

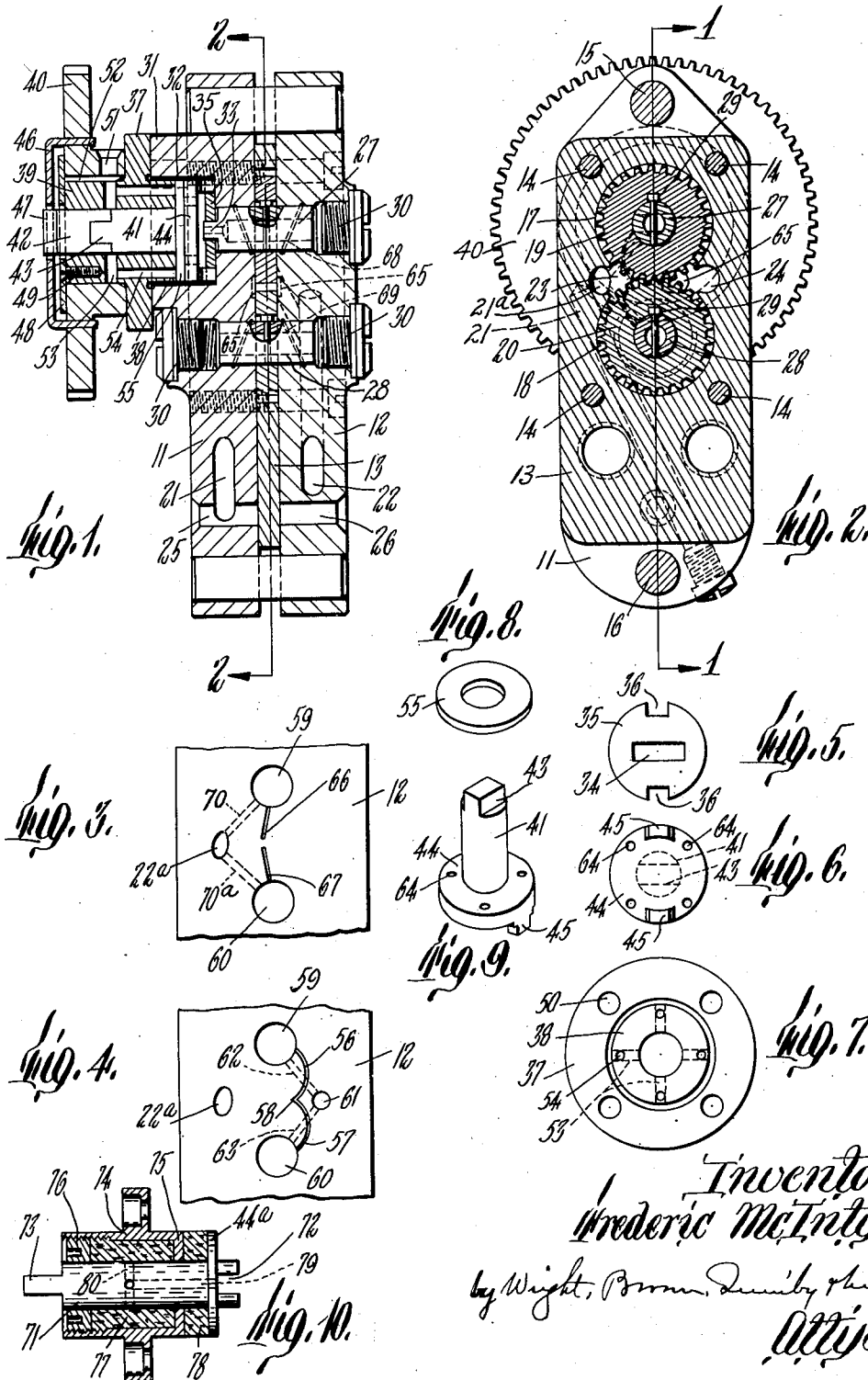
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METERING PUMP FOR CELLULOSE COMPOUNDS

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METERING PUMP FOR CELLULOSE COMPOUNDS

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18 Claims. (Cl. 103—126)

The present invention relates to metering pumps of the gear type suitable to be used for delivering cellulose compounds in solution at a uniform regulated known rate of flow to spin-
 5 nerets or spinning-jets to form the filaments used in the manufacture of rayon. Gear type pumps of this class differ from ordinary gear pumps used to propel oil, water, etc., in that they are run at low speed and are made so as to pre-
 10 vent as far as possible any leakage whatever of the solution between the intermeshing teeth of the propelling gears.

The problem of lubrication has caused the greatest difficulty in the use and operation of such metering pumps in the rayon industry, for oil cannot be used in any such manner as to en-
 15 danger mixing of the oil with the solution; while the solution itself has but poor lubricating qualities and, upon drying, has a highly detrimental action of cutting or tearing away particles of
 20 metal on the surfaces of relatively moving parts.

In my pending application, Serial No. 218,340, filed September 8, 1927, I have disclosed one means which I have invented of solving the lubri-
 25 cation problem; this being to provide an intentional and controlled leakage of the cellulosic solution, permitting the solution to flow continuously between rubbing surfaces and escape from the exterior of the pump at such a rate (less than
 30 enough to permit loss of pressure or to affect the rate of delivery of the pump) as to utilize what lubricating power it possesses, while at the same time giving no opportunity for the solution to dry and harden between relatively movable sur-
 35 faces and thereby effect its highly deleterious abrasive or tearing action.

There are, however, some cellulosic solutions, leakage of which from the pump is undesirable, for a variety of reasons. A different problem of lubrication is presented in the handling of such
 40 solutions, which I have solved by closing the pump so that evaporation of the solvent cannot occur and by causing a forced flow of the solution between rubbing surfaces. The present invention
 45 is concerned with improvements in gear pumps which effect lubrication by means of the solution being pumped, without external leakage, and comprises new structural features by virtue of which the solution is confined without possibility
 50 of solvent evaporation; the solution is forced between relatively moving surfaces, provision is made for lubricating the external driving shaft with oil, and a stop efficiently prevents access of oil to the interior of the parts. All moving parts
 55 of the pump are thus lubricated, while mixing of

the oil provided for lubricating external parts with the solution passing through the pump is prevented.

In the drawing herewith furnished I have illustrated an embodiment, which at present I prefer to others, of the invention above briefly de-
 60 scribed.

Fig. 1 of the drawing is a cross section through the axes of the shafts and gears of the pump, the location of the section being indicated by
 65 line 1—1 of Fig. 2;

Fig. 2 is a cross section at right angles to the one previously described on a plane indicated by line 2—2 of Fig. 1;

Fig. 3 is a fragmentary elevation of the inner surface of one of the side plates of the pump casing showing one means of delivering the solu-
 70 tion for lubrication to the shaft bearings;

Fig. 4 is a fragmentary elevation of the inner surfaces of one of the side plates of the pump casing, showing another mode of lubricating the
 75 shaft bearings;

Figs. 5, 6 and 7 are detail elevations showing parts of the means for transmitting motion from the external gear to one of the pump gears, and
 80 the provisions for admitting lubricant to such parts;

Fig. 8 is a perspective view of the sealing disc by which mingling of lubricating oil with the solution is prevented;

Fig. 9 is a perspective view of one of the sections or members of the driving shaft;

Fig. 10 is a detail sectional view of a stuffing box alternative to the external shaft bearing shown in Fig. 1 and having means to prevent
 90 mingling of lubricating oil with the solution.

The pump casing consists of two massive plates 11 and 12 and a center plate 13; all connected together by screws 14 or equivalent fastenings, and the side plates being additionally held rigidly in alignment by massive bars 15, 16, secured fric-
 95 tion tight in holes in one of the side plates and fitted closely into aligned holes in the other plate. The center plate is preferably made of steel ground and finished accurately to uniform thickness with plane surfaces, and the side plates are preferably
 100 of cast iron accurately ground with plane surfaces at the inner side. Cavities 17 and 18, merging into one another, are formed in the center plate to receive the pump gears 19 and 20; while the side plates have passageways 21 and 22 opening through orifices 21a and 22a respectively
 105 to the inlet space 23 and outlet space 24, in the center plate communicating with the gear cavities. These passages have external openings 25
 110

and 26 for connection with external conduits leading the solution to and from the pump.

The gears are mounted on shafts 27 and 28 which turn in alined bearings in the casing plates 11 and 12. All of these parts, namely, the gears, their shafts, and the bearing surfaces surrounding and enclosing the gears and shafts, are made with the same order of accuracy and with clearances between moving parts of the same order described in my prior application herein referred to, to the end that the solution may be propelled without loss by the gears at a speed and in quantities of which the speed of the pump is an accurate measure. The gears are fastened to their respective shafts so as to turn them and be turned thereby, by keys 29, each of which in the illustration here given is a pin driven through the shaft and having a projecting head which is received in a keyway in the gear.

The passageways in the casing plates which provide the shaft bearings extend through to the outside of these plates, and their ends, except as to the one which is coupled to the driving means, are enlarged and tapped, and receive closing screw plugs 30. The latter are set up tightly with whatever washers or other packing may be necessary and sufficient, so as to prevent evaporation of the volatile solvent in the solution which is forced by the action of the pump into these bearing passages. While the specific construction last described is desirable as affording scope for accurately finishing the bearing passages by grinding, it is not an absolutely essential feature.

For transmitting driving power to the pump gears, the casing plate 11 is made with a relatively large cavity 32 in its outer side, coaxial and communicating with the bearing of shaft 27, and an annular rib 31 on the plate (in this illustration of the invention) surrounds and extends such cavity. The shaft has a transverse rib 33 on its extremity protruding from the bearing into said cavity and entering a complementary slot 34 (see Fig. 5) in a disk or plate 35, which loosely occupies such cavity. This disk has peripheral notches 36 in opposite sides.

A cover 37 is secured detachably to the end of boss 31 and is provided with an inner hub 38, which enters the cavity but terminates short of the bottom thereof, and an outer hub 39 projecting outward and forming the bearing for a driving gear 40.

This cover or plate 37 with its hubs 38 and 39 may be considered also as a flanged sleeve. It has a central passageway, approximately, although not necessarily exactly, alined with the bearing for shaft 27, in which are located shaft sections 41 and 42 in rotation transmitting engagement through a transverse rib 43 on the end of one of them entering a complementary groove in the adjacent end of the other. The shaft section 41 is provided with an integral head 44 having axially projecting lugs 45 spaced and dimensioned to enter the notches 36 in the disk 35. The associated shaft section 42 is coupled to the gear 40 by means of a strap or bar 46 extending across the end of the shaft section and anchored at its ends in the gear. The shaft section has a transverse end rib 47 entering a slot in the strap. A holding plate 48, having a central hole through which the shaft section 42 passes, is secured by screws 49 to the end of the hub or sleeve 39, and overlaps the central part of the gear 40. Thus, as the plate or flange 37 is secured to the casing by screws entering holes 50 in this plate, the parts are all secured in assembled relationship.

Lubrication of the external shaft sections 41 and 42 is effected by oil introduced through the passageways which I will now describe. In the hub of the external driving gear 40 is an oil hole 51 opening into an internal groove 52. The hole 51 revolves about a zone of the bearing sleeve 39 wherein are located four (more or less) radial holes 53, each communicating with a longitudinal passage 54 extending to the extremity of sleeve 38. A ring or disc 55 is located between the end of sleeve 38 and the flange or collar 44 on shaft section 41. The opposite faces of this ring are accurately finished in true planes perpendicular to the axis of the ring, and the contiguous faces of the sleeve 38 and flange 44 are likewise accurately finished in planes truly perpendicular to the same axis. Such contiguous surfaces are pressed closely against one another by the pressure of the solution passing through the pump in the manner presently described, and the ring 55 serves as a sealing means to prevent escape of the solution through the bearing of the driving shaft or the lubricant passages above described, and to prevent also entrance of lubricating oil into the interior of the pump where it could mix with the solution.

In the embodiment of the invention shown in Figs. 1, 2 and 4, the surfaces of each of the casing plates 11 and 12 contiguous to the pump gears are provided with narrow shallow grooves leading from approximately the point of intersection of the outermost circumferences of the gears to the shaft bearings at the inlet side of the pump. The grooves so provided in the plate 12 are shown at 56 and 57 in Fig. 4. The corresponding grooves in plate 11 are shown in Fig. 2, being indicated by dotted lines where they pass behind the gears 19 and 20. The grooves in each plate at and near their junction point 58 are uncovered more or less at all times by the gears so that they receive the solution entering the space 23 from the inlet passage 21. The grooves extend on curved lines to the shaft bearings, represented in Fig. 4 by the holes 59 and 60, and the movement of the gears over the grooves sweeps the solution contained therein to the bearings. The solution spreads over the surfaces of the shafts and their bearings, lubricating them. There is also in the plate 12, opening to the inlet space 23, a cavity 61 from which passages 62 and 63 lead to the enlargements of the shaft bearing passages in which the closing plugs 30 are placed. Other passages similar to 62 and 63 are provided in the plate 11 leading from the chambers at the ends of the shaft bearings in the latter plate to the inlet orifice of the pump, or other part of the inlet passage, or other orifice equivalent to that shown at 61. Paths are thus provided for circulation of the solution which passes through each of the bearings in each plate.

The solution which passes through the bearing of shaft 27 in plate 11 enters the cavity in the outer side of said plate in which the flange 44 of shaft 41 is contained. It fills all the otherwise unoccupied space in this cavity and enters holes 64 in the flange 44, lubricating the contact surfaces of this flange and the sealing ring 55. The pressure imposed by the pump on this solution and transmitted into the cavity exerts pressure on the sealing ring, holding it in close contact with the adjacent end face of the sleeve or hub 38. At the same time the solution lubricates the contiguous surfaces of the flange 44 and ring 55. Thus the moving parts external to the pump are lubricated by oil, the parts within the pump to

which oil cannot be admitted are lubricated by the solution, and an efficient seal is provided, the rubbing surfaces of which are also lubricated, to prevent mixing of the external lubricant with the solution passing through the pump.

In order to prevent excessive pressure being imposed on the solution entrapped between the teeth of the pump gears coming into mesh at the delivery side, I provide a shallow recess 65 in the face of one of the side plates, in this case the plate 11, or permissibly in both plates, extending beside the paths in which the teeth of the respective gears travel in approaching each other, from a point outside of the location where the teeth first make contact with one another toward the common plane of the gear axes. It will be understood that each tooth of either gear, in entering the mating tooth space of the other gear continues to penetrate further into such space after making tangent contact with the tooth faces bounding such space. The solution thus entrapped in the diminishing tooth space would be subjected to great pressure and would cause great pressure of the gear shafts on their bearings if no avenue of escape were provided other than the minute clearances between the sides of the gears and the faces of the contacting side plates, owing to the fact that the gears are made and located with practically entire absence of backlash between their teeth. But the cavity 65, extending from beside the location where the penetration of the gear teeth into their complemental spaces is the maximum to a location outside of the meshing point, permits free escape to the outlet of the solution thus entrapped and so prevents such excessive pressure being thus imposed.

I may, however, utilize the pressure thus imposed on the solution as a means for forcing the solution to the shaft bearings and thereby effecting lubrication under greater pressure than is created by the wiping action of the gears in propelling oil through the grooves 56 and 57. Provisions for effecting such forced feed lubrication are shown in Fig. 3. This is an alternative construction to that for the wiping feed. In this instance grooves 66 and 67 are formed, preferably in both side plates, of such dimensions and in such locations that each is open at one end to the base portion of every tooth space in one of the gears from the position where the space becomes blocked by an entering tooth of the other gear, and throughout the period while its volume is being diminished by further penetration of the entering tooth, and each groove is separated from the other. These grooves lead separately to the two shaft bearings, around which are preferably spiral grooves 68 and 69, cut either in the walls of the bearings, or in the sides of the shafts, if preferred, to give free course for the liquid. The return passages 70 and 70a from the chambers at the ends of the shaft bearings lead to the space at the outlet side of the pump, those in the plate 12 conveniently entering the discharge orifice 22a, while the corresponding passages in the plate 11 lead to a recess in the plate opening to the outlet space 24 of the center plate. The reason for placing the return passage at the outlet side of the pump is to relieve the high pressure which may be thus impressed on the liquid and to ensure a positive circulation over the faces of the gears and bearings for lubrication.

A construction of cover plate and its adjuncts alternative to that previously described is shown in Fig. 10.

An alternative form of cover member and associated parts is shown in Fig. 10. A single shaft 71 is here substituted for the two-part shaft 41—42, having a notch 72 at one end and a tongue 73 at the other end for coupling, respectively, with shaft 27 and driving gear 40. A sleeve packing 77 of cork, or other suitable material, is placed in a stuffing box within this cover member, to surround shaft 71, and is compressed by a gland 76. A thrust bearing washer or disk is interposed between the end 75 of the cover and flange 44a of the shaft. Passages 79 and 80 in the shaft, and holes in the flange 44a like the holes 64 of Fig. 9 admit the solution from within the pump to the rubbing surfaces, for lubrication. I have found that solutions of the kind here contemplated cooperate excellently with cork to make substantially frictionless surfaces, in the situations here shown, while cork makes a sufficiently liquid tight packing to prevent escape of the solution or entrance of the lubricating oil.

It is to be understood that the driving gear will be mounted on the exterior end of the stuffing box, and may be lubricated, exactly as shown in Fig. 1.

In this pump the clearances of the gears are too slight to permit leakage from the delivery side to the inlet side, even under high back pressure, and are only enough to permit entrance between rubbing surfaces of a lubricating film of the solution, which is also a sealing film. Thus the quantity of solution delivered by the pump is a function of its speed and is uniform at any constant speed even though such speed be very small; say in the order of five to ten revolutions per minute. The pump is thus adapted to serve as an accurate metering pump maintaining a constant delivery even against considerably varying back pressures. But at the same time adequate provision is made for forcing the solution between all the moving parts and the adjacent stationary surfaces and for preventing evaporation of the solvent, such as would permit drying and hardening of the compound between bearing surfaces and scoring such surfaces.

What I claim and desire to secure by Letters Patent is:

1. In a metering pump of the character set forth, a casing having shaft bearings and pump gear cavities, intermeshing pump gears located in said cavities, shafts occupying said bearings on which said gears are respectively mounted, the casing having an external chamber into which one of said shaft bearings opens, a cover for said chamber having a shaft bearing aligned approximately with the last named bearing and an end-thrust bearing at its end which faces said chamber, said cover having an oil inlet leading to the shaft bearing surface and a passage from said inlet to the end-thrust bearing, a driving shaft occupying the shaft bearing in the cover having a flange located in said chamber and overlapping said end-thrust bearing, coupling means between said flange and the adjacent pump gear shaft for transmitting rotation from the first shaft to the other, and a sealing washer between the flange and the end-thrust bearing arranged to be pressed against the latter by the solution in the pump, the before-named-passage serving to conduct lubricant to the outer face of said washer.

2. In a metering pump of the character set forth, a casing having shaft bearings and pump gear cavities, intermeshing pump gears located in said cavities, shafts occupying said bearings on which said gears are respectively mounted, the

casing having an external chamber into which one of said shaft bearings opens, a cover for said chamber having a shaft bearing aligned approximately with the last named bearing, said cover
 5 having an oil inlet leading to the shaft bearing surface and a passage from said inlet to the inner end face of the bearing, a driving shaft occupying the bearing in the cover and having a flange located in said chamber, coupling means between
 10 said flange and the adjacent pump gear shaft for transmitting rotation from the first shaft to the other, and a sealing washer between the flange and the adjacent end face of the cover arranged to be pressed against the latter by the solution in
 15 the pump, the before-named-passage serving to conduct lubricant to the outer face of said washer, and the flange having an opening through it adapted to convey solution to the inner surface of the washer for lubricating the latter surface.
 20 3. In a metering pump, a casing, complementary pump gears contained and operating in said casing, a shaft on which one of said gears is mounted, the casing having a bearing for said shaft and an external chamber into which said bearing opens,
 25 and a shaft having a non-circular extremity projecting into said chamber, a disc located in said chamber having a hole complementary to said projection and receiving the same, and also having notches at either side of such hole, a cover secured
 30 to the casing over said chamber having an internal shaft bearing and an external bearing surface, a driving shaft section located in the said internal bearing having a flange in the chamber provided with projections entering the before mentioned
 35 notches of the disc, a driving gear mounted on the external bearing of said cover, and coupling means between said gear and said driving shaft section, the driving gear having an oil hole leading to the external bearing surface and the cover having
 40 passages extending to its internal bearing surface and to the inner end face thereof, combined with a sealing washer lying against the said end face and between the latter and the flange of the driving shaft section.
 45 4. A metering pump comprising a casing having internal gear cavities and shaft bearings, the latter being closed at both ends, complementary pump gears fitting rotatably in said cavities with minimum clearance between their surfaces and the
 50 boundaries of the cavities and with substantial absence of backlash between their teeth, shafts fitting said bearings rotatably and terminating short of the end closures thereof, separated grooves formed in the end walls of the gear cavities
 55 leading each from the outlet side of the pump to one of the respective shaft bearings, and the casing having passages leading from each of the shaft bearings to a space in the gear cavities outside of the circumference of either gear.
 60 5. In a gear pump of the character described, a casing surrounding the pump gears with minimum clearance and having shaft bearings, said casing comprising plates in which adjacent to the ends of the gears are channels leading to the
 65 respective bearings from the inner surfaces of said plates at points which are overpassed by the rotating gears, and the plates having return passages from the outer ends of the bearings to their surfaces which bound the internal pump space.
 70 6. In a gear pump of the character described, a casing surrounding the pump gears with minimum clearance and having shaft bearings, said casing comprising plates in which adjacent to the ends of the gears are channels leading to the res-
 75 pective bearings from points beside the locations

occupied by the tooth spaces in the respective gears when such spaces are blocked and contracted by entering complementary gear teeth; said channels being formed to prevent flow, elsewhere than to the bearings, of the fluid entrapped between the intermeshing gear teeth. 80

7. In a gear pump of the character described, a casing surrounding the pump gears with minimum clearance and having shaft bearings, said casing comprising plates in which adjacent to the ends of the gears are channels leading to the respective bearings from points beside the locations of the tooth spaces in the respective gears when such spaces are blocked and contracted by entering complementary gear teeth, said channels being otherwise closed to prevent flow, elsewhere than to the bearings, of the fluid entrapped between the intermeshing gear teeth, and means for returning solution forced through said bearings to the outlet side of the pump. 85

8. In a gear pump of the character described, a casing surrounding the pump gears with substantially leakage preventing closeness and having shaft bearings, the walls of said casing contiguous to the ends of the gears having unconnected
 100 grooves, each of which leads from one of the bearings to the location occupied successively by the tooth spaces of the gear centered on the same bearing when such spaces are blocked and reduced in volume by the entrance of meshing teeth on
 105 the other gear.

9. In a metering pump of the character described having a casing, intermeshing pump gears in said casing and bearing means for positioning said gears in the casing, means for utilizing the pressure imposed upon liquid entrapped in the tooth spaces of the respective gears for lubricating said bearing means comprising separate
 110 grooves in the casing walls contiguous to the end faces of the gears, each leading to the bearing means of one gear from the location occupied successively by the tooth spaces of the same gear when such spaces are blocked and diminished in liquid containing volume by entering teeth of the
 115 other gear.

10. In a metering pump having a casing, intermeshing pump gears, and centering bearing means for the respective gears, a lubricating groove formed in the face of the casing contiguous to the end face of one of the gears and leading to the bearing means of such gear from the location occupied successively by the tooth spaces of that gear when blocked and diminished in liquid containing volume by the entering teeth of the other gear, said groove being otherwise closed whereby
 120 the pressure imposed on the liquid being pumped, by entrapment and compression in such tooth spaces, is made effective to force such liquid to the bearing of that particular gear only.

11. A metering pump of the character set forth comprising a casing, pump gears within said casing, an interior shaft to which one of said gears is secured, an exterior driving shaft coupled to said interior shaft, a cover embracing said exterior shaft and having an end thrust bearing, said shaft having a flange overlapping said end thrust bearing, and a sealing member interposed between said flange and end thrust bearing, the flange having holes through which the liquid being pumped is admitted to the contiguous face of
 125 the sealing member for lubrication. 130

12. In a metering pump, a casing, pump gears within said casing, an interior shaft to which one of said gears is secured, an exterior driving shaft coupled to said interior shaft, a cover se- 135

- cured to the casing having an internal bearing for said driving shaft and a thrust bearing at its inner end, the driving shaft having a flange adjacent to its inner end overlapping said thrust bearing, means for lubricating the shaft bearing in said cover, and a sealing disk between the shaft flange and said end thrust bearing to prevent mingling of the shaft lubricant with the fluid acted on by the pump.
13. In a metering pump, a casing, pump gears within said casing, an interior shaft to which one of said gears is secured, an exterior driving shaft coupled to said interior shaft, a cover secured to the casing having an internal bearing for said driving shaft and a thrust bearing at its inner end, the driving shaft having a flange adjacent to its inner end overlapping said thrust bearing, means for lubricating the shaft bearing in said cover, a sealing disk between the shaft flange and said end thrust bearing to prevent mingling of the shaft lubricant with the fluid acted on by the pump, and means for admitting such fluid between the shaft flange and sealing disk for lubricating the latter by means of such fluid.
14. In a metering pump comprising a casing, intermeshing pump gears, a shaft secured to one of said gears and a bearing in the casing for said shaft, a channel in the casing adjacent to the end face of one of said gears leading to said shaft bearing from the location occupied by the successive tooth spaces of said gear when blocked by the entering teeth of the mating gear and being otherwise closed against escape of liquid, whereby the pressure imposed on the liquid entrapped in such spaces forces flow of the liquid through said groove and shaft bearing, the bearing being closed at the outer end of the shaft, and the casing having a return passage from the bearing to an interior space through which fluid is propelled by the pump gears.
15. A rotary pump or the like comprising two toothed pumping wheels meshing with each other, a casing in which the said wheels are mounted which closely fits the faces and a portion of the outer periphery of each wheel and has a relief passage extending from a position communicating with the clearance space between the crown of each tooth in turn and the base of the space between two teeth of the other wheel in which the fluid is trapped at the meshing point of the wheels during operation of the pump, and means whereby fluid is led from the aforesaid relief passage to the mounting for one of the said toothed wheels to serve as the lubricant therefor.
16. A rotary pump or the like comprising two toothed pumping wheels meshing with each other, a casing in which the said wheels are mounted which closely fits the faces, and a portion of the outer periphery, of each wheel and has a relief passage extending from a position communicating with the clearance space between the crown of each tooth in turn and the base of the space between two teeth of the other wheel in which the fluid is trapped at the meshing point of the wheels during operation of the pump, and means whereby fluid is automatically led from the aforesaid relief passage to the mountings for the said toothed wheels to serve as the lubricant therefor.
17. A rotary pump or the like comprising two toothed pumping wheels meshing with each other, a casing in which the said wheels are mounted which closely fits the faces, and a portion of the outer periphery, of each wheel and has a relief passage extending from a position communicating with the clearance space between the crown of each tooth in turn and the base of the space between two teeth of the other wheel in which the fluid is trapped at the meshing point of the wheels during operation of the pump, means whereby fluid is automatically led from the aforesaid relief passage to the mounting for one of the said toothed wheels to serve as the lubricant therefor, and means whereby the said lubricant is discharged from the mounting and led to the output chamber of the pump.
18. A rotary pump or the like comprising two toothed pumping wheels meshing with each other, a casing in which the said wheels are mounted which closely fits the faces, and a portion of the outer periphery, of each wheel and has a relief passage extending from a position communicating with the clearance space between the crown of each tooth in turn and the base of the space between two teeth of the other wheel in which the fluid is trapped at the meshing point of the wheels during operation of the pump, a shaft on which one of the said toothed wheels is fixedly secured to rotate therewith and a bearing in the said casing for the shaft, which bearing is formed with a lubricating groove extending along the substantial portion of the length of the bearing and almost completely encircling the shaft but terminating at one end at the said relief passage and leading at the other end to the output chamber of the pump.
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