

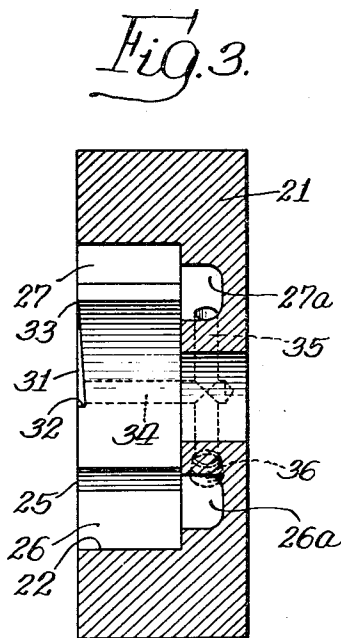
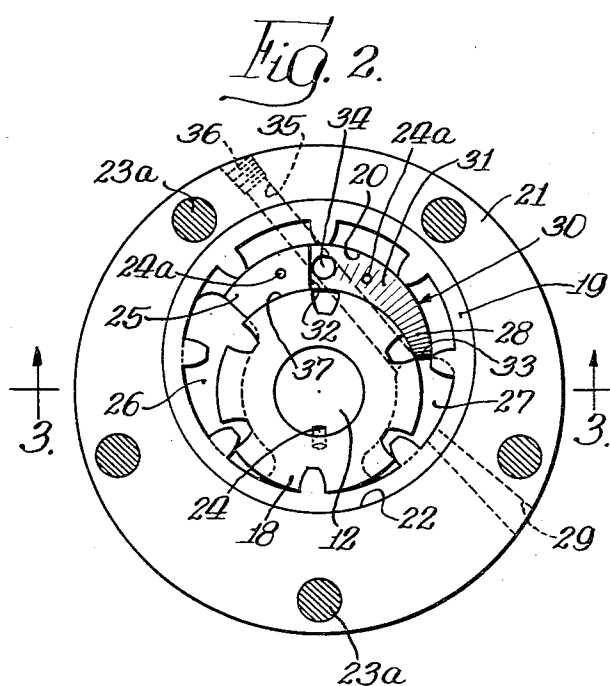
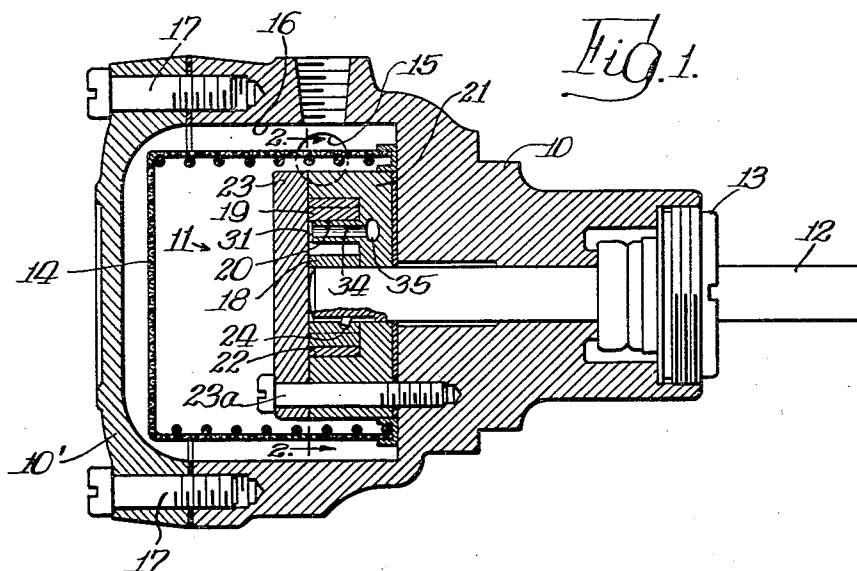
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This invention relates to a gear pump and more particularly to a gear pump constructed and arranged as to operate under extreme pressure conditions.

It is the general object of this invention to produce a new and improved gear pump.

It is a more specific object of this invention to produce a gear pump in which noise, erosion and other undesirable characteristics caused by cavitation are substantially completely eliminated.

Another object of the invention is to produce a gear pump provided with means for insuring complete filling of the gear spaces preceding the outlet port of the pump before oil in said gear spaces is subjected to the full extent of outlet port pressure thus reducing cavitation and cavitation erosion to an insignificant factor.

Another object of the invention is to produce a gear pump provided with means for gradually introducing oil substantially under outlet port pressure into partially void gear spaces preceding the outlet port so that the pressure and volume of oil in the gear spaces is gradually increased as the oil is brought to outlet port pressure.

A further object of the invention is to produce a gear pump of the type described in the preceding paragraphs in which means are provided for supplying to partially void gear spaces preceding the outlet port a gradually decreasing volume of oil under elevated pressure the maximum volume being introduced at a point where the void space is greatest and decreasing thereafter as the void spaces are gradually filled as the oil in said gear spaces is brought to outlet port pressure by rotation of the gears.

Yet another object of the invention is to produce a crescent type gear pump in which a portion of the crescent or end cap is beveled away to form a passage along the surface of the crescent, said passage being connected with the outlet port and being of a design for providing gear spaces preceding the outlet port with a gradually decreasing volume of oil under substantially outlet port pressure, the maximum volume being introduced at a point where the gear spaces are at substantially the greatest distance from the outlet port and still sealed from the inlet port, said volume decreasing thereafter as the gear spaces are gradually filled.

Other and further objects of this invention will be apparent from the following description and drawings in which:

Fig. 1 is a vertical section through an oil pump embodying the invention;

Fig. 2 is a vertical section along line 2—2 of Fig. 1; and

Fig. 3 is a section taken substantially along line 3—3 of Fig. 2.

While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail one specific embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the

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embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

In the form of the pump chosen for the purposes of disclosure, there is provided a two part casing 10, 10', a crescent type gear pump 11, a drive shaft 12, a mechanical seal 13 for the drive shaft, and a strainer 14. It is contemplated that the shaft 12 will be connected by suitable means to a driving motor (not shown), that an inlet port 15 will be connected to a source of oil supply.

The casing parts are formed to provide a chamber 16 in which the pumping device 11 and the strainer 14 are located. The part 10' is in the form of a closure or cover and is bolted to the part 10 by means of a plurality of screw devices 17.

The pumping device 11 comprises an externally toothed pinion gear 18 and an internally toothed ring gear 19 meshing with the pinion, a crescent guard element 20, and a housing for these members consisting of a cylindrical block 21 with a cut away cylindrical chamber 22 therein, said chamber being positioned eccentrically of the center of said block and being of a depth equal to the thickness of the gear, pinion and crescent which are housed in said chamber. The end plate 23 is used as a closure for the pumping unit. A plurality of screw devices 23a secure the end plate to the block 21 and the block to the casing 10.

The pinion is mounted centrally with respect to block 21 and eccentrically with respect to the center of the chamber 22 and is secured to the drive shaft 12 by means of the pin 24. The crescent member 20 fits snugly between the spaced or separated portions of the gear and pinion and is secured to the block 21 by means of the pins 24a. The end plate 23 is provided with an inlet passage (not shown) which opens at one end to the chamber 16 and at the other end to the inlet port 26 of the pump which is located at one end 25 of the crescent. Preferably, an arcuate cavity 26a is formed in block 21 opposite the inlet port so as to facilitate filling of the gear spaces in the gear and pinion. An outlet port 27 is formed in the block 21 adjacent the other end 28 of the crescent and an arcuate cavity 27a is associated therewith, and means in the form of an outlet passage 29 are connected to the outlet port.

The crescent member 20 is of substantially the same thickness as the gear and pinion. One surface 30 of the crescent is bevelled to provide a passage 31 along said surface, said passage being deepest at its beginning near the center of the surface at point 32, the portion of said bevelled surface most remote from the outlet port. The bevelled surface tapers gradually from point 32 toward the outlet port and terminates at point 33 where the outlet port end of the crescent is substantially the same thickness as the gear and pinion so that there is no seepage of oil from the outlet port over said crescent end. A passageway 34 opens in the surface of said passage near the area of maximum depth thereof and communicates with a passageway 35 to allow a flow of oil under substantially outlet port pressure into said passage. A plug in one end 36 of the passageway 35 prevents the escape of oil from said end. The end plate 23, gear 19, pinion 18, crescent 20 and block 21 are machined to close tolerances and positioned to permit substantially no leakage of oil except through the passage 31.

It is a general purpose of the passage herein disclosed to provide means for insuring complete filling of the gear spaces preceding the outlet port of the pump before oil in said gear spaces is subjected to the full extent of outlet port pressure and to thereby substantially reduce noise, cavitation erosion and other undesirable characteristics caused by cavitation.

The deleterious effects of cavitation on gear pumps be-

come particularly pronounced in gear pumps utilized under extreme pressure conditions such as the low atmospheric pressures existing at high altitudes. Because of low inlet pressure at high altitudes the oil supplied to the gear spaces by the inlet port frequently contains a good deal of undissolved air and oil vapor and may even be in the form of foam so that gear spaces after filling by the inlet port contain air and oil vapor bubbles entrained with the oil, the air and oil vapor having come out of solution because of low pressure conditions. The void space caused by said gaseous bubbles necessarily reduces the output volume of the pump and its operating efficiency. The pressure of the gaseous bubbles in the oil, as the gear spaces rotate toward the outlet port, causes cavitation erosion of the pump parts, noise and vibration, all of which become intensely pronounced when this mixture in the gear spaces is subjected instantaneously to high outlet port pressure upon discharge into the outlet port. The instantaneous effect of the high pressure is to violently force the gaseous bubbles in the oil back into solution, thereby causing the said bubbles to implode and to drive oil particles traveling at extremely high velocities against parts of the pump with eroding effect.

The positioning and design of the passage means disclosed herein for insuring substantially complete filling of the gear spaces and substantially complete reduction of cavitation and the effects thereof is important.

The passage 31 is formed to supply oil under elevated pressure in a decreasing volume to a plurality of gear spaces preceding the outlet port 27 and thus said passage has a volume decreasing toward the outlet port from point 32 of maximum depth to point 33 adjacent the outlet port. A decreasing volume of oil is supplied to the gear spaces to conform with the rate of filling of the void spaces therein; that is, as each gear space is gradually filled by oil under elevated pressure, the volume of void space therein gradually decreases and consequently the passage is designed to supply a decreasing volume of oil under elevated pressure in relation to the need therefor or the decrease in void space.

Initial communication by the passage with a gear space occurs at a point 32 of maximum passage volume when a gear space is at substantially the greatest distance from the outlet port yet still sealed from the inlet port after being filled thereby. At this point the volume of void space in each gear space is the greatest and said gear space is, at said point, subjected to an initial maximum volume of oil under elevated pressure, said volume gradually decreasing as the gear space gradually fills and the void volume gradually decreases as the gear space passes along the decreasing volume of the passage toward the outlet port.

The length of the bevelled surface or passage may be determined by the sealing effect which is desired for the pinion gear and hence the length of the passage may be varied to conform with differently spaced gear teeth. The bevel, as disclosed herein, is located in such a manner that at maximum condition one full pinion tooth 37 seals against the crescent, and at minimum condition one half a pinion tooth seals against the crescent.

The volume of the passage should be large enough to accommodate a substantially unrestricted flow of oil under elevated pressure to the gear spaces preceding the outlet port. In pumps having output flow of from 5 to 10 gallons per minute, the preferred depth of the passage is approximately .015 to .025 inch.

The depth of the passage and its taper are a function of certain known conditions such as inlet pressure, speed, capacity and discharge pressure and therefore must be varied when any of the combination of conditions are changed. A specific sized passage, however, will generally accommodate a 20 percent variation in oil flow.

The maximum depth of the passage and its taper are also a function of the volume of void spaces existing in the gear spaces after filling by the inlet port, and therefore

the depth and taper of the passage must vary as the volume of void spaces decreases or increases with a change in combination of conditions as aforesated.

Upon rotation of the shaft 12 the gear spaces passing the inlet port 26 are filled with oil under inlet pressure. As the gear spaces move along the crescent toward the outlet port they communicate with the passage 31 at a point where they are substantially the greatest distance from the outlet port and still sealed from the inlet port. Due to the design and positioning of said passage, said gear spaces are subjected to a gradually decreasing volume of oil under substantially outlet port pressure, said oil under elevated pressure serving to insure complete filling of the gear spaces prior to the discharge of the oil therein into the outlet port and to gradually increase the oil pressure in said gear spaces so as to gradually collapse gaseous bubbles which may be entrained in the oil; thus forcing gas in said gear spaces substantially back into solution prior to the point where oil in said gear spaces is subjected to the full extent of outlet port pressure. The gradual forcing of the gas back into solution and the smooth transition of the oil in the gear spaces from inlet pressure to the full extent of outlet port pressure is accompanied by practically no noise, vibration, cavitation erosion or other undesirable characteristics caused by cavitation.

We claim:

1. A gear pump comprising, a casing having a cylindrical pumping chamber with inlet and outlet ports, an internal ring gear rotatably mounted in the chamber, a pinion of the same thickness as and meshing with said ring gear, a shaft supported eccentrically of said chamber and carrying said pinion gear, said pinion gear having an external diameter less than the internal diameter of the ring gear to provide an arcuate space therebetween, a member of substantially the same thickness as the gear and pinion fixed in said chamber and located in said space, said member being tapered at each end to give the member substantially the shape of a crescent with said ends being located adjacent the inlet and outlet ports of the chamber, a plate closing one end of the chamber and contacting one surface of the gear and pinion in sealing relationship, said member having a bevelled portion extending from side to side of said member along one surface thereof beginning near the center of said surface and terminating short of the outlet end of said member to provide a passage sealed from said outlet port and defined between said member and said plate, said bevelled portion increasing in depth from adjacent said outlet end to said beginning whereby said passage gradually decreases in volume from its beginning toward the outlet port, a passageway connecting said passage with the outlet port, said passage establishing communication between the outlet port and a plurality of gear spaces in the ring and pinion gears immediately preceding the outlet port to introduce into said gear spaces a gradually decreasing volume of oil at substantially outlet port pressure.

2. A gear pump comprising, a casing having a cylindrical pumping chamber with inlet and outlet ports, an internal ring gear rotatably mounted in the chamber, a pinion of the same thickness as and meshing with said ring gear and carried on a shaft supported eccentrically of said chamber, said pinion having an external diameter less than the internal diameter of the ring gear to provide an arcuate space therebetween, a member of the same thickness as the gear and pinion fixed in said chamber and located in said space, said member being tapered at each end to give the member substantially the shape of a crescent with said ends being located adjacent the inlet and outlet ports of the chamber, a plate closing one end of the chamber and contacting one surface of the gear and pinion and of the member in a sealing relationship, said member having a bevelled portion along a surface thereof extending from side to side of said member and beginning intermediate the ends of said surface and terminating short of the out-

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let port end of said member to provide a passage sealed from said outlet port and defined between said member and said plate, said passage having a maximum depth at its beginning of approximately .015 to .025 inch and progressively decreasing to zero depth adjacent the outlet port whereby said passage decreases in volume from its beginning to adjacent the outlet port, passageway means connecting said passage with the outlet port, said passage communicating in decreasing volume with a plurality of gear spaces in the ring and pinion gears immediately preceding the outlet port to subject oil in said gear spaces to a gradually decreasing volume of oil substantially at outlet port pressure as oil in the gear spaces is brought to outlet port pressure with rotation of the gear and pinion.

3. A gear pump comprising a casing having a pumping chamber provided with inlet and outlet ports, a gear rotatably supported in the chamber, a second gear of the same thickness as the first gear and mounted to have a portion meshing with said first gear and a portion spaced therefrom, a member having a portion of the same thickness as the gears fixed in said chamber adjacent the outlet port and between the spaced portions of said gears in substantially a sealing relationship with said gears, means defining a passage in said chamber along a surface of said member and opening to gear spaces on both sides of the

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member, said passage being shaped to have a volume gradually decreasing toward said outlet port and being in communication with a plurality of gear spaces immediately preceding said outlet port, and a passageway formed in the casing independent of said surface and opening at one end to the outlet port and at its other end to said passage remote from the outlet port, whereby to subject oil in said gear spaces to a gradually decreasing volume of oil at substantially outlet port pressure as the gear spaces approach said outlet port with rotation of said gears.

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