June 17, 1952 R. V. BURT 2,600,477

PROPORTIONING PUMP

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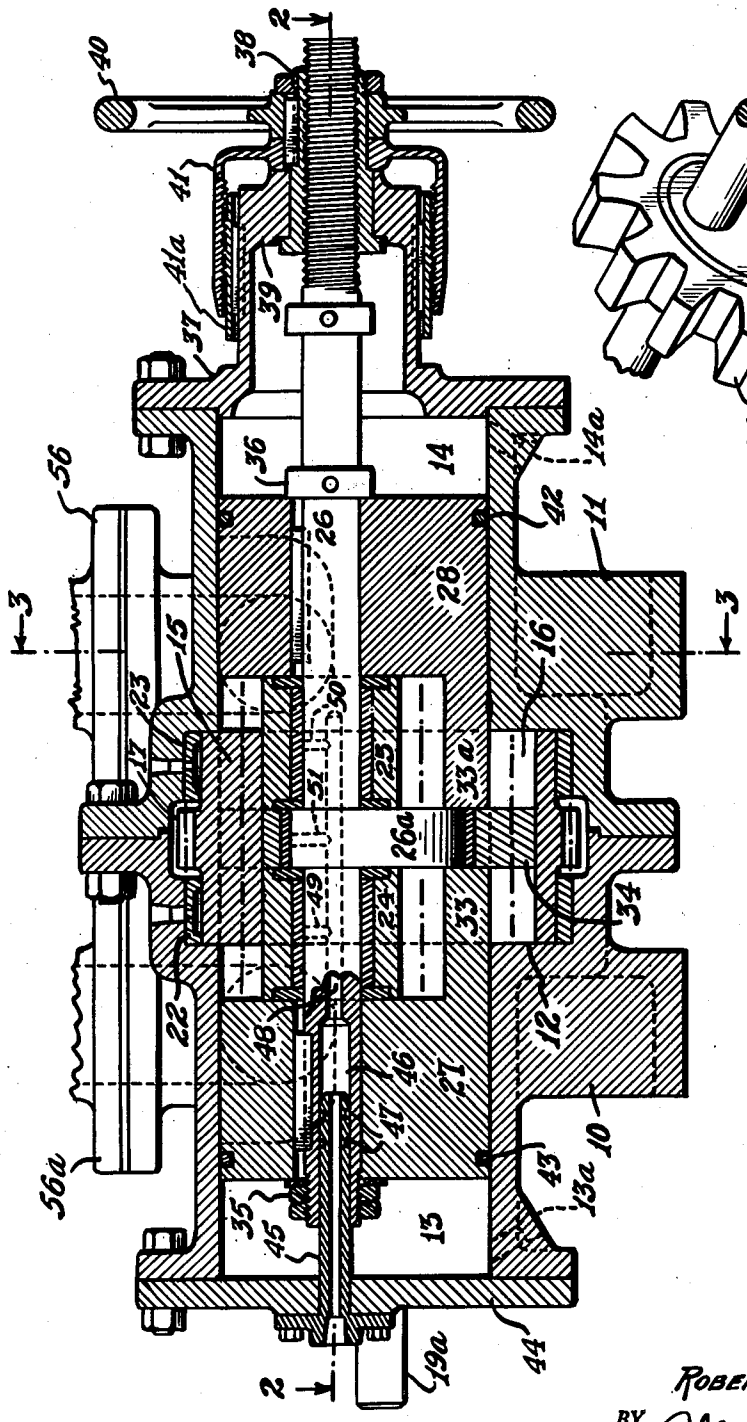



FIG. 1.




FIG. 5a.

INVENTOR.
ROBERT V. BURT.
BY Allen & Allen
ATTORNEYS.

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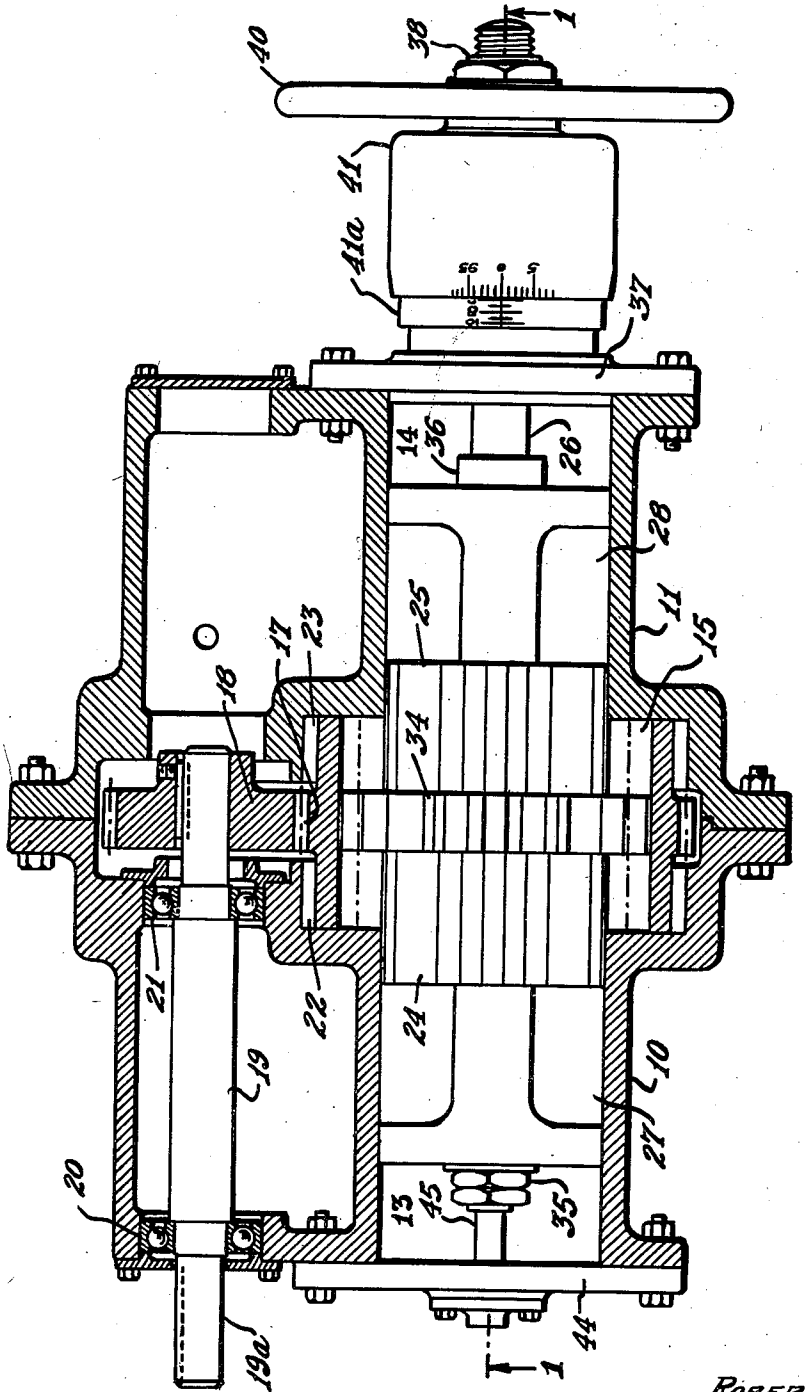



FIG. 2.

INVENTOR.
ROBERT V. BURT.
BY Allen & Allen
ATTORNEYS.

June 17, 1952 R. V. BURT 2,600,477

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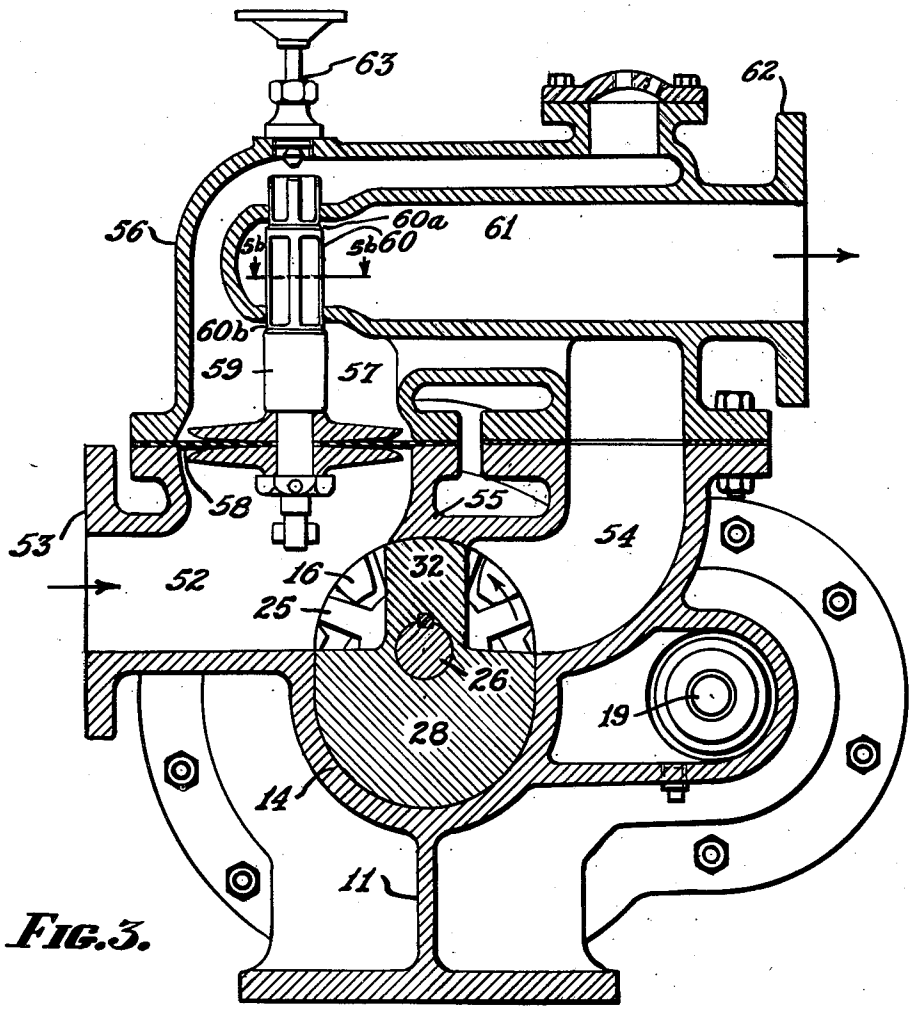



FIG. 3.

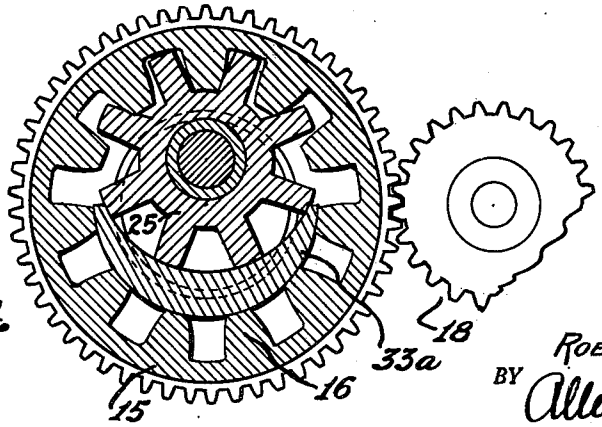



FIG. 4.

INVENTOR.
ROBERT V. BURT.
BY Allen & Allen
ATTORNEYS.

June 17, 1952 R. V. BURT 2,600,477

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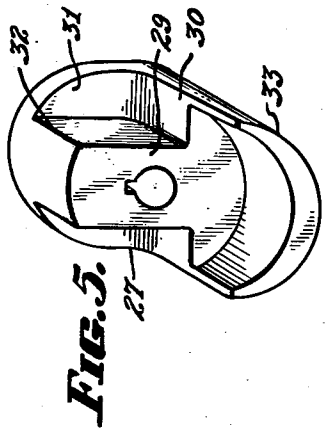



FIG. 5.




FIG. 6.




FIG. 5b.

INVENTOR.
ROBERT V. BURT.
BY
Allen & Allen
ATTORNEYS.

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PROPORTIONING PUMP

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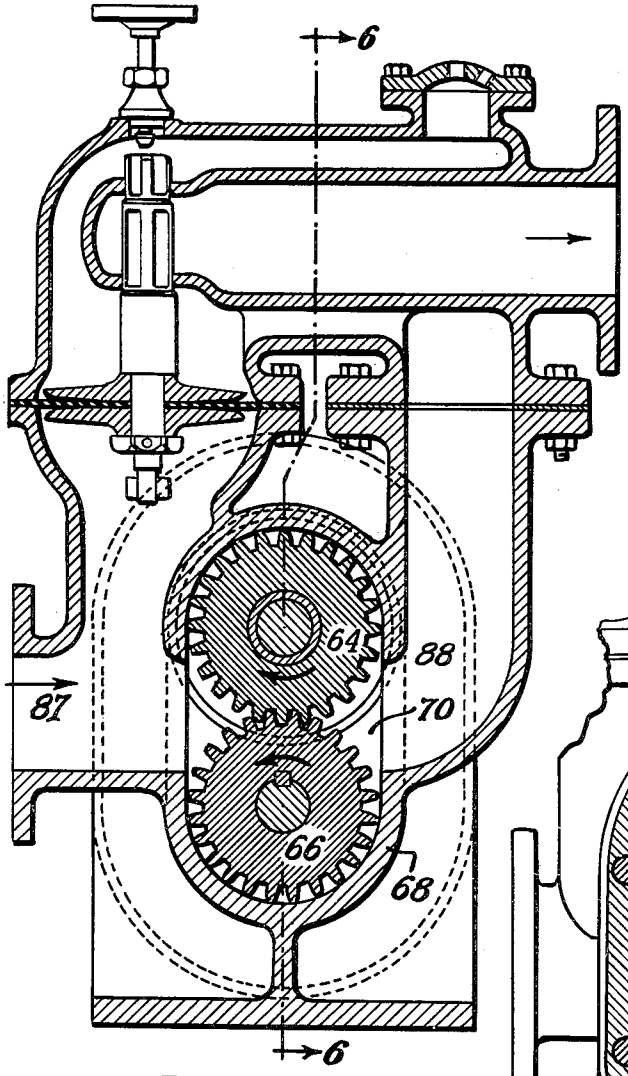



FIG. 7.

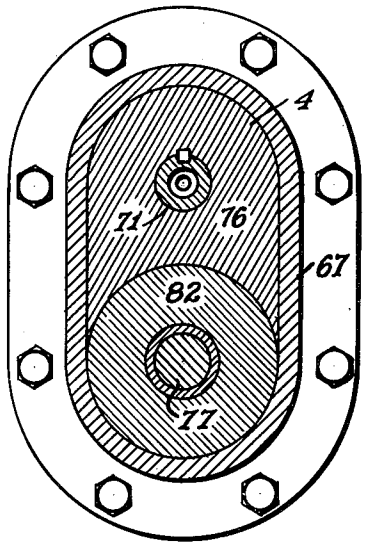



FIG. 8.

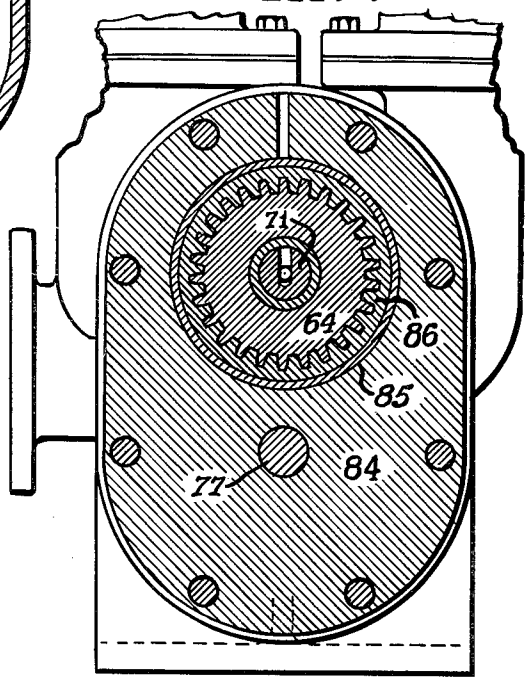



FIG. 9.

INVENTOR.
ROBERT V. BURT.
BY
Allen & Allen
ATTORNEYS.

Patented June 17, 1952

2,600,477

# UNITED STATES PATENT OFFICE

2,600,477

## PROPORTIONING PUMP

Robert V. Burt, Cincinnati, Ohio, assignor to The Procter & Gamble Company, Cincinnati, Ohio, a corporation of Ohio

Application August 21, 1947, Serial No. 769,820

15 Claims. (Cl. 103—120)

1

My invention relates to rotary pumps of the internal gear and external gear types. These are positive displacement pumps, and may be used as accurate meters of the materials pumped.

In such pumps a pair of gears divides an inlet chamber from an outlet chamber. The material being pumped is carried from the inlet chamber to the outlet chamber in pockets between the teeth of the gears, which pockets are closed by casing elements; and at the outlet chamber the meshing of the gears forces the material being pumped out of these pockets.

One of the objects of this invention is to provide adjustability in mechanisms of this class. The invention is based in part on the concept of means for shifting the gears relative to each other in the axial directions. This together with means for keeping the inlet chamber isolated from the exit chamber excepting through the pumping action of the gears, enables me to adjust or vary the actual displacement of the pump per revolution while retaining the advantage of positive displacement. The variation of actual displacement is thus accomplished through a variation in the axial extent of the meshing of the gears, which in turn controls the quantity of the material pumped or forced out of the pockets by the meshing action of the gears.

In another aspect of my invention, it is my object to provide, in a single device, a pair of pumping means, each driven concurrently at the same speed, each being adjustable as set forth above, but the adjustment of one being inverse to the adjustment of the other. Such a device may be employed to supply separate streams of different materials, which streams bear a definite but accurately adjustable relationship to each other. This relationship or proportion remains the same in spite of variations of total delivery effected by varying the over-all speed of the device. As a consequence, my device is an accurate proportionometer as well as a pumping means for delivering the separate streams of material.

This object is accomplished by providing in each pumping section a gear or gear section which I shall hereinafter designate as an "individual gear" meaning a gear or gear section individual to its particular pump section. Another gear, common to the two pumping sections, meshes with the individual gears. Appropriate casing elements are provided in association with the individual gears, and a partition element co-acting with the common gear is provided to divide the pumping sections from each

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other. Provision is made for relative axial movement of the partition element and the common gear. Adjustment may be effected by moving the common gear axially with relation to the individual gears, or by moving the individual gears and their related casing elements with respect to the common gear. It will be seen, however, that in such adjustment, to the extent that the meshing engagement of the common gear with one of the individual gears is increased, its meshing engagement with the other is diminished. Hence, the variations of the displacement of the pumping sections bear an inverse relation to each other. Since both pumping sections provide positive displacement, the proportion of the streams may be very accurately adjusted and maintained.

In another aspect of my invention, which will be later described, it is my object to provide pressure equalization between the inlet and outlet of my "pump" thus increasing its accuracy as a meter while depriving it of the function of impelling or pumping the liquid passing through it. Since in its broader aspects my invention may find use either with or without this pressure equalization attachment, I use the term "pump," either as noun or verb, when referring generally to the delivery of liquid through intermeshing gear devices of the character here dealt with, whether the liquid be independently impelled or not.

While there are many varieties of positive displacement pumps, it will suffice for an explanation of my present invention to describe it in connection with a pump mechanism of the external gear type and a pump mechanism of the internal gear type. The principal objects of my invention which have been set forth above, and others which will be pointed out hereinafter, or will be apparent to one skilled in the art upon reading the specifications, I accomplish by that structure and arrangement of parts of which I shall now describe the aforesaid exemplary embodiments. Reference is made to the accompanying drawings wherein:

Figure 1 is a vertical, longitudinal, sectional view of one form of my pump when of the internal gear type. It is a section taken along the line 1—1 of Figure 2.

Figure 2 is a horizontal section of the same pump taken generally along the line 2—2 in Figure 1, but showing the individual gears, the partition element, the movable casing structures and the adjustment means in plan.

Figure 3 is a transverse vertical section taken along the line 3—3 of Figure 1.

Figure 4 is a partial section through the rotor elements of one of the pump sections.

Figure 5 is a perspective view of one of the movable casing elements.

Figure 5*a* is a perspective view of the partition element and its associated parts.

Figure 5*b* is a horizontal cross section taken on the line 5*b*—5*b* of Figure 3.

Figure 6 is a vertical longitudinal section through a pump of my invention which is a pump of the external gear type. It is a section taken along the line 6—6 of Figure 7.

Figure 7 is a transverse vertical section through the same pump taken along the line 7—7 of Figure 6.

Figure 8 is a transverse vertical section taken along the line 8—8 of Figure 6.

Figure 9 is a transverse vertical section taken along the line 9—9 of Figure 6.

In Figures 1 and 2 I have shown a housing formed in two parts 10 and 11 which may be bolted together by means of flanges as shown. These housing parts are configured to provide a central cylindrical chamber 12 formed by the mating parts of each housing element. In addition each housing element provides an outlying oval chamber 13 or 14. (The cross sectional shape of these chambers might more accurately be described as being formed of two semicircles connected by parallel straight lines.)

A common gear, 15, which is hollow and has internal gear teeth 16 on its inner periphery, is mounted in the cylindrical chamber. Centrally it is provided with external gear teeth 17. These teeth mesh with a gear 18 on a shaft 19, journaled as at 20 and 21 in a portion of the housing element 10. A portion of the shaft 19 projects as at 19*a* from the housing element 10. The projecting portion may be provided with a suitable drive connecting it to a prime mover. The shaft 19 is the drive shaft for the pump, and through the gear 18 it causes the common gear 15 to rotate.

The common gear may be rotatably confined within the housing elements by bushings 22 and 23. The shoulders adjacent the inner extremities of the oval chambers 13 and 14 maintain a fixed axial position for the common gear 15.

A pair of individual gears 24 and 25, in axial alignment, and provided with external gear teeth, mesh with the common gear 15. These individual gears are rotatably journaled upon a shaft 26 extending longitudinally of the device. This shaft passes through casing elements indicated at 27 and 28. The form of these casing elements is shown in perspective in Figure 5. Each casing element has a central hub as indicated at 29 to accept the shaft 26. The hub is part of a body indicated at 30. At the outer end of the body there is a flange 31 shaped to fit the inner periphery of the oval chambers 13 or 14. Upwardly from the hub there extends a fin 32 the purpose of which is to provide, in part, a means for dividing the entrance chamber from the exit chamber in the particular pump section in which the casing is located. The inner end of the casing is prolonged as at 33. The length of this prolongation is the same as the width of the individual gear 24 or 25 with which the casing element is used. The shape of the prolongation is lunar, as shown. The shaft 26 passes through the hub 29 and is preferably splined to it. In this way the casing members 27 and 28 can hold the shaft 26 against



rotation. The individual gears 24 and 25 are mounted on the shaft and lie above the projections 33 and 33*a*.

It will be seen in Figure 1 that the shaft 26 passes through both casing members 27 and 28. The shaft is provided with an enlargement 26*a* intermediate its ends. This enlargement is an eccentric, and it serves to mount rotatably a partition element 34. The partition element has external teeth meshing with the internal teeth of the common gear 15. Its outer periphery is the same as the inner periphery of the common gear, and it rotates with the common gear on the eccentric 26*a* which gives it a pivot co-axial with the pivot of the common gear. The partition gear element 34 is, however, slidable with respect to the common gear 15.

The position of the partition element 34 on the eccentric 26*a* is maintained in part, as shown, by the projections 33 and 33*a* on the casing elements 27 and 28 and in part by the individual gears 24 and 25. Suitable wear rings may be employed. The assembly of casing elements, individual gears and partition gear element may be held together on the shaft by nuts 35 at one end and by a collar 36 at the other; and it will be understood that this entire assembly may be shifted longitudinally or axially with respect to the common gear 15, the partition element 34 following the individual gears 24 and 25.

The shaft 26 is continued through one end of the housing element 14, which is provided with a cap 37. An internally threaded sleeve 38, journaled in a barrel-like extension 39 of the cap 37, engages the projecting end of the shaft 26. This shaft is threaded. The sleeve 38 is provided with a handwheel 40 by means of which it may be turned. Turning this sleeve will move the shaft 26 longitudinally of the pump housing, carrying with it the casing elements 27 and 28, the individual gears 24 and 25, and the partition element 34. To give an accurate indication of the longitudinal position of the shaft, I provide the sleeve 38 with an internally threaded barrel 41 extending over an externally threaded sleeve 41*a* which loosely encircles the barrel-like extension 39, and I mark these elements 41 and 41*a* with appropriate indicia.

The casing elements 27 and 28, where they slide in the oval chambers 13 and 14 may be provided with packing rings 42 and 43. The end of the housing element 13 may be closed with a cap 44. This cap may be provided with an inwardly extending, hollow nozzle 45 lying within a bore 46 in the shaft 26. The nozzle 45 may have a liquid tight and pressure tight engagement within the bore 46 by means of seal rings 47 or the like. The bore 46 terminates in a passageway 48 extending longitudinally of the shaft 26, and provided with cross-passageways 49 and 50 to lubricate the bearings of the individual gears 24 and 25 on the shaft, and a cross-passageway 51 to lubricate the bearing of the partition element 34 on the eccentric enlargement 26*a* of the shaft. The chambers 13 and 14 may be provided with clean-out openings 13*a* and 14*a* passing through the walls of housing elements 10 and 11.

As shown in Figure 3, each pump section is provided with inlet or outlet chambers or passageways. Thus the housing element 11 is configured to provide an inlet chamber 52 provided with an inlet coupling 53, and an outlet chamber 54. These passageways or chambers are kept separate in part by the coacting gears 15 and 25

in their meshing position and in part by the coaction of a portion 55 of the housing and the fin 32 of the casing element 28. The passage of material to be pumped from the inlet chamber 52 to the outlet chamber 54, is in the pockets between the internal teeth 16 of the common gear 15 and the pockets between the teeth of the individual gear 25, these pockets being closed by the lunar extension 33*a* of the casing element 28. This is illustrated in Figure 4; and it will be appreciated that this relationship is that obtaining in conventional internal gear types of positive displacement pumps. In my apparatus, however, by shifting the longitudinal or axial position of the shaft 26, I can shift the position of the individual gear 25 with respect to that of the common gear 15. This varies the longitudinal area of meshing of these gears, and changes the specific displacement of the pump section. The effective volumes of the pockets aforesaid do not change; but the amount of material displaced from these pockets by the meshing of the gears at the outlet side of the pump does change with the relative longitudinal positions of the gears, and hence the displacement of the pump section changes in the way set forth above. Further, it will be noted that the individual gears 24 and 25, together with their appropriate casing sections, move as a unit with respect to the common gear 15. Hence as the length of the meshing engagement of the individual gear 25 with common gear 15 increases, the length of meshing engagement of the individual gear 24 with the common gear 15 decreases, the partition element 34 moving with the individual gears. Thus, the particular displacement of one pump section is increased at the expense of the particular displacement of the other pump section in an inverse relationship. An accurate proportioning of the streams is thus obtained, irrespective of the actual speed of the pump.

In Figure 3, I have shown another housing element 56 attached by flanges to the top of the housing element 11. The portion 56 is so configured as to provide a chamber 57, connected with the outlet chamber 54, and lying directly above the inlet chamber 52, from which it is separated by a flexible diaphragm 58. This diaphragm is connected through suitable flanged bearing members to an upwardly extending valve stem 59, terminating in a valve element 60 having truncated conical shoulders at 60*a* and 60*b* each surmounted by a guide portion of web shaped cross section (as shown in Fig. 5*b*). These shoulders coact with valve seats in the walls of the outlet passageway 61. This passageway may be provided with coupling means 62. Pumped material in the outlet chamber 57 can get into the passageway 61 only through the variable openings 60*a* and 60*b*. The position of the valve stem 60, and thus the size of the openings at 60*a* and 60*b*, is controlled by the opposing pressures on the opposite sides of the diaphragm 58, i. e. the pressures in the inlet chamber 52 and the outlet chamber 57. The pressure in the outlet chamber 57 in turn is controlled by the size of the openings at 60*a* and 60*b*. Since the effective areas of the lower and upper surfaces of the diaphragm 58 and the valve members attached thereto are substantially equal, this arrangement results, when the "pump" is delivering liquid supplied to it under positive pressure, in the valve stem 60 taking a position which restricts the openings 60*a* and 60*b* enough to create a back pressure in the outlet chamber 57 substantially equal to the externally imposed pressure on the fluid entering the inlet chamber 52. Thus the liquid is metered through the pump, but not impelled thereby, from the inlet chamber 52 to the outlet chamber 57 with essentially no gain or loss in pressure. This circumstance tends to eliminate any tendency for leakage or short circuiting of the liquid past the ends of the gear wheels or between the ends of the gear teeth and the surrounding housing members or along other undesired paths, even though the supply pressure in the inlet chamber 52 fluctuates rather widely, or even though the several parts of the pump have worn to such an extent that the clearances are more than the minimum working clearances. A manually operated means for forcing the valve stem 60 into a position such that the valve spaces at 60*a* and 60*b* are open, for cleaning purposes or when using the metering revice as a true pump, is indicated at 63. A similar pressure control housing element and appurtenances indicated at 56*a* in Figure 1 is provided for the other pump section.

Other forms of displaceable barrier between inlet and outlet chambers, to control the opening of a valve regulating the passage of liquid through one of these chambers, may be employed if desired.

Although the metering pumps herein described may be operated so as to impel the liquid being metered, thus serving the dual purpose of a true pump and meter, I prefer for greater accuracy of metering to impel the liquid by some independent means, such as a separate delivery pump in the line ahead of the metering pump, or a constant head liquid supply tank. Furthermore I find that the most satisfactory results are obtained when the liquid to be measured is delivered to the metering pump at a substantially constant pressure, and also when the metering pump discharges the metered liquid against a substantially constant back pressure, which may conveniently be provided by means of an adjustable pressure regulating valve in the discharge line.

In Figures 6 to 9 inclusive I have illustrated the principles of my invention applied to a gear pump of the external gear type, which is also preferably provided with pressure equalizing attachments as described above. In this external gear metering device the common gear 64, instead of being the driving gear, is driven by the individual gears 65 and 66. Also instead of being fixed longitudinally of the housing members, the common gear moves in this embodiment, while the individual gears remain in the same positions with respect to the housings.

I have indicated a pair of housing members at 67 and 68. These are bolted together by means of flanges as shown. They are configured internally to provide oval chambers 69 and 70.

The common gear 64 is rotatably mounted upon a non-turning shaft 71. At the ends of the common gear there are casing members 72 and 73. The outer ends of these members are of oblong configuration and entirely fill the cross-sections of the chambers 69 and 70. They may be provided with seal rings as indicated at 74 and 75. The inner ends of these members are shaped as indicated at 76 in Figure 8. The shaft 71 passes through these casing members, which, together with the common gear 64 form a unit movable as such in the chambers 69 and

70. The shaft 71 is preferably splined to the casing members 72 and 73, and the assembly is held together by means of nuts and a collar as described above. The same general type of lubricating means may be provided; and I also provide the same type of means for shifting the shaft 71 longitudinally and the same type of micrometer means for indicating its position.

The individual gears 65 and 66 are splined to a shaft 77. This shaft has bearings 78 and 79 in end caps 80 and 81 for the housing members. The projecting end of the shaft as at 77a is connected to a suitable source of power. It will be noted also that the shaft 77 passes through the enlarged outer end portions of the casing members 72 and 73.

I also mount casing members 82 and 83 on the shaft 77. These casing members, which may be provided with seal rings as indicated at 82a and 83a, are circular in form as shown at 82 in Figure 8; and the individual gears 65 and 66 together with the casing members 82 and 83 form a unit assembled by collars on the shaft 77.

In this embodiment of my invention the partition means comprises a plate 84 held between the flanges of the main housing member. As will be most clearly seen in Figure 9, this plate has a circular perforation 85 co-axial with the shaft 71. In this perforation I journal a rotary partition member 86 having interior teeth meshing with the teeth of the common gear 64. As the common gear 64 moves axially, its surface can slide through this rotary partition member while the latter maintains its alignment with the stationary partition element 84. The partition is held in position partially by shoulders on the ends of the housing members and partially by engagement between the individual gears 65 and 66, as will be apparent from Figure 6.

As shown in Figure 7, the housing elements 67 and 68 are further configured to provide an inlet chamber 87 and an outlet chamber 88. The material being pumped passes from the inlet chamber 87 to the outlet chamber 88 in the pockets between the teeth of the gears at the upper and lower portions of the housing, these pockets being closed by the housings. The meshing of the gears forces the pumped material out of the pockets in the outlet chamber 88. The partition means 84 keep the pump sections isolated from each other at all times; but by shifting the common gear 64, the extent of meshing of the common gear with either of the individual gears can be varied, and this variation will be inverse as respects the two individual gears. Thus while the volume of the pockets does not change, the amount of pumped material forced out of them by the meshing of the gears does change, and hence the specific delivery of each pump section per rotation of the drive shaft 77.

It will be seen that in both embodiments of my invention the combined lengths of the individual gears is substantially greater than the length of the common gear. In each embodiment there are casing elements which move with the movable rotary element or elements and serve as seals. In each case, there is a partition element continuously effective to seal one pump section from the other, but movable with respect to the common gear, though meshing and rotating with it.

Modifications may be made in my invention without departing from the spirit of it. Having thus described my invention in certain exemplary embodiments, what I claim as new and desire to secure by Letters Patent is:

1. In a pump, a housing having two sets of inlet and outlet chambers, a common gear in said housing, a pair of individual gears in said housing, each in meshing relationship with said common gear, means coacting with the teeth of said gears to close pockets formed between said teeth for the travel of material being pumped from said inlet chambers to said outlet chambers, and means for effecting a shifting of the axial positions of said common gear and said individual gears whereby to vary the axial extent of the meshing of said common gear with said individual gears inversely, and further means for dividing said sets of inlet and outlet chambers, said means comprising a partition element having teeth which maintain a continuous meshing with all of the teeth of said common gear, said element being rotatable with said common gear but slidable axially with respect to it, while maintaining a fixed axial position with respect to said individual gears and extending in part at least between said individual gears.

2. The structure claimed in claim 1, wherein said several gears are gears with external teeth, and wherein said rotating partition element is a member surrounding said common gear and having internal teeth.

3. The structure claimed in claim 1, wherein said common gear has internal teeth, and wherein said individual gears have external teeth, said rotary partition element being a member located within said common gear, and having external teeth.

4. The structure claimed in claim 1, wherein said several gears are gears with external teeth, and wherein said rotating partition element is a member surrounding said common gear and having internal teeth, and including casing elements within said housing slidable with respect to each other, and maintaining a fixed relationship respectively with the ends of said several gears.

5. The structure claimed in claim 1, wherein said several gears are gears with external teeth, and wherein said rotating partition element is a member surrounding said common gear and having internal teeth, and including casing elements within said housing slidable with respect to each other, and maintaining a fixed relationship respectively with the ends of said several gears, a rotatable drive shaft within said housing to which said individual gears are non-rotatably affixed, and a non-rotatable but axially movable shaft in said housing upon which said common gear is rotatably mounted but by means of which the said gear may be shifted axially, said shaft constituting in part said means for shifting.

6. In a pump, a housing formed in two joinable parts, each part having inlet and outlet chambers, a common gear in said housing, a pair of individual gears in said housing each of said gears in meshing relationship with said common gear, casing means in said housing maintaining respectively fixed relationships with the outer ends of said common gear and said individual gears, and a partition means for dividing said housing so as to divide the inlet and outlet chambers of one of said parts from the inlet and outlet chambers of the other of said parts, said partition means comprising a plate held between the parts of said housing, and a rotatable section in said plate surrounding said common gear and having teeth

meshing with the teeth of said common gear but slidable along its length, means for effecting a driving connection to at least one of said gears, and means for effecting a shifting of the axial relationships of said common gear and said individual gears whereby, inversely, to vary the axial extent of the mashing of said common gear with each of said individual gears.

7. A proportioning pump comprising in combination a housing with two sets of inlet and outlet chambers, a rotary, internally toothed gear, having liquid-tight connection with said housing peripherally, a pair of individual gears within said housing, said gears being coaxial, having external teeth, and having meshing relationship with the teeth of said first-mentioned gear, a shaft upon which said individual gears are rotatably mounted, casing means mounted on said shaft, and slidable within said housing, and partition means for dividing said sets of inlet and outlet openings, said partition means including a rotary element located in part between said individual gears, and having external teeth meshing with the teeth of said first-mentioned gear, said rotary element rotating with said first-mentioned gear, means for driving said first-mentioned gear, and means for shifting said shaft in an axial direction whereby inversely to vary the axial extent of the meshing of said individual gears respectively with said common gear.

8. A proportioning pump comprising in combination a positive displacement rotary gear pump mechanism in which the fluid being pumped is moved from the intlet side to the outlet side by the movement of teeth of intermeshing gears in slidable contact with close fitting walls, a common gear, two coaxial individual gears in meshing relationship with said common gear, a partition adapted to close the cross section of the pump in a plane perpendicular to the pump axes, and intermediate the ends of said individual gears, said partition comprising a circular rotatable portion engaging the toothed surface of said common gear and being axially displaceable thereon, and means for effecting an axial displacement of said gears whereby the axial extent of the intermeshing of said common gear with said individual gears on the opposite sides of said partition may be inversely varied, said pump having housing means with two sets of inlet and outlet chambers separated in part at least by said partition, whereby two separate streams may be delivered by said pump at any pre-determined volumetric ratio, which ratio may be varied.

9. A proportioning pump for pumping two fluids separately and in adjustable proportions comprising in combination a positive displacement rotary gear pump mechanism in which the fluid being pumped is impelled from the inlet side to the outlet side by the movement of the teeth of intermeshing gears in sliding contact with close fitting walls, intermeshing gears, means for shifting one of said gears axially with respect to the other, and partition means intermediate the ends of both said gears, said partition means having a fixed axial position with respect to one of said gears, and interrupting the teeth of said one of said gears at the midpoint thereof, and being rotatable with the other of said gears, but slidable along the surface of said other gear to a plurality of axial positions.

10. A proportioning pump capable when operated at fixed speed of delivering two separate fluid streams at any predetermined volumetric ratio, which may be varied, and comprising a housing, a pair of intermeshing gears rotatable within said housing, the first of said gears having non-interrupted teeth and the second having teeth centrally interrupted by a partition, said partition adapted to close completely the cross section of said pump in the plane of said interruption and thus to divide the housing into two separate compartments, said partition comprising a circular rotatable portion engaging the entire toothed surface of an axial segment of the first of said gears and being axially displaceable thereon, said partition having a circular opening permitting passage therethrough of the shaft of one of said gears, means for regulating the axial position of said partition, together with said second gear with respect to said first gear whereby the axial extent of the intermeshing of said first gear with said second gear on the opposite sides of said partition is regulated, inversely, two arcuate surface members, each adapted to be in sliding contact with full axial extent of the top surfaces of the teeth of a different one of said gears, each over an arc substantially diametrically opposed to the line of intermeshing, two arcuate surface members, each adapted to be in sliding contact with the opposite end portions of the top surfaces of teeth of said second gear which extends beyond the respective ends of the first gear, each over an arc passing through a prolongation of the line at which said top surfaces contact the inter-toothed valleys of said first gear, and members in said housing adapted to provide planar walls perpendicular to the gear shafts and adjacent the lateral ends of the toothed valleys of said first gear, end members in said housing adapted to provide planar walls perpendicular to the gear shafts and adjacent the lateral ends of the toothed valleys of said second gear, a barrier within said housing dividing each of the two compartments thereof into two cells, one on each side of an imaginary plane passing through the axes of the two gear shafts, said cells being in communication with one another only by means of movable inter-tooth spaces enclosed between the toothed surfaces of the gears, the arcuate surface members, the partition, and the end members, said housing having inlet and outlet openings on each side of said partition, and means to drive one of said gears.

11. A proportioning pump comprising a housing, slidable casings within said housing, said casings having a median portion which, with the housing provides an annular chamber, an internally toothed annular gear rotating in said housing and said chamber, and non-slidably held within the housing, the casings having lengthwise vanes on each side of the rotating member dividing the two ends of the casing into an inlet portion and an outlet portion, said gear having teeth on its exterior for driving the same by means of an external gear, a shaft extending into the housing and secured to said casings, a pair of gears idly mounted on said shaft, one on each side of a partition, the teeth of said pair of gears meshing with the teeth of said first mentioned gear, a partition mounted within the first-mentioned gear and held against sliding movement on said shaft, said partition having teeth which match and enter the inter-tooth spaces within the first-mentioned gear, said partition being rotatable but non-slidable on said shaft, and means for moving the shaft lengthwise, thereby moving the partition and second-mentioned gears for the purpose described.

12. In a proportioning pump of the gear type for pumping two fluids separately and in adjustable proportions, a pair of gear elements in meshing relationship, one of said gear elements being of greater axial extent than the other, said gear element of greater axial extent being divided into two parts, a partition element having a fixed relationship with said longer gear at a pre-determined position but rotatable with the shorter gear and having teeth maintaining a continuous inter-meshing relationship with all of the teeth of the shorter gear, housing means having two sets of inlet and outlet chambers, one set being located on each side of said partition element, and means for shifting said gears axially with respect to each other within said housing.

13. In combination with a pump according to claim 1, means for severally equalizing the inlet and outlet pressures between the inlet and outlet chambers respectively of said sets, comprising displaceable barrier elements separating each of said inlet chambers from its respective outlet chambers, each of said barriers having substantially equal effective areas exposed to the pressures in said chambers to which it is exposed, a valve for controlling the passage of fluid through one of said chambers of each set, and an operative connection between each of said barriers and its respective valve.

14. In combination with a pump according to claim 7, means for severally equalizing the inlet and outlet pressures between the inlet and outlet chambers respectively of said sets, comprising displaceable barrier elements separating each of said inlet chambers from its respective outlet



chambers, each of said barriers having substantially equal effective areas exposed to the pressures in said chambers to which it is exposed, a valve for controlling the passage of fluid through one of said chambers of each set, and an operative connection between each of said barriers and its respective valve.

15. In combination with a pump according to claim 8, means for severally equalizing the inlet and outlet pressures between the inlet and outlet chambers respectively of said sets, comprising displaceable barrier elements separating each of said inlet chambers from its respective outlet chambers, each of said barriers having substantially equal effective areas exposed to the pressures in said chambers to which it is exposed, a valve for controlling the passage of fluid through one of said chambers of each set, and an operative connection between each of said barriers and its respective valve.

ROBERT V. BURT.


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