March 18, 1952 C. J. BERGSMA 2,589,528

LOW CAPACITY GEAR PUMP

Filed March 13, 1948

Fig. 1.

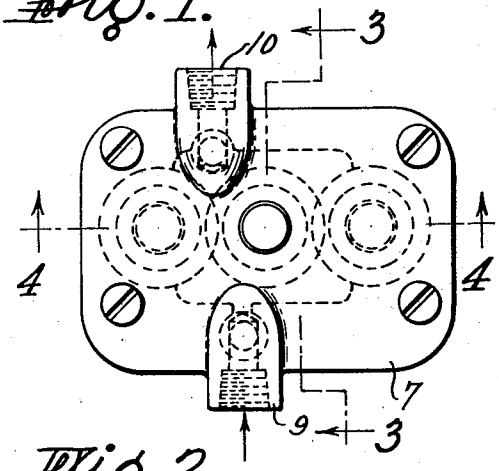


Fig. 5.

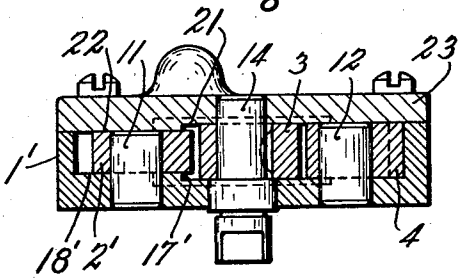


Fig. 2.

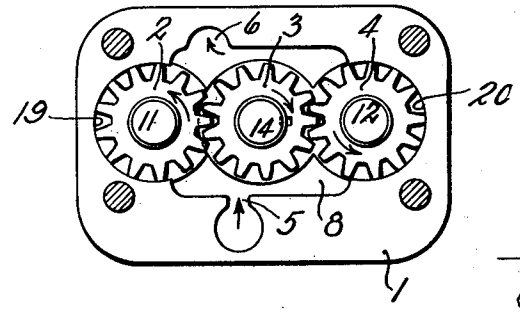


Fig. 3.

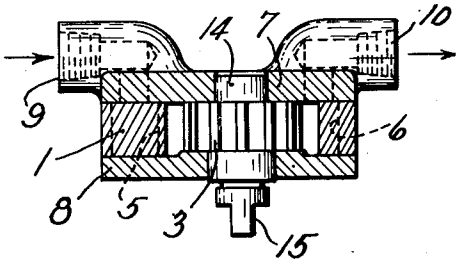
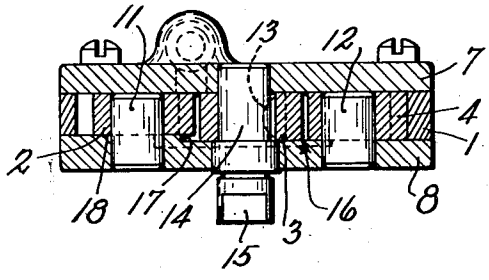


Fig. 4.



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Patented Mar. 18, 1952 2,589,528

UNITED STATES PATENT OFFICE

2,589,528

LOW CAPACITY GEAR PUMP

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Application March 13, 1948, Serial No. 14,732

4 Claims. (Cl. 103—126)

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This invention relates to improvements in rotary gear pumps and has for its object a simple and efficient structure for delivering a small and even minuscule stream of liquid at a precision rate of delivery under a positive pumping action.

The construction and operation of the routine types of rotary gear pumps are too well known to need description. The differences between them and the new pump will appear as the new one is described.

A purpose of the present invention is to provide a rotary gear pump of a construction which will at any given speed deliver a small or minuscule stream at a predetermined rate under the positive action of a rotary gear pump and without making the pump so small as to have weak or expensive parts. In other words the new pump can be made generally as if it were one to deliver a very much larger quantity and thus have all the advantages of rugged rotary pump parts and the economy of their manufacture. The specific differences over such a pump will be seen in the way of limiting its pumping action to the accurate delivery of oil to an engine for example, at a rate so small as to be out of the capacity range of rotary gear pumps as they are generally constructed.

The many advantages of the structure will be seen from the following description of a preferred form of the invention as shown by the accompanying drawings in which,

Fig. 1 is a top plan view of the gear pump;

Fig. 2 is a top view with the top casing plate removed;

Fig. 3 is a view on line 3—3 of Fig. 1;

Fig. 4 is a view on line 4—4 of Fig. 1; and

Fig. 5 is a view similar to Fig. 4 of a modified construction.

Referring to the drawings a casing 1 with a train of three gears 2, 3 and 4 rotatably mounted therein is provided with an inlet passage 5 and outlet passage 6. A casing top side plate 7 and casing bottom plate 8 hold the casing 1 between them by retaining screws. Plate 7 is provided with passages connecting inlet 5 and outlet 6 with an inlet port 9 and an outlet port 10.

Gears 2 and 4 are mounted and freely rotatable in the casing on hubs 11 and 12 fixed in plate 8. Intermediate gear 3 in mesh with gears 2 and 4 is fixed by a key 13 to a shaft 14 which is rotatably journaled in top plate 7 and plate 8. A flat 15 on the outer end of shaft 14 (Fig. 4) is for connection to a drive shaft for rotating the gear 3.

As shown by Fig. 4 the gear 2 is not quite as thick as gears 3 and 4 and the surface 16 of the

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plate 8 on which the gears 3 and 4 are seated is stepped as at 17 to provide an offset platform 18 underneath gear 2. The height of platform 18 is determined by the difference in the thicknesses between gear 2 and gears 3 and 4 so that the upper edges of all the gears are in the same plane. The difference in thickness may be made as small as desired—less than twenty thousandths of an inch has been used in an actual pump successfully tested and used.

The operation of the structure will now be described with particular reference to Fig. 2. As the gears rotate in the directions indicated by arrows, the liquid carried down from the outlet to the inlet side between the teeth of gear 2 past the narrowed casing gear cover 19 will be less in quantity than the liquid carried up to the outlet side between teeth of gear 4 past casing gear cover 20. This is because the gear 4 is slightly thicker than gear 2 and the carrying space is therefor slightly more between the teeth of gear 4. The excess of liquid then is carried to the outlet side by gear 4 being pumped through outlet 6 and port 10.

Since the teeth of gear 3 mesh with those of both gears 2 and 4 no liquid will be carried along the lines of tangency except for a small quantity between gears 2 and 3 now to be explained. Gear 3 is also slightly thicker than gear 2. To the extent that the teeth of gear 3 extend beyond the teeth of gear 2 at the step portion at 17 as indicated (see Fig. 4), the entire space between the teeth of gear 3 will not be filled by the teeth of gear 2. In other words the spaces between the teeth of gear 3 adjoining the stepped platform at 17 will be filled with liquid to be carried from the inlet to the outlet side.

It will be seen that this slight amount of liquid carried by the teeth of gear 3 past the stepped portion at 17 will be pumped to the outlet side in addition to the previously described amount pumped by gear 4 (the amount in excess of the return flow by gear 2). The sum of these two amounts determines the output of the pump.

The result of this construction is that a pump may be provided with parts large enough to avoid troubles of manufacture and use and yet operate for a very small rate of oil delivery and with positive pumping action at all times at any speed range. It is important in the desired use that no random variations enter into quantity or pressure of the oil delivered and the nature of the positive action of the structure described avoids the random variations.

It operates with precision as effectively as in theory a gear pump of minuscule size would but which in practice is too small a pump for feasible manufacture and use.

Considering the new pump from its structural standpoint it should be noted except for the provisions of design for the special mode of operation it is structurally no more than a three gear rotary pump instead of the two gear rotary pump of routine practice. And the new pump is adapted to retain all the advantages of the highly developed efficiency of gear pumps and add the important one of a precisely determined minuscule rate of delivery.

In the design of the new pump it is possible to provide for a precise and minuscule oil pumping rate by precision manufacture of the differences in the dimension between the casing plate walls enclosing gears 3 and 4 on the one hand and the dimension between the corresponding walls enclosing gear 2 on the other hand. In Fig. 4 this difference in dimension is evidenced by step 17.

A modification shown by Fig. 5 provides for the narrower dimension between the casing walls adjacent gear 2 by providing a step 21 and offset portion 22 on a top plate 23. Casing 1' is cup shaped, eliminating the bottom plate 8 of Fig. 4. A step 17' and offset portion 18' also narrow the dimension for the thinner gear 2'. Of course one of the offset portions alone if of the required dimension would suffice in this form of the invention. My preferred and more economical form is shown by Fig. 4.

It will also be readily apparent from a consideration of the new pump and its operation that the gears 3 and 4 do not need to be of the same thickness. The outer gear, gear 4, may be thinner than gear 3 and also provided with a platform portion and step. The primary consideration is to provide a gear 2 of thinner dimension than gear 4 to permit the pumping of a predetermined small stream of liquid to the outlet port.

When the pump of Fig. 4 is assembled it will have a precision rate of positive pumping at any given driving speed. This rate will of course vary with the driving speed. There are, however, no other variables once the pump is assembled and put in use.

The pump is thus not adjustable in the ordinary sense to vary its capacity. The simplicity of the structure as disclosed in its preferred form is, however, such as to render adjustability for different capacities in the following sense. Parts of different dimensions can be carried to vary the pump capacity. A thicker or thinner gear 2 can be substituted for the one shown by Fig. 4, and a plate 8 with a differently dimensioned shelf 18 and step 17 can be provided with the substitute gear 2. Such a change of parts would change the capacity and be accomplished with a minimum of expense in substituting these two parts.

Having described my invention I claim:

1. A gear pump comprising a stationary casing having two side walls and a peripheral wall, inlet and outlet ports in said side walls, a spur gear rotatably mounted in the casing between the ports with a hub supported in one of said side walls, the ends of said gear abutting the inner surface of said side walls, a second and a third spur gear rotatably mounted in like manner in the casing, each in mesh with said first gear and having teeth rotatably abutting the inner surface of said peripheral wall, one of said latter gears being in axial dimension thinner than the other and thinner than the first gear, said casing having an inner surface portion of one side wall adjacent said thinner gear offset to correspond to the difference in thicknesses of said gears, said offset portion having its edge curved and in end abutment with a portion of the teeth of said first gear and forming a pumping space for said teeth of the first gear in this region, and a driving shaft connected with one of said gears.

2. A gear pump having a stationary casing with two side walls and a peripheral wall forming a chamber, an inlet and outlet port in the casing at opposite ends of the chamber, a train of three spur gears rotatably mounted in the chamber between said ports with a hub of each gear supported by one of said side walls, the ends of each gear abutting the side walls, said peripheral wall having recesses receiving the teeth of the outer gears and forming closed pumping spaces between successive gear teeth, one of the outer gears of said train being thinner in axial dimensions than the intermediate gear of said train and thinner than the other outer gear and forming spaces of less volume between the teeth of said thinner gear and peripheral recess than those spaces between the teeth of the thicker of said outer gears and its peripheral recess, a casing side wall adjacent one end of said thinner gear having a portion offset to correspond with the difference in axial dimensions of the thinner gear and the intermediate gear, said offset portion being in end abutment with the teeth of said intermediate gear in the region beyond their meshing engagement with said thinner outer gear and providing pumping spaces between said teeth and offset portion, and a driving shaft connected with one of said gears.

3. A gear pump for the precision pumping of a miniscule stream of liquid comprising in combination a stationary casing with two side walls and a peripheral wall forming a chamber, a train of three spur gears rotatably mounted in said chamber, one end of each gear being supported by one of said side walls, said train of gears dividing said chamber into two sub-chambers, an inlet port in said casing connected with one sub-chamber and an outlet port connected with the other, said peripheral wall being recessed and curved to abut the ends of the teeth on the outer gears of said train as said gears rotate, and forming pumping spaces between said teeth and said wall, an outer gear of the train being shorter in axial dimensions than the intermediate gear and in mesh therewith, one side wall adjacent an end of said shorter gear being provided with an offset platform corresponding in thickness with the difference in axial length of said shorter gear and its meshing intermediate gear, the edge of said platform being stepped and curved and abutting the ends of the teeth of the intermediate gear in that portion of the teeth of the intermediate gear extending beyond the teeth of said outer gear, and a driving shaft attached to one of said gears.

4. A gear pump comprising a stationary casing and a chamber therein, said chamber having two end walls and a peripheral wall; a train of three spur gears rotatably mounted in the chamber with a hub of each gear supported by one of the end walls, the ends of each gear abutting said end walls and fixed against axial movement relative thereto; an outer gear of said train being shorter in axial length than the other two gears,

one end wall of the chamber having an offset portion for the seating of the ends of said shorter gear; said gear train positioned to divide said chamber into inlet and outlet sub-chambers; inlet and outlet ports in said casing connecting with said sub-chambers; a driving shaft on one of said gears extending through one end wall of the chamber and the casing; said peripheral wall of the chamber having substantially half-cylindrical recesses for the outer gears of the train; the teeth of the longer of said outer gears abutting the surface of one of said recesses forming a closed space between successive gear teeth and the recess surface for fluid passage from the inlet sub-chamber to the outlet sub-chamber on revolution of the gear train; the teeth of the shorter of said outer gears abutting the surface of the other of said recesses forming a closed space of less volume between the successive gear teeth of the shorter gear and its recess surface for passage of less fluid from the outlet sub-chamber back to the inlet sub-chamber on revolution of the gear train; the offset portion of the casing abutting an end of the shorter gear being adjacent the overlapping portion of the teeth of the central gear of the train and the the shorter outer gear and forming a closed space between this portion of succesive teeth of the central gear of the train for fluid passage from the inlet sub-chamber to the outlet sub-chamber on revolution of the gear train.

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