May 21, 1946. J. S. CARDILLO 2,400,485

TWO-GEAR METERING PUMP

Filed Dec. 12, 1942 2 Sheets-Sheet 1

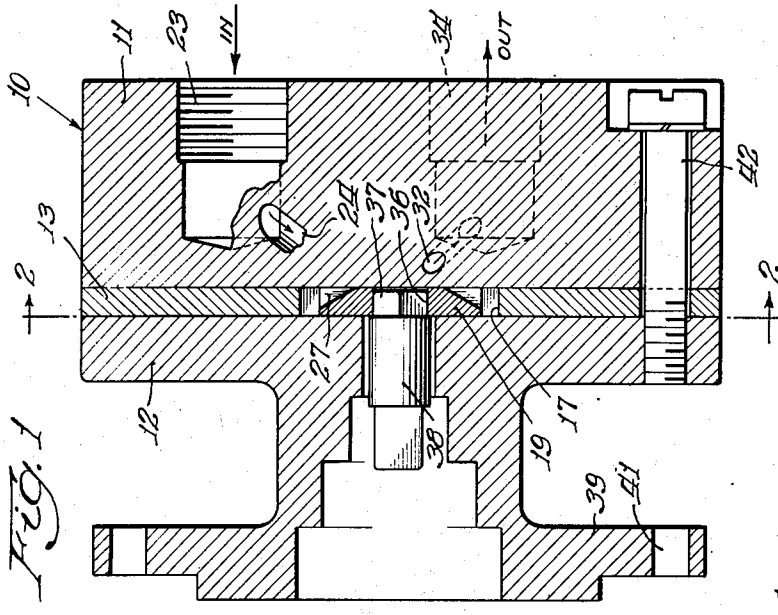


Fig. 1

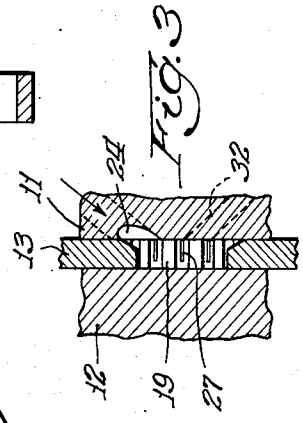


Fig. 3

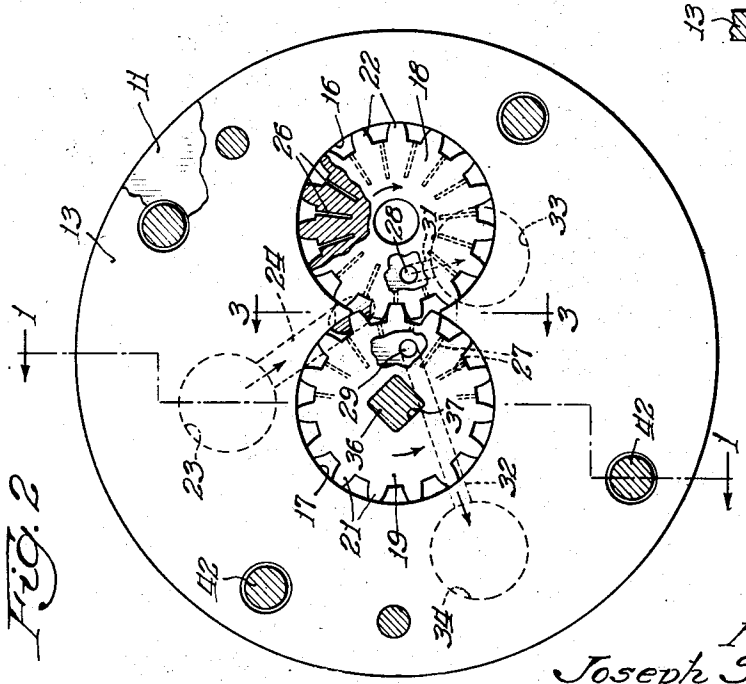


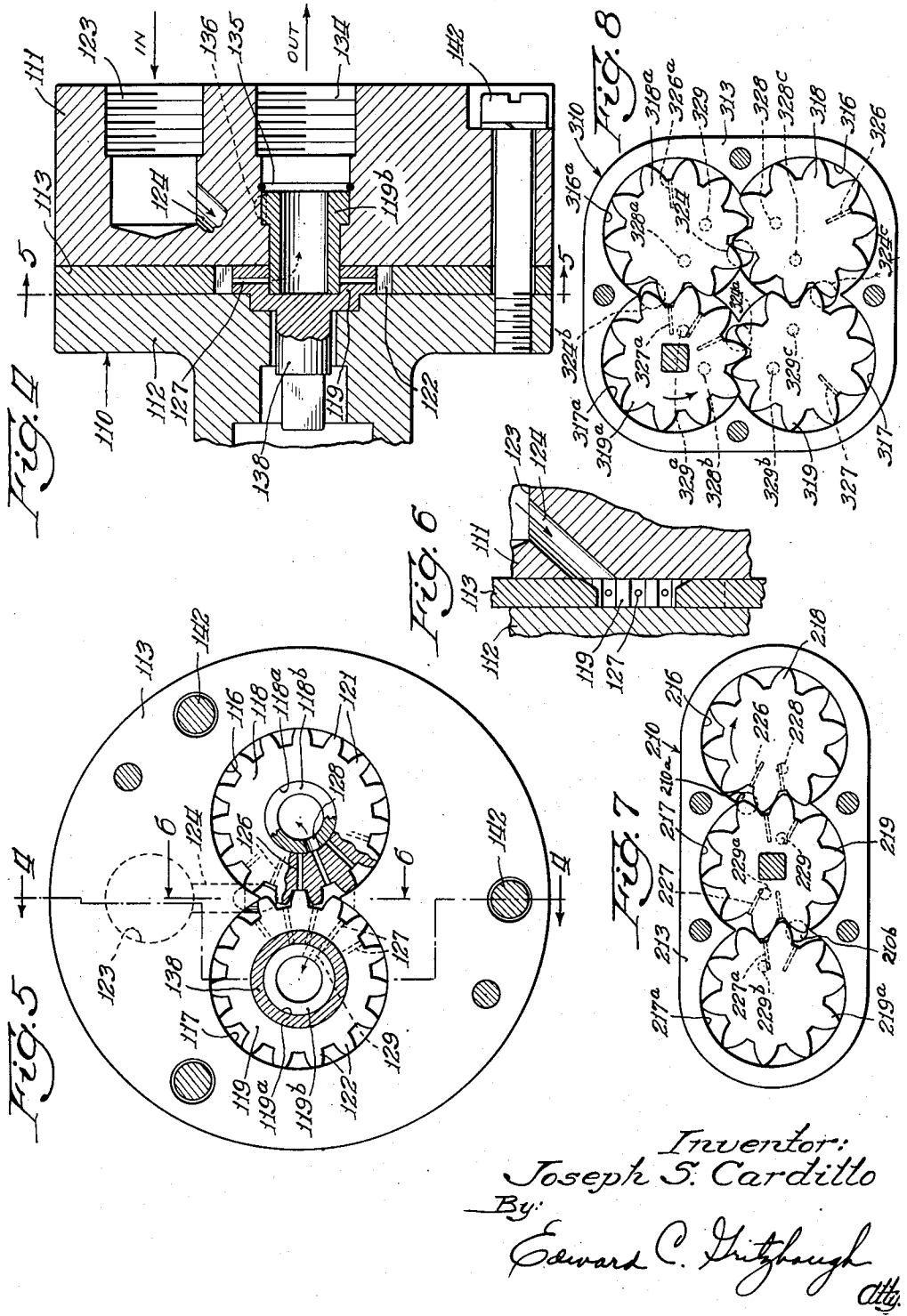
Fig. 2

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TWO-GEAR METERING PUMP

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TWO-GEAR METERING PUMP

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3 Claims. (Cl. 103—126)

This invention relates to arrangements for dividing a single stream of liquid into a pair of separate streams of predetermined relative volumes.

Intermeshing gear arrangements have been proposed heretofore for dividing a single stream of liquid into a plurality of separate streams. However, it is the object of this invention to provide an improved arrangement of intermeshing gears, single inlet conduit and separate outlet conduits for accomplishing the desired division.

It is a more particular object to provide an improved arrangement making it possible to effect the requisite division of a single stream into a plurality of streams by the use of only two intermeshing gears as distinguished from previous arrangements wherein three or more intermeshing gears have been required.

A still further and more detailed object is the incorporation in a two-gear divider of a particular arrangement of separate outlet ports associated with the respective gears in such a manner that the flow from between successive corresponding teeth of the respective gears takes place in a substantially overlapping manner, the maximum rate of flow through one of said two outlet conduits corresponding to the minimum rate of flow through the other and vice versa.

A still further detailed object is the provision of an arrangement such as contemplated in the preceding paragraph wherein the separate discharge conduits are so arranged with reference to the position of meshing of the gear teeth that the movement of the teeth into meshing position functions to reduce the volume of the space occupied by the liquid for driving the same out through said two discharge conduits in very much the same manner as a piston operates to force liquid from its associated cylinder.

It is another object to adapt the above to the division of a plurality of separate inlet streams by employing three or more meshing divider gears arranged in an improved and efficient manner.

Other and more detailed objects, advantages and uses of my invention will become apparent from a reading of the following specification taken in connection with the accompanying drawings which form a part thereof and wherein:

Fig. 1 is an axial cross-section view of an arrangement incorporating one preferred embodiment of my invention and is taken substantially along line 1—1 of Fig. 2;

Fig. 2 is a view taken substantially along line 2—2 of Fig. 1 with one of the closure members removed and portions of the divider gears broken away in order to show the structural arrangement of parts somewhat more clearly;

Fig. 3 is a section view taken substantially along line 3—3 of Fig. 2 bringing out somewhat more clearly the relationship of the single inlet and outlet ports to the meshing gear dividers, the surrounding structure being broken away for clarification;

Fig. 4 is an axial cross-section view corresponding to Fig. 1 but showing an alternative embodiment of my invention, this view being taken substantially along line 4—4 of Fig. 5;

Fig. 5 is a view taken substantially along the line 5—5 of Fig. 4 with the closure member removed and certain portions of the gear structure broken away for clarification;

Fig. 6 is a cross-section view taken substantially along line 6—6 of Fig. 5 bringing out to advantage the relationship of the single inlet to the gears at one side of the area of meshing thereof;

Fig. 7 is a view similar to that shown in Fig. 2 but presents an alternative embodiment wherein three meshing gears are made effective to divide two separate inlet streams into four separate outlet streams; and

Fig. 8 is a view similar to that shown in Fig. 2 but presents still another alternative embodiment wherein four meshing gears are made effective to divide four separate inlet streams into eight separate outlet streams.

Referring now in greater detail to the figures of the drawings and at first to Figs. 1 through 3, numeral 10 indicates generally a divider unit incorporating a preferred form of my invention including essentially a housing composed of a first end closure member 11 and a second end closure member 12 between which there is positioned a sandwich ring 13, there being formed in this sandwich ring a pair of cylindrical overlapping bores 16, 17, these bores together with the inner surfaces of closure members 11 and 12 defining gear-receiving chambers. Gears 18 and 19 complementary in size to the above chambers are received therein with the gear teeth 21 and 22 meshing in the area of overlapping between cylindrical bores 16 and 17. Closure member 11 is formed with a single inlet conduit for introducing a single stream of liquid to the gear teeth adjacent one side of the area of meshing therebetween, including an inlet port 23 leading by way of passage 24 to a position in contact with gear teeth 21 and 22. Rotation of gear 18 in a clockwise direction looking at Fig. 2, and the rotation of gear 19 in a counterclockwise direction, is effective to divide

the single stream of liquid introduced in contact with the gear teeth into two portions, a first portion being conveyed about the gear 18 in the spaces defined between successive teeth 21 and the surrounding chamber walls including bore wall 16, while the other portion is similarly conveyed around gear 19 in the spaces defined between successive teeth 22 and the embracing chamber walls including bore wall 17.

For separately removing the liquid portions carried around each gear, I have provided a special arrangement of separate discharge conduits including discharge ports cooperating with the respective gears in accordance with the positions of arcuate movement thereof. A plurality of passages 26, 27 lead from between successive teeth of the respective gears to a position radially inwardly in the faces of the respective gears for cooperation with gear discharge ports 28 and 29 of outlet conduits 31 and 32 leading to outlet ports 33 and 34. It is important to note that gear discharge ports 28 and 29 are located intermediate the extremities of the radii of the respective gears passing therethrough and are arcuately staggered in a manner such that as the passage 26 of gear 18 moves into communication with gear discharge port 28 the corresponding radial passage 27 in gear 19 is moving out of communication with gear discharge port 29. In other words, the discharge through the respective ports 28 and 29 in effect is alternated and overlaps only to the extent necessary for effecting smooth operation. It will further appear that gear discharge ports 28 and 29 are disposed adjacent the position at which gear teeth 21 and 22 are rapidly moving into full meshing position and as a result of this particular location, the liquid has an ejecting force imparted thereto. Specifically, it will be seen that as a tooth of one gear moves into the space between the teeth of an adjacent gear, the volume of this space is rapidly reduced in very much the same manner as a piston effects a reduction in the volume of the cylindrical area in advance thereof as the piston is moved forward. By arcuately staggering gear discharge ports 28 and 29 as above described, full advantage is taken of this piston-like action, since for any particular arcuate position the piston-like action is functioning to force the majority of the liquid through only one of the gear discharge ports.

It will be apparent that radial passages 26 and 27 may be formed in the gears 18, 19 in a number of different ways; however, I have found that this may be accomplished to particular advantage by a simple hobbing operation using a relatively thin disc cutter having a thickness not substantially greater than one-third the circumferential width of the root at the base between successive teeth. A slot so cut in the gear need extend in depth not substantially more than one-half the thickness of the gear between faces and need extend radially inwardly only a sufficient distance to communicate with the gear discharge port which is preferably located at approximately midway of the radius of the gear. Gear 18 may ride about the periphery thereof against the wall of the enclosing bore 16, as shown, or be mounted on a shaft the opposite ends of which may be journaled in closure members 11 and 12. Gear 19 is formed with a non-circular coaxial socket 36 cooperating with the complementarily formed terminal portion 37 of a coupling member 38 adapted to be driven by any suitable source of power through any well-known form of connection, not shown. Such source of power will normally include a housing to which the flange 39 of closure member 12 may be fastened by means of suitable bolts or other clamping means passing through orifices 41. Clamping bolts 42 hold closure members 11, 12 and sandwich plate 13 in assembled relation.

Turning now to Figs. 4 to 6, there is shown an alternative embodiment including a unit indicated generally at 110 having end closure members 111 and 112 with sandwich plate 113 held therebetween likewise formed with overlapping cylindrical bores 116, 117, all similar in construction to the above described modification, but containing a modified pair of gears 118, 119 and modified cooperating discharge conduit arrangement. Gears 118 and 119 are formed with internal radially extending passages 126 and 127 extending from a position between the successive teeth 121 and 122 into communication with internal bores 118*a* and 119*a*. These bores embrace a tubular nipple-like journal 118*b*, 119*b*, which are formed with ports 128, 129 through which radial passages 126 and 127 discharge as successive ones of said radial passages are brought into cooperating opposed arcuate position with reference to said ports. These ports 128 and 129 correspond in position and function to ports 28 and 29 in the modification of Figs. 1 through 3. In other words, ports 128 and 129 are arcuately staggered with reference to successive radial passages 126 and 127 so that the maximum rate of flow radially inwardly through port 128 corresponds to the minimum rate of flow through port 129 and vice versa. As in the case of the above described modification, it is necessary that there be a certain amount of overlapping between the discharge through one port and the discharge through the other in order to effect the transition smoothly. However, generally speaking, the reduction in volume of the spaces between successive teeth as the same move into mesh is effective to accelerate and force the liquid conveyed around the gears in the corresponding spaces through the corresponding gear discharge ports 128 and 129 in succession as differentiated from simultaneously. This materially improves the discharge operation into a pair of separate streams.

A single inlet stream is introduced into inlet 123 and passed into communication with the gear teeth 121 and 122 adjacent the area of meshing by way of conduit 124. Nipple-like tubular members 118*b* and 119*b* communicate with separate coaxially located outlet port 134 serving gear 119, port 134 being the only outlet port shown, it being understood that an identical separate outlet port is provided for gear 118. Tubular members 118*b* and 119*b* may be held in coaxial position by means of a snap ring arrangement and fastened against arcuate movement by means of a suitable keyway. Snap ring 135 and keyway 136 for tubular member 119*b*, being indicated on Fig. 4, while a duplicate construction is provided for tubular member 118*b* but a showing thereof is omitted for the purpose of simplification. Gear 119 may be provided with an axially protruding coupling member 138 similar in function to coupling member 38 in the above modification. Bolts 142 serve to fasten the assembly together, while any of the usual arrangements, not shown, may be employed for supporting the unit, such for example as that described in connection with Fig. 1.

Turning now to Fig. 7, there is shown somewhat schematically an adaptation of my invention to the problem of dividing two separate in-

let streams into four separate outlet streams. Indicated generally at 210 is a divider unit incorporating a sandwich plate 213 formed therein with three overlapping bores 216, 217 and 217a, receiving gears 218, 219 and 219a meshing in the areas of overlapping. Each of the gears is formed with radial slots or passages in the manner described in connection with Figs. 1 and 2, these being designated 226, 227 and 227a. These radial slots cooperate with the teeth and the two separate inlet ports 210a, 210b and separate outlet ports 228, 229, 229a and 229b to provide four separate outlet streams in very much the same manner as two outlet streams are provided in the two-gear arrangement of Figs. 1 and 2. A detailed showing of the end closure plates cooperating with sandwich plate 213 is omitted for the purpose of simplification, but it is to be understood that the same will be provided as shown in Fig. 1, the inlet passages, as well as the outlet ports, being formed preferably in the back one of said plates as indicated in dotted lines in Fig. 7.

Turning now to Fig. 8, there is also shown somewhat schematically another adaptation of my invention to the problem of dividing four separate inlet streams into eight separate outlet streams by the use of four meshing dividing gears formed in a manner similar to the above. Indicated generally at 310 is a divider unit comprising sandwich plate 313 formed with four overlapping cylindrical bores 316, 317, 316a and 317a, receiving four meshing gears 318, 319, 318a and 319a. Four inlet ports 324, 324a, 324b and 324c cooperate to introduce four separate streams to the gears in the areas of meshing of the teeth corresponding to the positions described in Fig. 7.

Eight separate discharge ports 328, 329, 328a, 329a, 328b, 329b, 328c and 329c cooperate with radial slots or passages 326, 327, 326a and 327a in a very much similar manner to that disclosed in connection with the preceding alternatives. The end closure plates similar to those shown in Fig. 1 will be provided; however, a detailed showing thereof has been omitted from Fig. 8 in order to simplify presentation. As in the case of Figs. 1 and 2 it is preferred that the inlet ports leading to the gear teeth, as well as from the gears to the discharge ports, be formed in the back one of the end closure plates, which arrangement has been indicated in dotted lines in Fig. 8.

While I have indicated that the gears in the above modifications are to be driven from an external motor arranged to be coupled thereto, it will be apparent that in the event it is desired to eliminate such sources of power and deliver a high pressure inlet stream to the gears, such high inlet pressure may be taken advantage of in effecting the rotation of the gears and a division of such stream will be effected in very much the same manner as above described.

While I have described my invention in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration rather than limitation and that the invention is to be defined by the appended claims which should be given a scope as broad as commensurate with the prior art.

I claim:

1. In an arrangement for dividing a single stream of liquid into a pair of streams, including means defining a housing having a single pair of overlapping cylindrical gear-receiving chambers, a single pair of gears complementary in size to said chambers received therein and having the teeth thereof meshing in said overlapping area, means defining a single inlet conduit for conducting said single stream to said gear teeth at one side of the area of meshing therebetween, said liquid stream being divided and conveyed around said gears in the spaces defined between adjacent teeth of said gears and the enclosing walls of said chambers, separate means effective to deliver into separate streams the liquid conveyed around said respective gears, comprising a discharge port formed in the end wall of each of said chambers communicating with each of said gears on a radius inwardly of the root line of said teeth, passages formed in said gears on one side only leading from a position intermediate the extremities of the roots between said teeth radially inwardly to a position wherein said passages are effective to cooperate with said corresponding discharge ports as said gears are rotated for delivering liquid from the spaces between the teeth of said respective gears to the corresponding separate outlet ports.

2. In an arrangement for dividing a single liquid stream into a pair of streams of substantially equal volume, including means defining a housing having a single pair of overlapping cylindrical gear-receiving chambers, a single pair of gears complementary in size to said chambers received therein and having the teeth thereof meshing in said overlapping area, means defining a single inlet conduit for delivering said single stream directly to said gear teeth adjacent one side of said area of meshing, said liquid stream being divided and conveyed around said gears in the spaces defined between adjacent teeth of said gears and the walls of said enclosing chambers, means for removing liquid from said spaces between adjacent teeth including; separate discharge conduits for the liquid thus conveyed by each gear, a first outlet port formed in the end wall of a first one of said chambers leading to one of said discharge conduits, said outlet port being disposed radially inwardly of the root line of the corresponding gear teeth and located on a radius of the corresponding gear which intersects said overlapping area at an arcuate position on the opposite side of the completely meshed position of said gear teeth from the position of communication of said inlet stream therewith and a second outlet port leading to the other outlet conduit and formed in the end wall of the other of said chambers likewise positioned radially inwardly of the root line of said gear teeth and similarly disposed on a radius intersecting said area of overlapping but staggered arcuately with reference to said first outlet port so that the position of maximum rate of flow through one outlet port is made to correspond to the position of minimum flow through the other of said outlet ports all of said ports being on the same side of said gears.

3. In an arrangement for dividing a single liquid stream into a pair of streams, including means defining a housing having a single pair of overlapping cylindrical gear-receiving chambers, a single pair of gears complementary in size to said chambers received therein and having the teeth thereof meshing in said overlapping area, means defining a single inlet conduit for conducting said single stream to said gear teeth at one side of the area of meshing therebetween, said liquid stream being divided and conveyed around said gears in the spaces defined between adjacent teeth of said gears and the enclosing walls of said chambers, separate means for removing the divided portions of said stream from

said respective gears comprising a first gear discharge port formed in the end wall of a first one of said chambers at a position radially inwardly of the root line of the gear teeth and a second gear discharge port formed in the end wall of said other chamber radially inwardly of the root line of said gear teeth, a plurality of radial slots formed in the face of each gear on the side thereof adjacent said associated port extending from the root area between said teeth radially inwardly to a position effective to communicate with the associated port when the gear is rotated to move said slots opposite to said associated port, said gear discharge ports having their positions staggered with reference to the corresponding slots in the respective gears so that the position of maximum flow through one discharge port corresponds to the position of minimum flow through the other, said discharge ports both being located with reference to the area of meshing between said gear teeth so that said slots are brought into communication with the respective ports as the gear teeth are moved into meshing relation to thus cause the liquid to be discharged through said ports.

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