Feb. 21, 1939. N. SEAGREN 2,147,928

GEAR PUMP

Filed Oct. 19, 1936 2 Sheets-Sheet 1

Fig. 1.

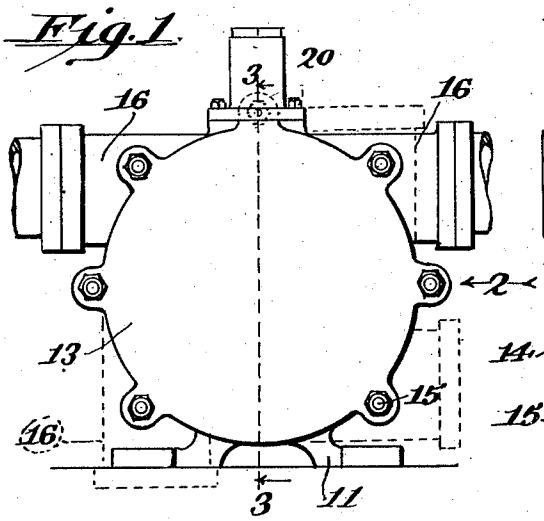


Fig. 2.

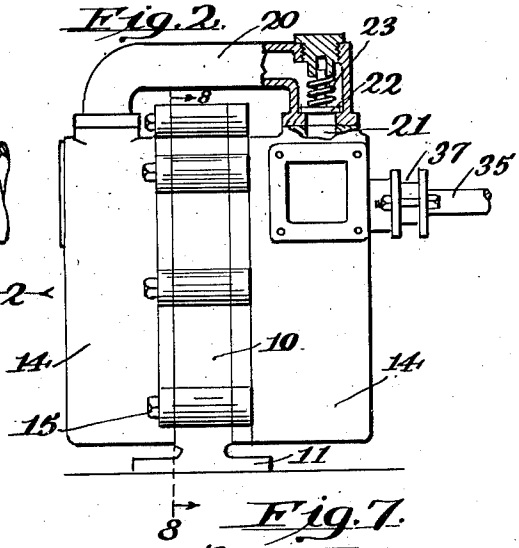


Fig. 3.

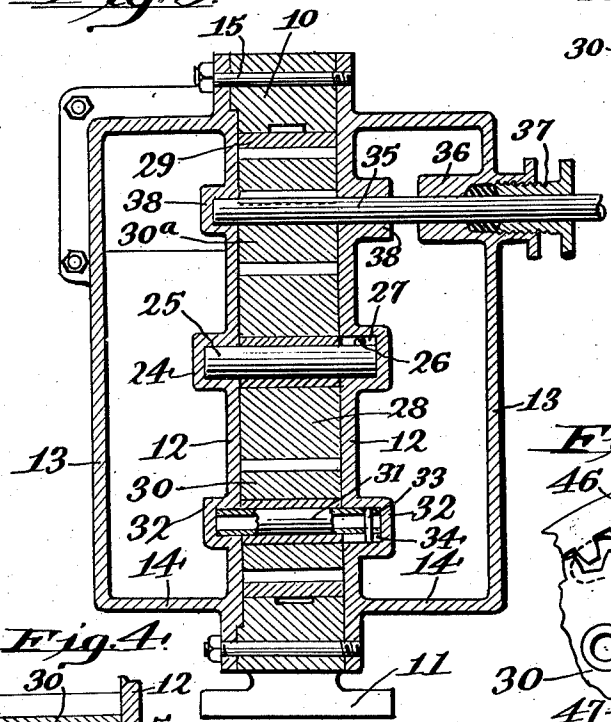


Fig. 7.

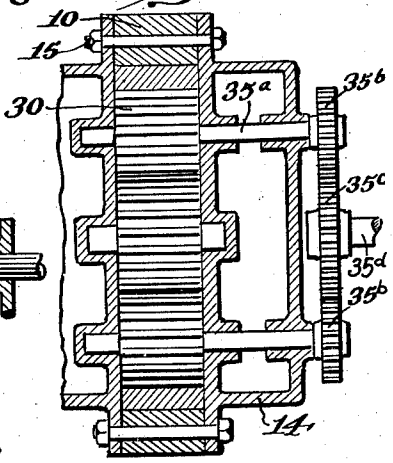


Fig. 4.

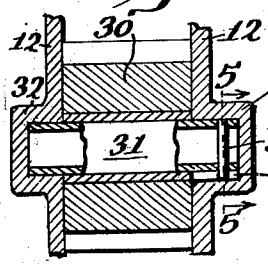


Fig. 5.

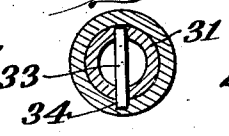
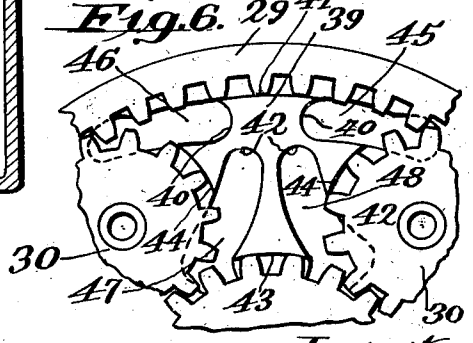


Fig. 6.



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Feb. 21, 1939. N. SEAGREN 2,147,928

GEAR PUMP

Filed Oct. 19, 1936 2 Sheets-Sheet 2

Fig. 8.

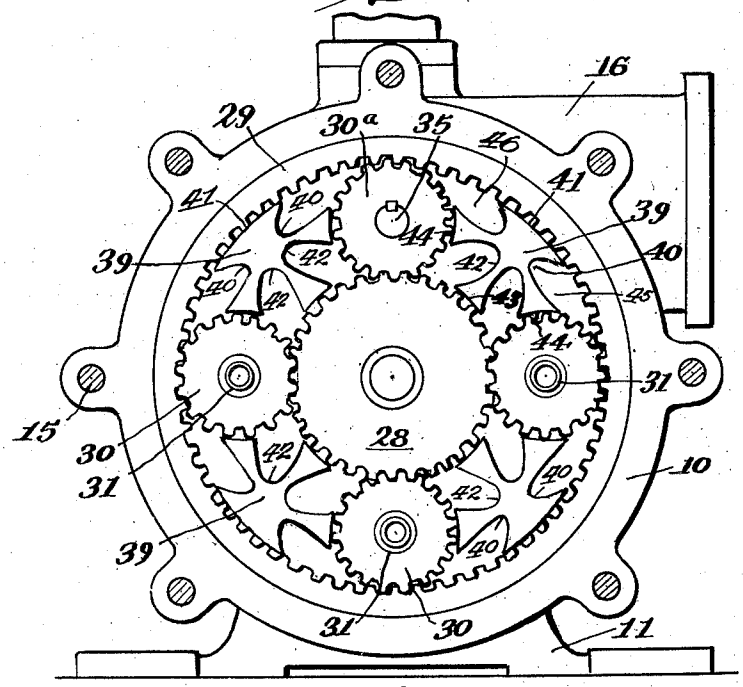


Fig. 10.

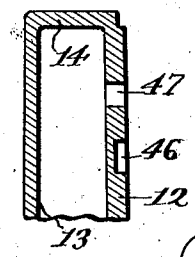
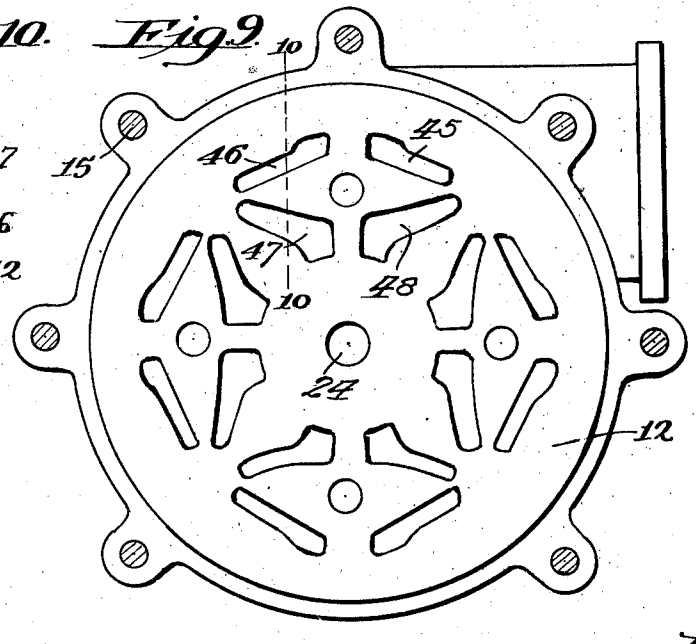


Fig. 9.



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GEAR PUMP

Nils Seagren, Los Angeles, Calif.

Application October 19, 1936, Serial No. 106,282

1 Claim. (Cl. 103—126)

My invention relates to rotary pumps of the gear type, particularly designed for pumping liquids, and the principal object of my invention is to provide a pump of the character referred to which shall be of simple and improved construction, having a relatively large capacity for a given size and capable of being driven at high speed directly from an electric motor or the like.

A further object of my invention is to provide a pump wherein the gears and the ports through which the liquid passes are disposed so that in operation the driving pressures, as well as the liquid pressures, are equalized, thereby minimizing the friction and consequent wear upon the operating parts.

A further object of my invention is to provide a gear pump that is very compact, light in weight, and which will handle a relatively large amount of liquid within a given period of time, and the housing of the pump capable of being adjusted so that the intake and outlet openings of the pump may be disposed either vertically upwardly or downwardly or laterally in either direction.

A further object of my invention is to provide improved means for driving the gears within the pump housing and which driving means is arranged so as to equalize or effect a balance between the gears within the housing, which latter during operation act on the liquid with pressure so as to cause the same to pass through the housing.

A further object of my invention is to provide a pump having a center gear with a plurality of smaller gears disposed around said center gear and in mesh therewith with lugs disposed between the smaller gears with plates of the housing arranged to the sides of said gears and lugs, and said plates and lugs having two inlet and outlet ports for each of the smaller gears, which arrangement provides a pump of increased capacity and equalizing or balancing both driving and liquid pressures.

With the foregoing and other objects in view, my invention consists in certain novel features of construction and arrangement of parts that will be hereinafter more fully described and claimed and illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevational view of a gear pump constructed in accordance with my invention.

Fig. 2 is an elevational view of the pump looking in the direction indicated by the arrow 2 in Fig. 1.

Fig. 3 is an enlarged vertical section taken on the line 3—3 of Fig. 1.

Fig. 4 is an enlarged detail view showing one of the shafts and the internal gear that is arranged thereon.

Fig. 5 is an enlarged cross section taken on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged detail view showing the positions of the inlet and outlet ports with respect to the center gear, the radial gears and the ring gears.

Fig. 7 is a vertical section taken through the center of the gear pump and showing a modified arrangement for driving the gears thereof.

Fig. 8 is an enlarged cross section taken on the line 8—8 of Fig. 2.

Fig. 9 is an elevational view looking against the inner face of one of the side members of the housing of the pump.

Fig. 10 is a detail section taken on the line 10—10 of Fig. 9.

Referring by numerals to the accompanying drawings which illustrate a preferred embodiment of my invention, 10 designates a ring that serves as the central or intermediate member of the pump housing and formed integral with the bottom of said ring is a base 11 that provides a support for the pump.

The circular housings each comprising an inner wall 12, an outer wall 13 and a circular wall 14, are secured to the sides of ring 10 by means of bolts 15 and these housings, which are practically identical in construction, provide chambers through which the pumped liquid circulates. Each housing is provided with a tangentially arranged tubular member 16 that may function as an intake or outlet for the pump, depending upon the direction of rotation of the gears within the pump, and such construction enables either one of the housings to be shifted so that the discharge outlet projects upwardly or downwardly or laterally in either direction.

In some instances it may be found desirable to equip the pump with a by-pass between the chambers in the two housings, and such by-pass includes a tubular member 20, the open ends of which are connected to ports 21 formed in the circular walls 14 of the housing, and arranged within one end of this tube or duct is a check valve 22 that is normally held on its side by a spring 23.

Where such construction is employed, the check valve will be lifted from its seat to permit the pumped liquid to pass from the chamber in one housing to the chamber in the other housing in

the event that the discharge from the pump is closed or cut down to such a degree as to endanger the motor that is utilized for driving the pump.

Formed on the central portions of the inner walls 12 of the housings are cup-shaped bearings 24 for a shaft 25, either solid or tubular, and to hold said shaft against rotation a pin or stud 26 projects radially from said shaft adjacent one end and the projecting portion of said pin occupies a slot 27 in the corresponding bearing. Mounted for rotation on shaft 25 is a gear wheel 28.

Mounted to rotate freely within the ring 10 of the housing is a gear 29, the side faces of which bear directly against the adjacent faces of the walls 12 of the housings.

Arranged between the center gear 28 and the ring gear 29 are gear wheels 30 that are slightly smaller in diameter than the center gear 28 and the teeth of these smaller gear wheels mesh with the teeth of gear wheel 28 and the teeth of ring gear 29.

While I have shown the pump having four small gear wheels 30, in larger sized pumps the number of these gear wheels may be increased, and in small pumps three gear wheels may be used.

Three of the smaller gear wheels 30 are mounted on shafts 31, either solid or tubular, the ends thereof occupying cup-shaped bearings 32 that are formed on the inside walls 12 of the housings, and each shaft being held against rotation by the engagement of the end of a pin 33 that is carried by one end of each shaft in a groove 34 that is formed in the corresponding bearing 32 (see Figs. 4 and 5).

The fourth small gear wheel which is designated by the numeral 30*a* is mounted on a driving shaft 35 that extends through a bearing 36 formed in the outer wall 13 of one of the housings, said bearing being provided with a gland or stuffing-box 37, and said shaft also engaging in bearings 38 that are formed on the inner walls of the housings. The shaft 35 is driven at high speed by an electric motor.

The smaller gear wheels 30 and 30*a* are spaced equal distances apart around the center gear 28 and formed integral with the inner wall 12 of one of the housings, preferably the housing that is provided with the bearing 36 for the driving shaft 35, are lugs 39, and the outer corners of each lug are cut away to form notches 40, which, in effect, constitute ports through which the pumped liquid passes. The outer face 41 of each lug between the notches 40 is secured lengthwise concentric with the axis of shaft 25, and this curved surface is engaged by the inner ends of the teeth of the ring gear 29 during rotation thereof, and such engagement provides a seal between the curved outer face of the lug and the inner ends of the teeth that are in engagement with said curved face.

The inner corners of each lug are cut away to form notches 42, which constitute ports through which the pumped liquid passes and the curved face 43 between these notches is engaged by the outer ends of the teeth of center gear 28, thus providing a seal between said curved face and the teeth that are in engagement therewith.

The outer faces 44 of the lugs between the notches 40 and 42 are curved lengthwise and are engaged by the outer faces of the teeth of the small gear wheels 30, thus providing seals between said curved faces and the teeth that are in engagement therewith.

Formed through the inner plate 12 that carries the lugs 39, is a port 45, one end portion of which coincides with one of the notches 40 in the adjacent lug, and the opposite end of this port registers with the notches between the teeth of the adjacent gear wheel 30 and the notches between the teeth of the ring gear 29 (see Fig. 6).

Formed in the inner face of the wall 12 in which port 45 is formed and on the opposite side of the lug is a pocket or recess 46, one end of which registers with the corresponding notch 40 in the lug and the opposite end registers with the notches between the teeth of the corresponding gear wheel 30 and the notches between the teeth of ring gear 29.

Formed through the wall 12 on the opposite side of the lug from port 45 is a port 47, the outer portion of which registers with the corresponding notch 42 in lug 39 and the inner portion of this port registers with the notches between the teeth of center gear 28 and the notches between the teeth of the adjacent small gear 30.

Formed in the inner face of wall 12 on the opposite side of each lug 39 from port 47 on the same side with port 45 is a pocket or recess 48, the outer portion of which registers with the corresponding one of the notches 42 in the lug and the inner portion of this recess registers with the notches between the teeth of center gear 28 and the notches between the teeth of the adjacent small gear wheel 30 (see Fig. 6). The ports 45 and 47 function as inlet or outlet ports, depending on the direction of rotation of the gears within the pump.

As a result of this arrangement each small gear wheel 30 that is positioned between a pair of the lugs 39 is always positioned between a pair of ports 45 and 47, and the members forming each pair of said ports are disposed on opposite sides of the axis of one of the small gear wheels 30.

The inner wall 12 of the opposite housing is provided adjacent the bearings for the shafts 31 and 35 with the pair of ports 45 and 47 and likewise the pairs of recesses 46 and 48, the housings comprising the walls 12, 13 and 14 are practically identical in structure, so that when they are applied to the sides of ring 10, the ports 45 and 47 in one wall 12 are in transverse alignment respectively with the corresponding recesses 46 and 48 in the opposite wall 12. This arrangement is essential in order that the liquid will flow from the chamber in the housing on one side of the pump to the chamber in the housing on the other side.

The ports 45 and 47 function as both inlet and outlet ports depending on the direction in which the pump is running.

In the operation of my improved gear pump, the shaft 35 is driven at high speed, preferably directly from an electric motor and as the gear wheel 30*a* that is secured on said shaft rotates, its teeth mesh with the teeth of the ring gear 29 and the teeth of the center gear wheel 28, thereby driving the same in opposite directions. The small intermediate wheels 30 journaled on the shafts 31 will be rotated in the same direction as the gear wheel 30 rotates as the result of the engagement of the teeth of said gear wheels 30 with the teeth of ring gear 29 and center gear wheel 28.

This driving of one of the small gear wheels arranged between the center gear wheel and the ring gear is effective in balancing or equalizing

the driving pressures for in driving one of the small gear wheels power is applied from one side of the small gear wheel to the internal gear and on the diametrically opposite side to the center gear, and in turn the center gear wheel and the ring gear become drivers for the other three intermediate small gears.

Each of these three small gear wheels **30** engages the ring gear on one side and the center gear wheel **28** on the diametrically opposite side, and thus the driving pressure, as well as the pressure of the liquid passing through the pump, is balanced and equalized with the result that the developed friction and wear is minimized.

By driving one of the small or intermediate gear wheels, a high-speed motor may be utilized in operating the pump and such provision brings about a reduction in speed of the center gear wheel and the ring gear.

As the pump is operated the inner faces of the teeth of the ring gear bear on the curved outer faces **41** of the lugs **39**, the outer faces of the teeth of center gear **28** bear on the curved inner faces **43** of the lug, and the outer faces of the smaller gear wheels **30** and **30***a* bear on the curved side faces **44** of the lugs, thus providing practically sealed joints between the curved faces of the lug and the faces of the teeth of the gear wheels and ring gear that engage said curved faces.

As the small gear wheels **30** and **30***a* rotate during the operation of the pump, water or other liquid will be drawn through the ports **45** and **47** in one of the walls **12** and as the teeth of the small gear wheels engage the teeth of ring gear and the center gear wheel **28**, the liquid will be forced with pressure out through the ports **45** and **47** in the opposite side wall **12**, and thus the liquid is drawn into the pump and then discharged or forced therefrom under pressure.

The liquid is drawn into one of the side housings through its tubular member **16** and discharges through the tubular member **16** that projects from the other one of the housings, such admission and discharge depending on the direction in which the small gear wheel **30***a* is driven. Inasmuch as there is a pair of the ports **45** and **47** formed through each side wall **12** adjacent each of the smaller gear wheels **30** and **30***a*, the developed water pressure will be impressed on the toothed peripheries of said small gear wheels at diametrically opposite points, and as a result of such arrangement the pressure of the water passing through the pump is equalized or balanced and this effect, together with the balanced or equalized driving pressure minimizes friction and wear, with the result that the pump and its operating parts have relatively long periods of life or service.

The recesses **46** and **48** that are formed in the faces of the walls **12** directly opposite the ports **45** and **47** in the other wall are all of such size as to contain substantial amounts of water or liquid that is passing through the pump and these several amounts of pocketed water, or other liquid, two for each small gear wheel **30**, function as liquid cushions that equalize the pressures developed by the liquid in passing through the pump.

By driving the pump through one of the small gear wheels **30**, the driving pressures, as well as the liquid pressures in the pump, are equalized, inasmuch as the power is applied to the internal gear **29** from one side of the driver **30***a* and to the center gear **28** from the directly opposite side of the driving gear **30***a*, so that the driving gear is balanced between the two pressures developed by its engagement with the internal ring gear **29** and center gear **28**. These two gears, namely, the internal ring gear and center gear, in turn become drivers for the other gears **30** in the pump, so that the driving pressures are equalized on both sides of all of the smaller gears **30**.

In the event that the line or conduit leading from the pump becomes closed for any reason, the rise of liquid pressure within the pump will automatically open check valve **22**, thus permitting the liquid to pass from the outlet chamber back to the inlet chamber without resultant injury to the pump or its driving motor.

The ends of the shafts **25** and **31** upon which the center gear wheel and smaller gear wheels are mounted are mounted in bearings that are formed on the inner side walls **12** of the housings of the pump, and such construction eliminates all stuffing boxes excepting the one that is provided for shaft **35** in the outer wall of the housing through which said shaft passes and, consequently, leakage of liquid under pressure while passing through the pump is minimized.

By making the side housings separate from the ring **10** and detachably connecting the same by means of bolts **15**, it is possible to position the housings so that both the intake and discharge ports of the pump may be arranged at the top, at the bottom, or on either side.

In the modified construction illustrated in Fig. 7, and which is particularly intended for pumps where extremely high pressures are developed, an oppositely disposed pair of small gear wheels **30** are mounted on shafts **35***a*, the outer ends of which shafts carry gear wheels **35***b* and which mesh with an intermediate gear wheel **35***c* that is carried by a driving shaft **35***d*.

Such arrangement is highly effective in bringing about a balance or equalization of driving pressures in the pump.

My improved pump may be advantageously employed in the pumping of liquid from deep wells, and where the pump is so used it occupies a horizontal position within the pump casing, and by arranging a plurality of the pumps at different elevations within the casing, a multi-stage pumping arrangement is provided.

Thus it will be seen that I have provided a gear pump that is relatively simple in construction, very compact, capable of pumping a large volume of liquid within a given period of time, and which pump is very effective in performing the functions for which it is intended.

It will be understood that minor changes in the size, form and construction of the various parts of my improved gear pump may be made and substituted for those herein shown and described without departing from the spirit of the invention, the scope of which is set forth in the appended claim.

I claim as my invention:

In a gear pump for moving liquid comprising juxtaposed side by side units fixed together to form a central gear chamber, an inlet chamber on one side and an outlet chamber on the other side thereof, inlet and outlet conduits connecting with their respective chambers, a ring gear having teeth on its inner periphery and bearing surfaces on its outer periphery and journalled against the walls of the gear chamber, a large central gear journalled in the gear chamber, a plurality of relatively small gears with re-

spect to said central gear, meshed with the central and ring gears, a drive shaft journalled in one of said units and connected to one of the small gears, said one of said small gears being the sole driver of the other gears, guide lugs having notches positioned around the central gear and between the small gears to guide the liquid being moved, ingress and egress ports in the walls of the gear chamber communicating with said inlet and outlet chambers, alined with the notches in the guide means to complete liquid passages through the pump.

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