***a*. Chamber **37** is, at this instant, filled with liquid at substantially the discharge pressure. As the gears continue their turning in the direction shown by the arrows, tooth **14***a* would ordinarily compress the liquid in chamber **37** because it continues in sealing contact with both of the teeth **13***a* and **13***b* while simultaneously entering farther into the chamber **37**. However, it will be noted that substantially at or slightly after the instant that sealing contact is made at **38** between teeth **13***a* and **14***a* chamber **37** is opened to communicate with groove **35** at **39**. This is achieved by extending the groove **35** beyond the centerline to the pressure side of the pump as noted above and sufficiently far that the groove **35**, in effect, acts as a pressure relief groove. As the gears continue to turn, the minimum volume of chamber **37** will be reached. Such a condition is illustrated with respect to chamber **40** which is shown in Figure 4 with tooth **13***b* directly on the centerline. However, at this point chamber **40** is completely in communication with the intake port **27** through either or both grooves **35** and **36**. It will thus be seen that not only was there no opportunity for excessive pressure to build up causing roughness of the pump, but the early fluid communication between teeth chambers and the intake chamber tends to equalize any pressure differences in the chamber.

Ordinarily, as the gear teeth pass beyond the centerline and disengage, there is a tendency to create a vacuum or a low pressure condition in the chambers, if any, between the teeth. Thus it will be seen that chamber **41** is of substantially greater volume than chamber **40** and, in fact, equal to chamber **37**. However, this increase in volume, as shown at chamber **41**, does not create a low pressure condition therein even though there is still a seal at **42** between teeth **13***c* and **14***b* because chamber **41** is in fluid communication with the intake chamber and liquid through grooves **35** and/or **36**. Of course, as soon as the seal **42** is broken, as shown between teeth **13***c* and **14***c*, the tooth chamber such as **43** is in full communication with the intake chamber **24**. It will thus be seen that the location of the groove **35** as shown in Figure 4 provides a pressure relief to inhibit pressure rise in the fluid trapped between gear teeth. It does not, however, adversely affect the seal between the teeth since there is no point at which direct communication takes place through the teeth between the pressure and intake chambers of the pump. Groove **35** also inhibits any decrease in pressure in the teeth chambers as the teeth disengage, and therefore there is no time nor opportunity for excessive pressure to be built up which would tend to form bubbles when released.

It will be understood that the shape and location of the relief groove or grooves can be varied substantially within the scope of the invention. However, any further positioning of the grooves to the right, as shown in Figure 4, would sharply decrease the pump capacity due to the loss of a seal. Should it be desired to restrict the right-hand terminus of the grooves, as seen in Figure 4, so that the teeth chambers would be opened at about the centerline there would, of course, then be some pressure build-up in chambers **37**, **40**, **41** and **43**. This would more effectively seal the pressure and intake chambers but might result in slight rough running. The tendency under these conditions, however, to produce bubbles would be minimized because the percentage reduction in volume of chambers **37**, **40**, **41** and **43** would be much less than where the conventional non-undercut gear tooth is used.

Having thus described my invention, I claim:

A metering gear pump for pumping viscous fluids comprising a pair of pump side plates, a pair of meshing gears mounted between said side plates, each of said gears having cut-away portions between the teeth thereof whereby chambers of substantial volume are formed at the point of full meshing engagement of the teeth of the gears, a housing plate secured between the side plates and closely embracing the major portion of the peripheries of said gears, said housing plate and said side plates cooperating to form a suction chamber on one side of the centerline of said gears and a pressure chamber on the other side of the centerline of said gears, an intake for viscous fluid extending through a first one of said side plates and communicating with said suction chamber, an output port in the other of said side plates communicating with said pressure chamber, and a circular indentation in the inner wall of said first one of said side plates, said indentation encompassing an area aligned with the intake, the chambers formed at the point of complete meshing engagement of the gear teeth and the suction chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,129,090	Hawley	Feb. 23, 1915
1,348,773	Auger	Aug. 3, 1920
1,719,025	Scheminger, Jr.	July 2, 1929
1,863,160	Jensen	June 14, 1932
1,891,793	Kauffman	Dec. 20, 1932
1,976,227	Howard	Oct. 9, 1934
1,985,748	Svenson	Dec. 25, 1934
2,281,767	Heckert	May 5, 1942
2,498,790	Caughrean	Feb. 28, 1950
2,540,235	Berkley	Feb. 6, 1951

FOREIGN PATENTS

366,152	Germany	Dec. 30, 1922
421,373	Germany	Nov. 10, 1925