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M. CORNELL

2,109,331

PROPORTIONING DEVICE

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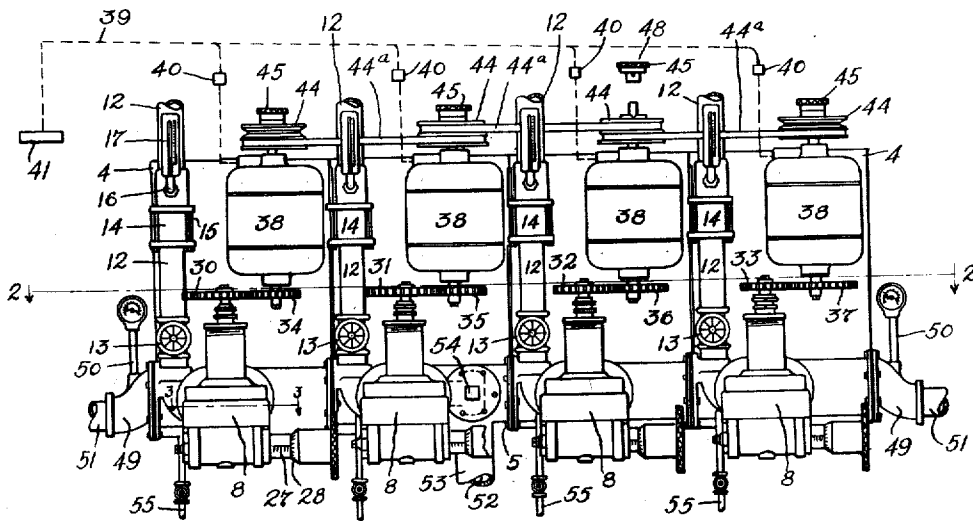


Fig. 1

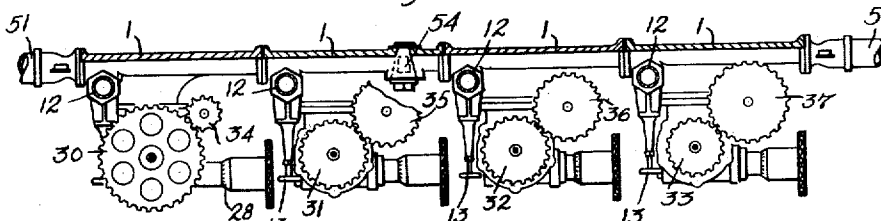


Fig. 2

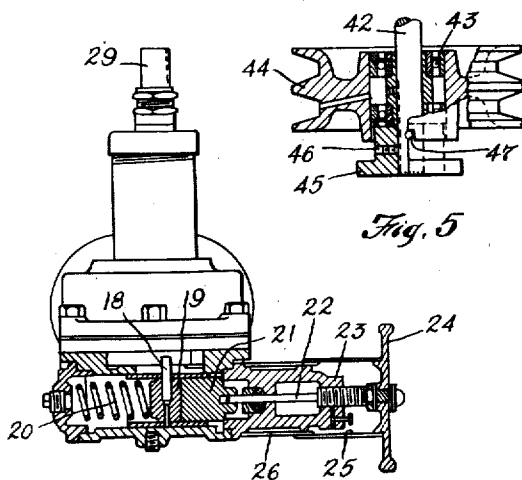


Fig. 4

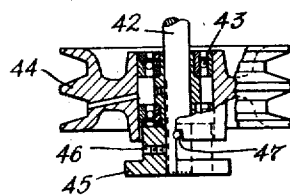


Fig. 5

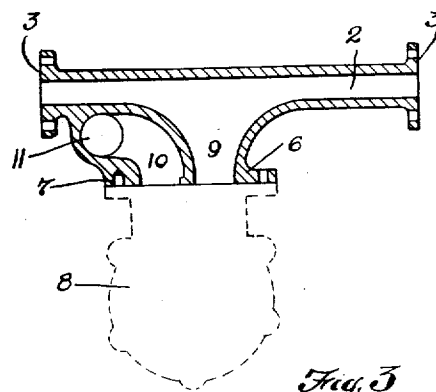


Fig. 6

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2,109,331

PROPORTIONING DEVICE

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This invention relates as indicated to a proportioning device and more particularly to apparatus for bringing together in a closely controllable and extremely accurate proportional relationship a plurality of liquids sought to be blended.

The term "liquid" as used herein is intended to include any material capable of being handled by a pump such as the pump embodied in the apparatus comprising this invention, for example, such materials as suspensions of solids in liquids, etc.

More particularly, this invention relates to apparatus of the character described characterized by such unusual flexibility as to make possible the bringing together, within the desired proportional relationship, of any reasonable number of separate components of the ultimate mixture and at the same time permitting a control over a variation of such proportional relationship over a relatively wide range.

It is a principal object, therefore, of my invention to provide an apparatus having all of the above-named desirable characteristics. It is a further object of my invention to provide an apparatus characterized by the fact that extensive variations may be made in the number of separate liquids brought together thereby without materially disturbing the apparatus as arranged.

It is a further object of this invention to provide an apparatus of the character described which is characterized by the fact that the possibility of variations in a given desired proportional relationship between the several components brought together by such apparatus to the production of the desired mixture is reduced to a minimum by means notable for their simplicity of construction and operation and even though actual conditions under which the device operates may vary widely.

Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is an elevational view of one form of apparatus constructed in accordance with the principles of my invention, it being noted that the apparatus here shown is normally mounted as shown on a vertical wall so that the operator standing in front of the apparatus views the same as shown in Fig. 1; Fig. 2 is a transverse sectional view of the apparatus illustrated in Fig. 1 taken

on a plane substantially indicated by the line 2—2; Fig. 3 is a fragmentary sectional view drawn to an enlarged scale of a portion of the apparatus shown in Fig. 1 taken on a plane substantially indicated by the line 3—3; Fig. 4 is a part sectional, part elevational view of one of the pumps employed in the apparatus shown in Fig. 1; and Fig. 5 is a part sectional, part elevational view drawn to an enlarged scale of one of the pulleys shown in Fig. 1 whereby a particular unit of the assembly may, at will, be included in or operatively disconnected from the remainder of the apparatus without, however, disturbing the mechanical interconnection between such several units relied upon for the purpose of insuring synchronous operation.

Referring now more specifically to the drawing and more especially to Figs. 1 and 2, the apparatus illustrated may be generally described as consisting of a plurality of substantially rectangular base members 1 formed of any suitable material such as by casting or the like. The lower ends of the base members 1, as viewed in Fig. 1, have a transversely extending passage 2 formed therein in the manner most clearly illustrated in Fig. 3. Bosses such as 3 and 4 with machined faces are provided on opposite sides of the base members 1 so that any desired number of such base members may be secured together by means of bolts such as 5. This makes possible the assembly into a single unit of any desired number of such base members.

Upstanding from the face of the base members 1 and over the areas occupied therein by the passage 2 are bosses 6 provided with ground faces generally indicated at 7 and upon which are supported pumps generally indicated at 8 and the construction of which will be hereinafter more fully explained.

Formed in each of the bosses 6 is an opening 9 which leads inwardly into the transverse passage 2. Likewise opening on the machined face 7 of each boss 6 is a passage 10 separate, however, from the passage 9 and leading to an opening 11 to which is connected a supply conduit 12. The supply conduits 12 are provided with valves 13 whereby such supply conduits may be opened or closed at will. The supply conduits 12 may also have included within their lengths on the base members, sections of glass pipe generally indicated at 14 and held between the contiguous metallic sections of the conduits 12 by means of conventional clamps 15. The glass section 14 thus forming a portion of the conduit 12 is provided so that the operator may visually inspect at all times the material passing downwardly through the conduit 12, this being desirable in order that the operator may be assured that each of the pumps 8 is at all times provided with an adequate supply of the proper type of material.

The fitting of which the clamp 15 for the glass tube 14 forms a part may also have a thermometer well 16 provided therein for the reception of the thermometer, generally indicated at 17, and by means of which the operator may constantly check the temperature of the material being supplied through the conduit 12. While thermometers of the alcohol or mercury type have been illustrated in the drawing, it is nevertheless, with-
 10 in the contemplation of my invention to provide any other type of temperature indicating or recording-device including thermocouples in place of the thermometers shown, particularly where it is desirable to employ a recording device for the temperatures of the several separate materials blended by the apparatus and also if it should be found desirable to take readings of the temperature at a point remote from the apparatus.
 20 While usually not necessary, particularly when the several components to be blended are fed by gravity, it may, on occasion be desirable to employ pressure gauges in conjunction with each of the supply conduits 12 in order to insure that the conditions of operation of the apparatus are maintained substantially constant.

As previously indicated, separate and independent pumps 8 are mounted on the bosses 6 on the respective base members 1. The pumps 8 are generally of the type illustrated and described in U. S. Patent No. 2,042,880. As indicated in said patent, the quantity or volume of material displaced by each such pump is directly related to the eccentric displacement of a center pin illustrated at 18.

The pump which I employ is a modification of a structure disclosed in the above identified patent to the following extent:—

The plunger 19, similarly to the construction illustrated in the patent, engages the pin 18, thus fixing the position of the pin and accordingly the volume or quantity displaced by the pump. In the aforementioned patent the plunger, similar to the plunger 19 of my construction, is urged against a fixed stop by means of a spring such as 20. In my improved construction, however, I provide an adjustable, movable stop 21 for the plunger 19, which stop is carried by a screw shaft 22, the latter being threaded in the housing 23 and thus upon rotation will axially adjust the plunger 21. The hand-wheel 24, by means of which the plunger 21 is adjusted through the medium of the screw 22 has a barrel 25 secured thereto, which barrel telescopically surrounds the cylindrical housing 26. By the application of a zero line, most clearly illustrated at 27 in Fig. 1 on the member 26 and uniformly spaced marks 28 on the barrel 25, the relative position of the plunger 21 and accordingly the output of the pump associated therewith may be accurately indicated.

It has been found that pumps of this character may be so calibrated that their output for predetermined operating conditions may be adjusted with micrometer accuracy.

Each of the pumps 8 is provided with a drive shaft 29 to which may be keyed a suitable driving means such as a spur gear 30.

Mounted on the base members 1 adjacent their upper ends are electric motors 38 which respectively have secured to their drive shafts spur gears such as 34 which mesh with and drive the gears attached to the pumps.

In the construction illustrated in Fig. 1, the pump gear 30 is shown as considerably larger than the motor gear 34, such difference in size being

not as great with respect to the gears 31 and 35 associated with the next adjacent unit. The gears 32 and 36 of the next adjacent unit are shown as of substantially the same size with the pump gear 33 of the final righthand unit of considerably smaller size than the motor gear 37. With all four motors 38, therefore, operating at the same speed, the several pumps 8 will be driven at different uniform speeds depending entirely upon the proportional relationship between the number of teeth of the two gears comprising the driving gears for each unit.

The motors 38 are separately electrically energized from a single power line, generally indicated at 39. Individual switches 40 are employed for the purpose of controlling the energization of the separate motors and a single main switch 41 is employed for the purpose of simultaneously energizing and deenergizing the entire bank of motors or those selected for a particular operation.

With the several motors each usually operating under different conditions from the standpoint of the character and volume of liquid displaced by the pump driven thereby, some means must be provided to so synchronize the operation of the several motors and accordingly, their associated pumps, so as to eliminate substantially entirely any variations between the speeds of the different motors arising from such different conditions of operation.

This essential synchronization is very simply accomplished in the following manner:—

As most clearly illustrated in Fig. 5, the shaft 42 of each of the motors at the end remote from the driving gear, has rotatably mounted thereon by means of anti-friction bearings 43 a double grooved pulley generally indicated at 44. The pulleys 44 are grooved to receive the well-known type of molded V-belts 44a, which, when properly adjusted, will be found unusually free from slippage. While this type of driving connection between the several motors is shown and preferred for numerous reasons, it is within the contemplation of my invention, however, to establish driving communication between the several pulleys in any of the well-known conventional ways such as by gears, chains, etc. The motors may also be of a type which produces synchronization by electrical means.

Mounted on the outer ends of the shafts 42 are removable collars 45 provided with a set screw 46 by means of which the collars may be secured to the shafts 42 and also provided with pins 47 extending axially from the collars into slots provided therefor in the hub of the pulley 44.

The pulley 44 may, therefore, be connected at will to the shaft 42 by positioning the collar as illustrated in Fig. 5 and tightening the set screw 46 onto the shaft 42. Alternatively the collar 45 may be removed, as illustrated at 48 in Fig. 1, and when so removed, the pulley 44 will rotate freely on the motor shaft 42 by means of the anti-friction bearings 43. The purpose of this particular arrangement will be better understood when the operation of the apparatus is described in detail.

Secured to the bosses 3 at opposite sides of the assembly are respectively header fittings 49 which may be provided with a conventional pressure gauge 50 and likewise connected with an out-fall conduit 51.

While not essential for certain installations, it will usually be found advantageous to employ at least one unit or more particularly, base mem-

ber, which in addition to being provided with a transverse passage 2 extending therethrough, is likewise provided with a branch discharge passage 52 formed in a lateral extension 53 of such

base member. By the provision of a conventional three-way valve, generally indicated at 54, the assembly may be made to deliver two separate and distinct streams of mixtures resulting from the combination of the deliveries of different elements of the total assembly. Thus, as illustrated in Fig. 1, the valve 54 may be turned to such a position that the materials delivered by the two left-hand pumps are discharged through the left-hand out-fall conduit 51 and the combined streams delivered by the two right-hand pumps delivered through the right-hand out-fall conduit 51. By turning the valve to a different position, the entire apparatus may be conveniently drained through the branch conduit 52. While only one of such specially constructed base members characterized by the inclusion therein of the valve 54 has been shown, nevertheless, it will be found practical for certain installations, particularly where a large number of individual units are brought together in a single assembly to render such assembly unusually flexible by the inclusion therein of a plurality of units each having a valve such as 54. If desired, and in order to render the assembly universally adjustable with respect to the manner in which the mixture produced by the several pumps may be delivered in a wide variety of separate streams, each of the base members may be provided with a valve such as 54.

Each of the several units comprising the assembly may also be provided with separate drain pipes 55 which are normally closed by means of conventional valves and only opened to drain the apparatus when desired, either at the end of a run or when a different type of material is to be handled by the apparatus and when it is desired to avoid contaminating the new material with that of the previous run.

The manner in which the above described apparatus may be operated may be briefly described as follows:—

Several units will be respectively connected with sources of supply of the different materials which it is desired to blend in a particular proportional relationship. It may be desirable to provide means for maintaining the supply pressure to the several units of the combination within certain limits. Any convenient means such as constant pressure pumps or gravity tanks provided with conventional means for maintaining a constant head may sometimes be employed to advantage for this purpose.

With each of the units calibrated as it is possible to so calibrate them for different settings of the plunger 21 in the pumps 8, it may be determined beforehand exactly how much of each particular material at a stated pressure and temperature will be supplied by each pump for each revolution of its drive shaft. In this manner and by a proper selection of the gear ratio between the motor shaft and the pump shaft in each unit, coupled with the setting of the hand-wheel 24 on each unit, makes it possible to adjust within micrometer accuracy the proportional relationship between the volumetric discharge of all of the pumps in the assembly. It is thus possible to very accurately control the proportional relationship between the components comprising the mixture discharged from the apparatus so long as the motors 38 all operate at relatively

the same speed. The synchronization between the motors 38 effected through interconnecting V-belts 44a insures such relative uniformity in speed of operation of all of the motors.

If, for example, the finished product is to contain only three, instead of all four components respectively delivered by the separate pumps, then one of the collars 45 may be removed as at 48 and the valve 13 in the supply conduit of such unit closed. The raw material of this particular unit will then be prevented from entering the out-fall passage 2 and the motor 38 of this particular unit may then be deenergized by its individual control switch 40. The sheave 44 associated with this deenergized motor will then rotate freely on the shaft of such motor and thus the mechanical synchronization between the several motors of the assembly will be maintained even with an intermediate unit thus idle. It frequently occurs that in handling particular types of material in one unit of the assembly, the nature of the particular material may be such as to over-tax the pumping motor of the unit handling such material. With the mechanical synchronization between the several units, the more lightly loaded motors will assist the more heavily loaded motor in performing its function. Similarly, when one unit is not operating, a closure of the valve in the supply conduit 12 of such idle unit is sufficient to prevent the material normally supplied by such idle unit passing into the mixture and then if the collar 45 of such idle unit is retained locked on its motor shaft, then the motor not pumping when energized may be employed to assist those motors which are operating the remaining active pumps.

While in the foregoing description of the mode of operation of the apparatus it has been stated that generally each unit may handle a different type of material, it should be noted, however, that if a mixture containing a major proportion of the single component is to be made, then a plurality of units of the assembly may be employed for the purpose of delivering the same material.

It is, of course, within the contemplation of my invention to provide for the motors of the several units to operate at different speeds with, however, a definite and constant relation between such different speeds. This may be accomplished in the apparatus illustrated by variations in the sizes of the pulleys 44.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any of the following claims or their equivalent be employed.

I therefore, particularly point out and distinctly claim as my invention:—

1. In a proportioning device, the combination of a plurality of separate pumping units arranged to discharge into a common outfall manifold, separate motors respectively driving said units, and means for coupling any two or more of said pumping units to maintain synchronized the speed of operation thereof.

2. In a proportioning device, the combination of a plurality of separate pumping units arranged to discharge into a common outfall manifold, separate motors respectively driving said units, and means for coupling any two or more of said pumping units to maintain constant the relative speeds of operation thereof.

3. In a proportioning device, the combination

of a plurality of separate pumping units arranged to discharge into a common outfall manifold, separate motors respectively driving said units, and means for coupling any two or more of said motors to maintain constant the relative speeds of operation thereof.

4. In a proportioning device, the combination of a plurality of separate pumping units arranged to discharge into a common outfall manifold, separate motors respectively driving said units, means for coupling at least two of said pumping units to maintain constant the relative speeds of operation thereof, and at least one of said last named pumping units provided with means whereby the output thereof may be adjusted.

5. In a proportioning device, the combination of a plurality of separate pumping units arranged to discharge into a common outfall manifold, each of said pumping units adapted to deliver a predetermined amount of material to said manifold per cycle of operation, separate motors respectively driving said units, means for coupling at least two of said pumping units to maintain constant the relative speeds of operation thereof, and at least one of said last named pumping units provided with means whereby the output thereof may be adjusted.

6. In a proportioning device, the combination of a plurality of separate pumping units arranged to discharge into a common outfall manifold, each of said pumping units adapted to deliver a predetermined amount of material to said manifold per cycle of operation, separate motors respectively driving said units, means for coupling at least two of said pumping units to maintain constant the relative speeds of operation thereof, and at least one of said last named pumping units provided with means whereby the output thereof may be adjusted.

7. In a proportioning device, the combination of a plurality of adjacently mounted pumping units arranged to discharge into a common outfall manifold, separate motors for driving said units, a sheave rotatably mounted on the shaft of each of said motors, means interconnecting said sheaves whereby the same are all driven at the same speed and means for selectively connecting or disconnecting any one of said sheaves with the respective motor shaft upon which the same is mounted.

8. In a proportioning device, the combination of a plurality of adjacently mounted pumping units arranged to discharge into a common outfall manifold, separate motors for driving said units, a double-grooved sheave rotatably mounted on the shaft of each of said motors, an endless belt interconnecting each of said sheaves with the sheaves on the adjacent motors whereby said sheaves are all rotated at the same speed and means for selectively connecting or disconnecting said sheaves with their respective motor shafts.

9. In a proportioning device, the combination of a plurality of base members, each provided with a manifold opening extending therethrough in such a way that a continuous manifold is produced when a plurality of such base members are secured together in predetermined relation, pumps mounted on said base members with their respective discharge passages in communication with the manifold opening in the base member on which the pump is mounted and means for driving said pumps.

10. In a proportioning device, the combination of a plurality of base members, each provided with a manifold opening extending therethrough in such a way that a continuous manifold is produced when a plurality of such base members are secured together in predetermined relation, pumps mounted on said base members with their respective discharge passages in communication with the manifold opening in the base member on which the pump is mounted and a plurality of motors respectively mounted on said base members and in driving communication with the respective pumps.

11. In a proportioning device, the combination of a plurality of base members, each provided with a manifold opening extending therethrough in such a way that a continuous manifold is produced when a plurality of such base members are secured together in predetermined relation, pumps mounted on said base members with their respective discharge passages in communication with the manifold opening in the base member on which the pump is mounted, motors respectively mounted on said base members and in driving communication with the respective pumps, and means for selectively mechanically synchronizing the speed of operation of any two or more of said pumps.

12. In a proportioning device, the combination of a plurality of substantially identical base members each provided with an opening extending therethrough in such a way that a continuous manifold is produced when a plurality of such base members are secured together, a pump mounted on each of said base members with its discharge passage in communication with said manifold opening, a separately controlled electric motor mounted on each of said base members and connected with the pump thereon, a member rotatably mounted on the shaft of each of said motors, means interconnecting all of said last-named members whereby they are all caused to rotate at the same speed, and means for selectively locking said members respectively on their associated motor shafts.

13. In a proportioning device the combination of a base member provided with a manifold opening extending therethrough, a pump mounted on said base member with its discharge opening in communication with said manifold opening, said pump adapted to discharge into said manifold an adjustable amount of fluid per cycle, a motor mounted on said base member and in driving communication with said pump, a sheave rotatably supported on the shaft of said motor, and means for connecting said sheave with said motor shaft.

14. In a proportioning device, the combination of a plurality of substantially identical base members each provided with an opening extending therethrough in such a way that a continuous manifold is produced when a plurality of such base members are secured together, a pump mounted on each of said base members with its discharge passage in communication with said manifold, each of said pumps adapted to deliver a predetermined quantity of material to said manifold during each cycle of operation, means for driving said pumps at substantially constant relative speeds, and means for selectively varying the output per cycle of each of said pumps.