Oct. 9, 1934. C. J. HOWARD 1,976,227

GEAR PUMP

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Fig. 1.

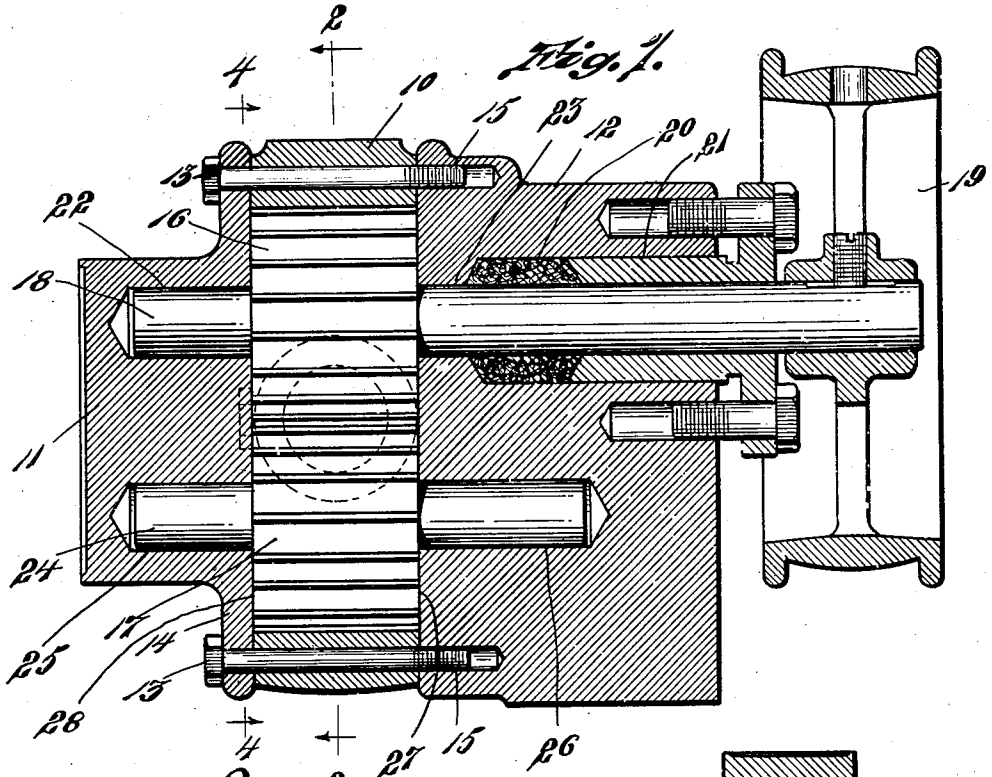


Fig. 2.

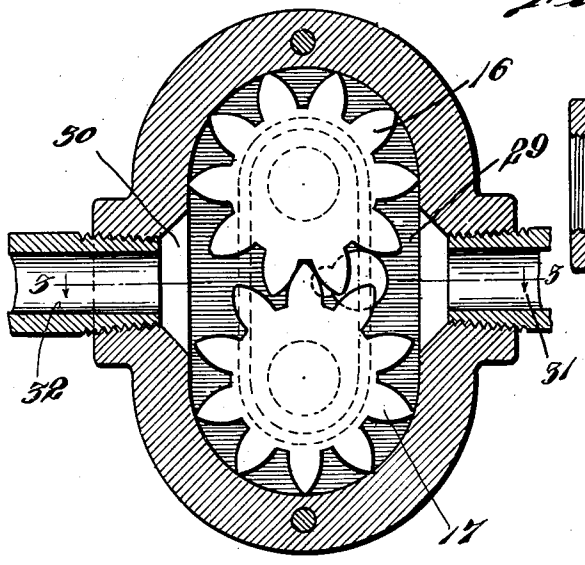
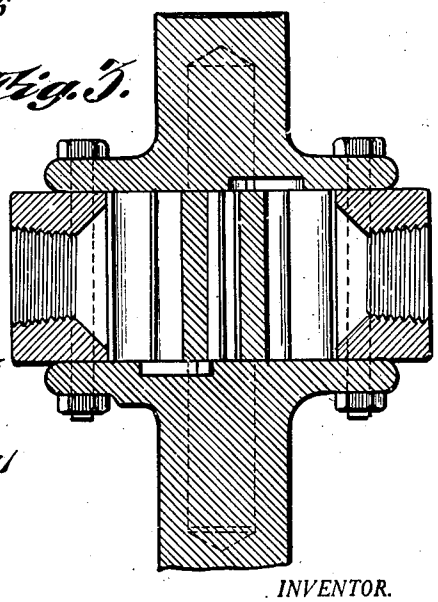


Fig. 3.



INVENTOR.
Clarence J. Howard
BY
Barlow & Barlow
ATTORNEYS.

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Fig. 4.

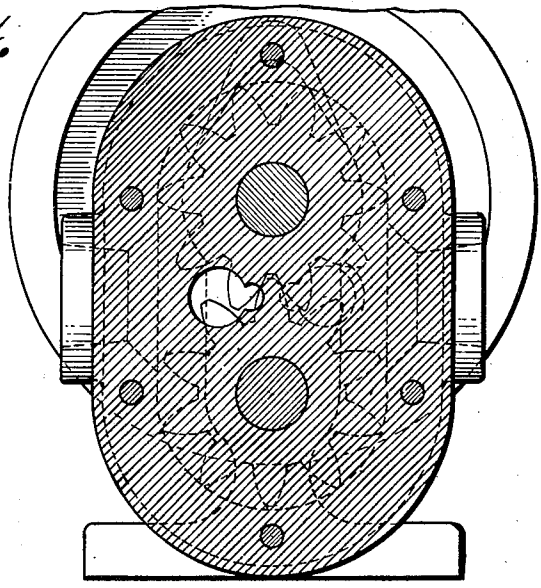


Fig. 5.

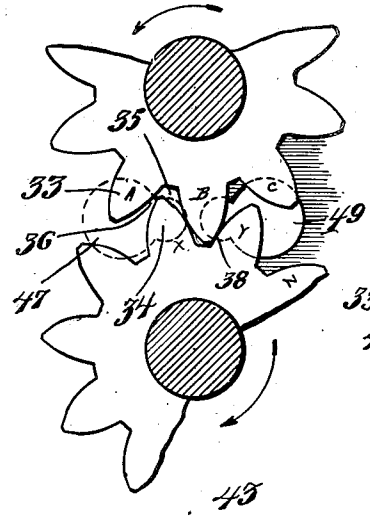


Fig. 6.

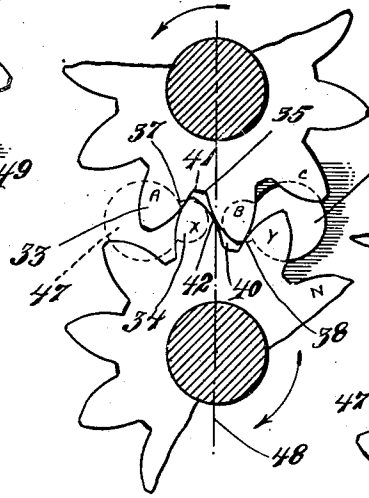


Fig. 7.

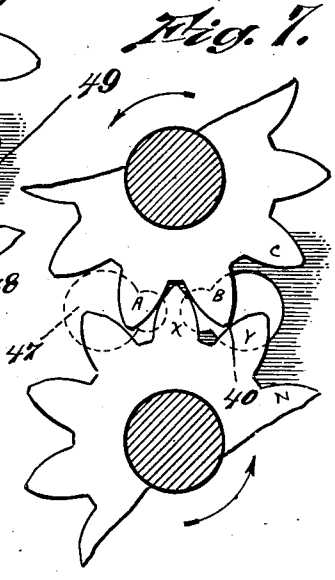


Fig. 8.

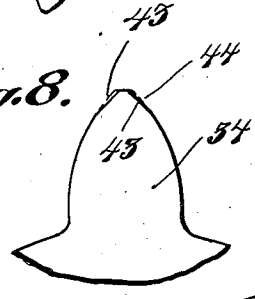
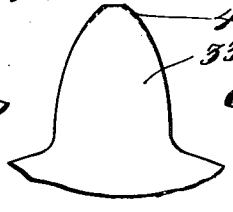


Fig. 9.



INVENTOR.
Clarence J. Howard
BY
Barlow & Barlow
ATTORNEYS.

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1,976,227

GEAR PUMP

Clarence J. Howard, Manton, R. I., assignor to Brown & Sharpe Manufacturing Company, a corporation of Rhode Island

Application March 20, 1931, Serial No. 523,993

13 Claims. (Cl. 103—126)

This invention relates to a gear pump, and has for its object to provide a construction which will operate at greater efficiency than gear pumps heretofore designed.

Another object of the invention is to increase the flow and force of the pump due to the better functioning of its parts.

Another object of the invention is the provision of a gear pump so constructed as to eliminate trapping of the liquid in sealed pockets of a decreasing volume between the teeth of the pumping elements, thereby eliminating back pressure on the gears moving them against their driving action to release the trapped liquid.

A further object of this invention is to so construct the teeth of the gears that sealed pockets will not be formed except when the pockets are at substantially minimum volume.

A still further object of this invention is the arrangement of the gear teeth and parts so as to be in the same relative position regardless of the direction of movement of the gears, whereby the pump may be equally well used for pumping liquids in either direction.

With these and other objects and advantageous features in view, the invention consists of a novel arrangement of parts more fully disclosed in the detailed description following, in conjunction with the accompanying drawings, and more particularly set forth in the appended claims.

In the drawings:

Fig. 1 is a sectional view through the housing showing the driving and driven gears constituting the pumping elements;

Fig. 2 is a section on line 2—2 of Figure 1;

Fig. 3 is a view on substantially line 3—3 of Figure 2;

Fig. 4 is a section on line 4—4 of Figure 1, showing the position of the relief port;

Fig. 5 is a fragmental view of two of the gears in one position of rotation;

Fig. 6 is a view similar to Figure 5 showing the gears in another position of rotation;

Fig. 7 is a view similar to Figures 5 and 6 showing the gear teeth in still a further different position of rotation;

Fig. 8 is an enlarged view of one of the teeth of the driven gear showing its modification;

Fig. 9 is an enlarged view of one of the teeth of the driving gear showing the addendum thereof enlarged at its end.

Gear pumps are usually noisy, indicating loss of power and wear of the operating parts. A large portion of this noise and wear is caused by trapping of the liquid in sealed pockets between the gear teeth which become somewhat smaller due to progressive movement thereof bringing pressure to bear upon the trapped liquid and causing a relative backward movement from the driving direction of the teeth, due to play or back lash left between the teeth that this trapped liquid may be released, causing a consequent noise in the action of the pump, and I have minimized this noise by preventing this relative backward movement of the gears by shaping the teeth so as to prevent sealing of the pocket formed between the teeth until minimum volume of the pocket has been reached, which I accomplish by providing clearance until the pocket has reached minimum volume. Also, I arrange relief ports which function in addition to the shaping of the teeth, whereby when heavy liquids are being pumped, such as molasses or the like, or such liquids which cannot escape between the narrow space formed by the removal of a portion of the driven tooth, the ports may assist escape of the liquid; and the following is a detailed description of the present embodiment of this invention, illustrating the preferred means by which these advantageous results may be accomplished.

With reference to the drawings, 10 designates the body of the casing, 11 one head, and 12 the opposite head therefor. The heads are held together through the body by bolts 13 engaging the flanges 14 of the head 11 and extending into threaded recesses 15 in the head 12. A driving gear 16 engages a driven gear 17, which gears form the pumping elements of the device. The driving gear 16 is fast on the driving shaft 18 having bearings 22 and 23 in the head members and is suitably driven by pulley 19 from a belt or other suitable source of power. A packing 20 is positioned about the shaft and is held in place by means of bushing 21 to prevent leakage of the pump.

The driven gear 17 is suitably mounted upon a shaft 24 having bearings 25 and 26 in the head members. The gears or pumping elements at their ends 27 and 28 are close to the head members 11 and 12 of the housing, while the body of the housing forms with the gears a suction chamber 29 and a pressure chamber 30 communicating with suitable inlet and outlet openings 31 and 32 respectively. The driving gear or pumping element has teeth 33 which mesh with the teeth 34 of the driven gear or pumping element.

In the position of the teeth illustrated in Figure 5, the pockets 35 are shown prior to sealing, and the liquid may pass therefrom as the volume

is reduced. In Figure 6, tooth X is shown in its position of first contact with the tooth A as at point 37. At this position, the more advanced pair of teeth B and Y are in contact as at point 38, thus closing the pocket 35 between the teeth A, B, X, Y, which is sealed by reason of the contact of the teeth at points 37, 38 and the close proximity of the heads at either end of the gears sealed by the liquid. The pocket 35 is divided in two portions 40 and 41 connected by a narrow neck portion 42. This position of first contact at point 37, however, is a position in which the pocket 35 is of minimum volume and the portions 40 and 41 of the pocket are substantially equal. Any further movement of the teeth will contract the volume of the portion 41 of the pocket, but will increase the volume of the portion 40 of the pocket. The portion 40 of the pocket will increase at a greater rate than the reduction in volume of the portion 41 until such point is reached that the contact 38 leaves the driven tooth, as illustrated at 40 in Figure 7. As this pocket increases in volume, a partial vacuum would be formed but for the relief ports hereinafter referred to so that as point of contact 38 breaks, liquid would flow toward the pocket 35 just formed; this, however, occurs through the relief port when such is provided.

I control this point of contact by suitably shaping the gear teeth. The driven tooth 34 is reduced at its end portion, as illustrated at 43 in Figure 8 in an amount substantially that illustrated between the dotted line 44 indicating the shape of a true involute tooth, and the line 43, thus the tip end or outer portion of the addendum of the tooth of the driven gear is reduced to such a point as to delay the tooth from receiving driving contact at its outer portion and thus leaving a space 36 between this flattened portion and the driving tooth for a considerable longer time as the gears rotate to permit escape of liquid as the pocket 35 decreases in size. At the same time, I have enlarged the end portion or addendum of the driving tooth so as to longer maintain contact with the lower portion or dedendum of the driven tooth as at point 38 in Figure 6. The driving teeth are usually sub-involute and thus this is accomplished by adding to the tooth to cause it to become substantially an involute form, as indicated at 45 in Figure 9, the dotted line therein being the customary sub-involute form.

The above description relates to the leading face of the driving and driven teeth by which I refer to those faces which contact in the operation of the gears. Back lash is left between the gears so that their trailing faces do not contact. I, however, duplicate on the trailing faces of the gear teeth the shape which I have just described on the leading faces so that the pump functions the same in the opposite direction should the driving gear be oppositely rotated, which enables the pump to operate in either direction by varying the rotation of the driving shaft. Such reverse of course causes the former suction chamber 29 to become a pressure chamber and the pressure chamber to be a suction chamber.

A pump with no relief ports as above described, operates satisfactorily upon thin liquids. It is found, however, that the space 36 left between the end of the driven tooth and the driving tooth just prior to contact as illustrated in Figure 5 is so small as to prevent free egress of a heavy liquid which it might be desired to pump. The face of the tooth cannot be further removed as a driving contact between the two gears must be constantly maintained for smooth action; and in order to permit egress of the heavier liquid from the pocket formed between the gear teeth, I have provided relief ports or conduits connecting with the chambers 29 and 30 to assist in the minimizing of pressure in the pockets formed between the gear teeth. The relief port on the suction side is formed by suitably hollowing out the head 12 to form a recess or conduit 47 which communicates with the pressure chamber and the pocket 35 being formed between the teeth, see Figure 5. This port or conduit is located wholly to one side of the center line 48 between the gears, and a similar port located in the opposite side of center line 48 in the opposite head 11 and designated 49 is provided for communication with the suction chamber and the pocket being formed between the gear teeth. Thus, in Figure 6 for illustration, as the pocket 35 is being closed, it is in communication with the relief port 47 and as it is becoming smaller just prior to contact at point 37, the liquid will be forced as much as possible through the small opening 36 formed as above described, and the remainder of the liquid which cannot so escape will be forced through the relief conduit 47 to the pressure chamber and thus be discharged. When the gear teeth are in the position illustrated in Figure 6, a minimum volume of the pocket 35 is obtained, the port 47 has just become closed and this position is just prior to the opening of the relief port 49 which occurs by further advance movement of the gears, thus the relief port 49 on the suction side will open prior to breaking of contact 38.

The relief ports are located at opposite ends of gears and on opposite sides of the centers, thus regardless of the direction of pumping action, they are located the same so that it is immaterial in which direction the driving gear operates, the function of the device will be the same.

While I have described certain construction forms which embody the principles of my invention, it is obvious that other desired changes in arrangement may be made within the spirit and the scope of the invention as defined in the appended claims.

I claim:

1. In a pump, a housing, a rotary driving pumping element, and a rotary driven pumping element therein having intermeshing gear teeth, the driven teeth of said driven element being shaped in that portion thereof immediately adjacent the crest of the teeth and extending the full width of the teeth so as to delay reception of driving contact adjacent their ends with the intermeshing driving teeth.

2. In a pump, a housing, a rotary driving pumping element, a rotary driven pumping element therein having intermeshing gear teeth, said driven element having its intermeshing driven teeth so shaped in that portion thereof immediately adjacent the crest of the teeth and extending the whole width of the teeth, as to delay reception of driving contact adjacent their ends with the intermeshing driving teeth, and said intermeshing driving teeth each shaped, in the corresponding portion, to continue its engagement until its end portion is in contact with said intermeshing driven teeth.

3. In a gear pump, a housing, driving and driven gears therein constituting pumping elements, and having generally involute intermeshing teeth forming pockets between them, said

pockets being sealed at certain relative locations of said gears, the end portion of the teeth of said driven gear including the crest of the teeth and extending the whole depth thereof, along both faces thereof to a point short of the pitch diameter, being reduced from a general involute shape to delay its contact with the tooth of the driving gear, whereby said pocket is reduced in size before being sealed.

4. In a gear pump, a housing, driving and driven gears therein constituting pumping elements and having generally involute intermeshing teeth forming pockets between them, said pockets being sealed at certain relative locations of said gears, the end portion of the teeth of said driven gear including the crest of the teeth and extending the whole depth thereof, along both faces thereof to a point short of the pitch diameter, being reduced from a general involute shape to an extent to delay sealing of said pocket until minimum volume thereof has been reached.

5. In a pump, rotary pumping elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming a pocket at certain positions in the revolutions of said elements, and conduit means for causing communication between one of said chambers and the pockets except when said pockets are substantially at minimum volume, said intermeshing portions being shaped to be sealed only at substantially minimum volume of said pocket.

6. In a pump, a rotary driving pumping element and a rotary driven pumping element, said elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming pockets of varying volume at certain positions in the revolution of said elements, and conduit means for causing communication between said chambers and said pockets except when said pockets are substantially at minimum volume, said conduit means being located so as to be the same with reference to said elements regardless of which direction said driving pumping element rotates.

7. In a pump, a rotary driving pumping element and a rotary driven pumping element, said elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming pockets varying in volume as the relative positions of said elements change, and conduit means for causing communication between one of said chambers and said pockets except when said pockets are substantially at minimum volume, said intermeshing portions being shaped to be sealed only at substantially minimum volume of said pockets.

8. In a pump, a rotary driving pumping element and a rotary driven pumping element, said elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming pockets of varying volume at certain positions in the revolution of said elements, and conduit means for causing communication between one of said chambers and said pocket except when said pocket is substantially at minimum volume, said intermeshing portions being shaped to seal said pocket only at substantially minimum volume of said pocket, said conduit means being located so as to be the same with reference to said elements regardless of which direction said pumping elements rotate.

9. In a pump, a rotary driving pumping element and a rotary driven pumping element, said elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming pockets of varying volume at different positions in the revolution of said elements, a single conduit at one end of said gears and at one side of the axial center between them communicating with one chamber and a pocket, and a single conduit at the other end of said gears and at the other side of the axial center between them communicating with the other chamber and a pocket, said intermeshing portions being shaped to seal the pockets from both chambers only at substantially minimum volume thereof.

10. In a pump, a rotary driving pumping element and a rotary driven pumping element, said elements having intermeshing portions comprising driven teeth having reduced portions along the crest and extending the whole width thereof, along both faces thereof to a point short of the pitch diameter for delaying sealing contact until minimum volume has been reached in the pockets formed between the teeth, a housing for said pumping elements providing suction and pressure chambers, said intermeshing portions forming pockets of varying volume at different positions in the revolution of said elements, a single conduit at one end of said gears and at one side of the axial center between them communicating with one chamber and a pocket, and a single conduit at the other end of said gears and at the other side of the axial center between them communicating with the other chamber and a pocket, said intermeshing portions being shaped to seal the pockets from both chambers only at substantially minimum volume thereof, said intermeshing portions being relatively similarly shaped regardless of the direction of rotation of said driving element.

11. In a gear pump, driving and driven gears constituting pumping elements and having intermeshing involute teeth, a housing for said gears closely adjacent the ends of said gears and form-

ing pressure and suction chambers on either side of their axial centers, said intermeshing teeth forming pockets closed at their ends by said housing, a conduit in one end of said housing located at one side of the axial center between said gears connecting one chamber with the formed pocket, and a conduit in the other end of said housing located on the other side of the axial center between said gears and connecting the other chamber with a formed pocket, the pockets in one position each being located between said conduits and sealed from communication with either chamber, the involute teeth of said driven gear having both their leading and trailing faces removed at their end portion from the involute form sufficient to prevent contact with the driving tooth until said pocket is of minimum volume.

12. In a gear pump, driving and driven gears constituting pumping elements and having intermeshing involute teeth, a housing for said gears closely adjacent the ends of said gears and forming pressure and suction chambers on either side of their axial centers, said intermeshing teeth forming pockets closed at their ends by said housing, a conduit in one end of said housing located at one side of the axial center between said gears connecting one chamber with said pocket, and a conduit in the other end of said housing located on the other side of the axial center between said gears and connecting the other chamber with said pocket, said pocket in one position being located between said conduits and sealed from communication with either chamber, the involute teeth of said driven gear having both their leading and trailing faces removed at their end portion from the involute form sufficient to prevent contact with the driving tooth until both conduits are closed by said teeth.

13. In a gear pump, a gear having a plurality of generally involute teeth, said teeth having reduced portions along the crest and extending therefrom on the leading and trailing faces of said teeth to a point short of the pitch diameter and the whole depth of the teeth, to delay the relative contacting action of said teeth with cooperating intermeshing gear teeth until minimum volume of the pockets between the teeth has been formed regardless of the direction of rotation of said gear.

CLARENCE J. HOWARD.