

Aug. 25, 1936.

C. M. ALEXANDER

2,051,932

APPARATUS FOR COMPOUNDING LUBRICATING OILS

Original Filed May 23, 1931

3 Sheets-Sheet 1

Fig. 1.

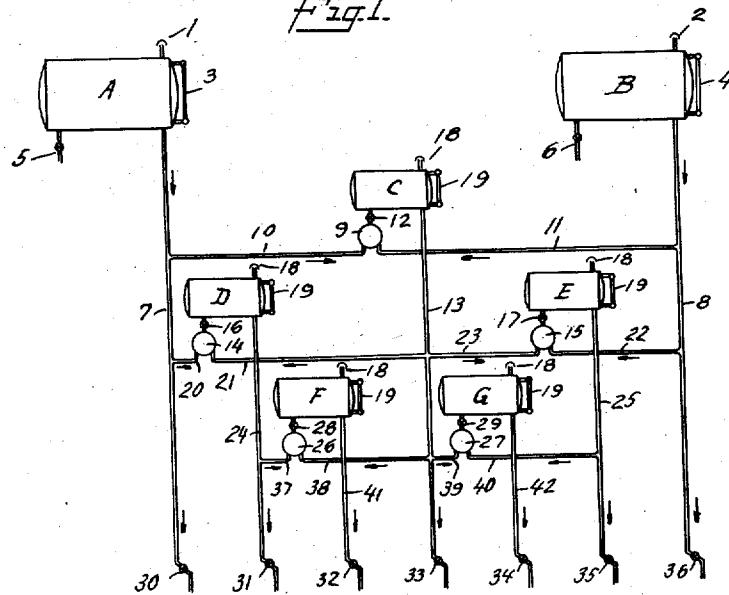
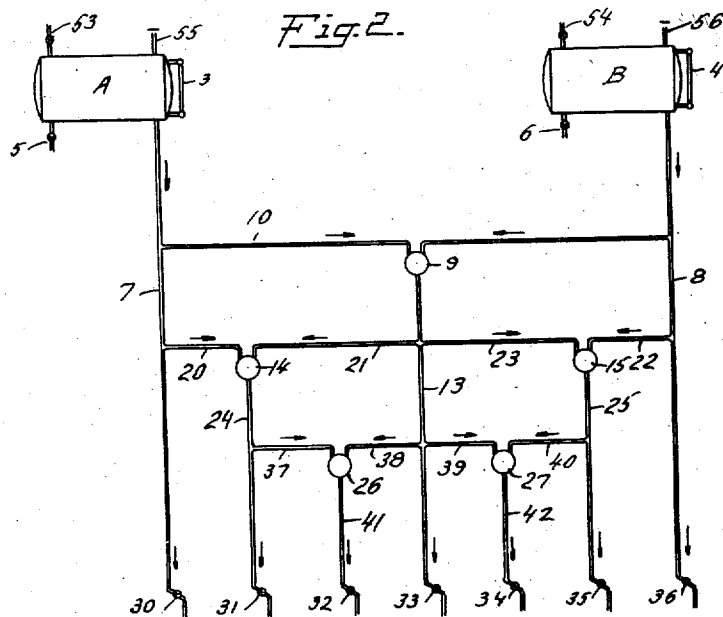


Fig. 2.



INVENTOR
Clive M. Alexander
BY
Penny, Davis, Munn & Edwards
ATTORNEYS

Aug. 25, 1936.

C. M. ALEXANDER.

2,051,932

APPARATUS FOR COMPOUNDING LUBRICATING OILS

Original Filed May 23, 1931

3 Sheets-Sheet 2

Fig. 3.

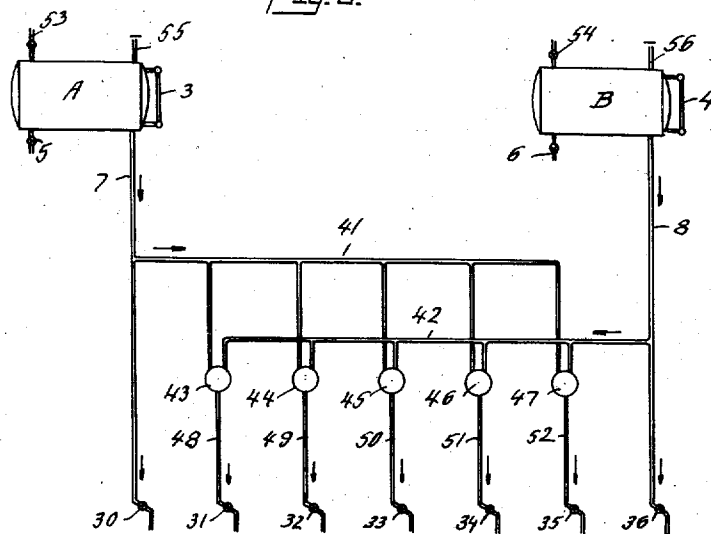
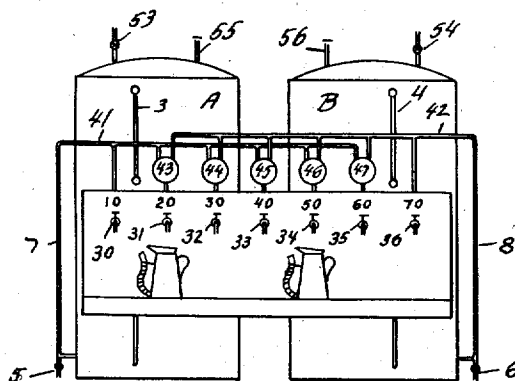


Fig. 4.



INVENTOR
Clive M. Alexander
BY
Penney Davis, Harwin & Edwards
ATTORNEYS

Aug. 25, 1936.

C. M. ALEXANDER

2,051,932

APPARATUS FOR COMPOUNDING LUBRICATING OILS

Original Filed May 23, 1931

3 Sheets-Sheet 3

Fig. 5.

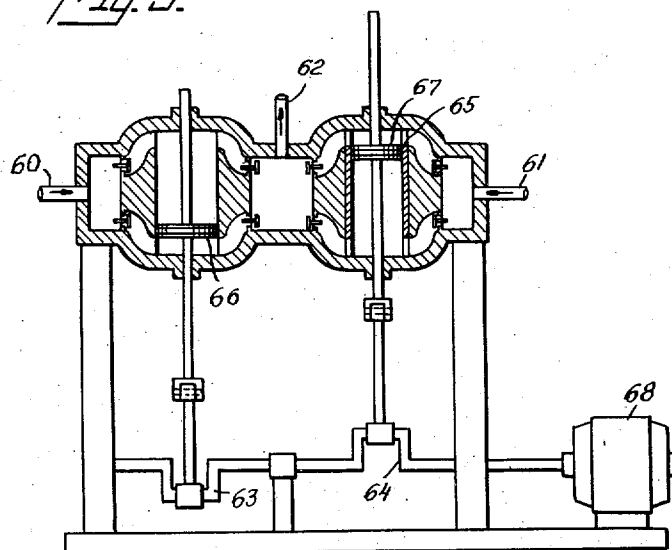
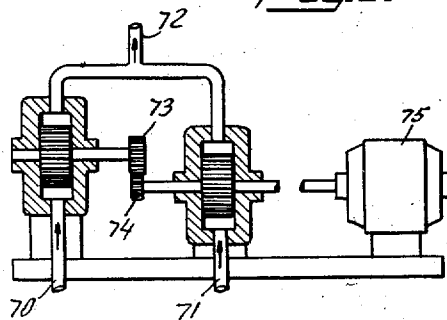


Fig. 6.



INVENTOR
Clive M. Alexander
BY
Pamie, Davis, Marvin & Edwards
ATTORNEYS

UNITED STATES PATENT OFFICE

2,051,932

APPARATUS FOR COMPOUNDING
LUBRICATING OILS

Clive Morris Alexander, Webster Groves, Mo.

Application May 23, 1931, Serial No. 539,501
Renewed October 4, 1934

14 Claims. (Cl. 221-96)

This invention relates to apparatus for compounding or for blending lubricating oils. It is one of the purposes of the present invention to provide an apparatus adapted to accurately compound lubricating oils of different viscosities in predetermined proportions to produce oils having desired predetermined viscosities, the operation of such apparatus being entirely free from irregularities encountered in the usual blending operation through the personal equation of the operator.

In the operation of petroleum refineries for the manufacture of lubricating oils, the finished lubricating oils may be obtained either by direct fractionation to produce an oil of the desired physical properties, or by the fractionation of two or more stocks followed by compounding or blending of these stocks in predetermined proportions. The majority of lubricating oils for use in the automotive trade and for use in lubricating industrial machinery are prepared by compounding lubricating oil stocks. Because of the fact that a number of different grades of oil are required in different industries and especially in the lubrication of automobiles, there is at the present time a tendency to establish certain different grades of lubricating oils in accordance with the Society of Automotive Engineers specification and to identify the different grades by different numbers. There are at present seven S. A. E. grades corresponding to the recognized numbers 10, 20, 30, 40, 50, 60 and 70, the viscosities of which progressively increase in the order named. The lower number designating a relatively light oil of low viscosity and the higher numbers designating relatively heavy oils of high viscosity. This entire range of lubricating oils can be produced by compounding two well established lubricating stocks manufactured by the refineries known respectively as neutral stocks and bright stocks.

This compounding or blending is either done at the refinery or at the jobber's bulk plant and the various grades are then furnished to the retailer as the trade demands. However, regardless of whether the blending is done by the refiner or the jobber, it enables the refiner to concentrate in the production of a relatively small number of stocks thus greatly simplifying his operations and reducing his operating and sales costs. Similarly, when a jobber is in a position to start with a few lubricating stocks and from these make up his entire trade requirements of lubricating oils, his operations are much simplified and his costs greatly reduced if he can

through small investment carry two or three lubricating stocks and manufacture therefrom, by compounding, all of the grades of lubricating oils required, for example, for automobiles, tractors and other industrial machinery. These same advantages could be carried still further to the retail service station operator if it were practical for him to carry only lubricating stocks of say a light and a heavy grade and from these compound directly the various lubricating oils required by the consumer.

The present invention consists of a novel assembly of apparatus comprising two storage tanks, one for light lubricating stock and the other for heavy lubricating stock, together with proportioning apparatus adapted to effect compounding of these stocks in predetermined proportions and dispensing means whereby finished lubricating oils of the various desired grades can be obtained directly as required. The invention can best be described with reference to the accompanying drawings, but it will be understood that these drawings are merely for the purpose of illustration and that the invention is not limited thereto.

Figures 1 and 2 are diagrammatic illustrations in elevation of two generally similar types of apparatus embodying one form of the invention.

Figures 3 and 4 are diagrammatic illustrations in elevation of two generally similar types of apparatus embodying a modified form of the invention.

Figure 5 is an elevation partly in section of one type of reciprocating proportioning device comprising two positive displacement proportioning elements synchronized so as to operate in a predetermined fixed relationship.

Figure 6 is an elevation partly in section of another type of proportioning device comprising two positive displacement proportioning elements of the rotary type, synchronized so as to operate in a fixed predetermined relationship.

Referring to Figure 1, A and B are storage receptacles which may contain widely divergent grades of lubricating oil stocks. For example, the oil in A may be the lightest lubricating oil which it is desired to have available; whereas the oil in B may be the heaviest lubricating oil which it is desired to have available. The characteristics of these two oils would depend upon the limits of the range of grades of oil which it is desired to produce. Receptacles A and B may be provided with vents 1 and 2 and gauge glasses 3 and 4 for observing the contents of the receptacles and with valve controlled connections 5 and 6 for fill-

ing the receptacles. Connection 7 communicates with the receptacle A and is provided with a control valve 30 through which oil from the receptacle A may be dispensed directly. Connection 8 communicates with the receptacle B and is provided with a control valve 36 through which the oil from the receptacle B may be dispensed directly. A positive displacement proportioning device 9 communicates through lines 10 and 11 with connections 7 and 8 respectively. The proportioning device 9 is arranged to discharge through valve controlled connection 12 to the storage tank C. Tank C may be provided with a vent 18 and a gauge glass 19 for observing the character and amount of oil in the tank. Discharge connection 13 communicates with the receptacle C and is provided with a control valve 33 so that oil may be dispensed directly from tank C as desired. Storage tanks D, E, F, and G are similar to tank C and similarly equipped with vents 18 and gauge glasses 19.

Proportioning devices 14 and 15 are arranged to discharge into storage tanks D and E respectively through valve controlled connections 16 and 17. Proportioning device 14 communicates on one inlet side with receptacle A through connections 7 and 20 and on the other inlet side with tank C through connections 13 and 21. Proportioning device 15 communicates on one inlet side with receptacle B through connections 8 and 22 and on the other inlet side with receptacle C through connections 13 and 23. Storage tanks D and E are provided with discharge connections 24 and 25, respectively, and these discharge connections are provided with control valves 31 and 35 respectively, in order that oil may be dispensed from storage tanks D and E directly. Proportioning devices 26 and 27 are arranged to discharge into storage tanks F and G respectively through valve controlled connections 28 and 29. Proportioning device 26 communicates on one inlet side with storage tank D through connections 24 and 37 and on the other inlet side with storage tank C through connections 13 and 38. Proportioning device 27 communicates on one inlet side with storage tank C through connections 13 and 39 and on the other inlet side with storage tank E through connections 25 and 40. Storage tanks F and G are provided with discharge connections 41 and 42 respectively which are in turn provided with control valves 32 and 34 through which oil may be dispensed from storage tanks F and G directly.

The proportioning devices 9, 14, 15, 26, and 27 each consist of a pair of positive displacement proportioning elements, the two elements of each pair being synchronized to transfer liquids in a fixed predetermined ratio. The proportioning elements may be any of the well known types of reciprocating proportioning pumps having a definitely fixed length of stroke. The transmission ratio of the elements of a pair may be fixed by varying the relative sizes of the elements and providing an arrangement to drive them at the same speed, or the separate elements of a pair may be of the same size and provided with means for driving them at speeds having a definite fixed ratio. The elements of a pair for example may be connected to a common driving mechanism, either directly so as to drive them at the same speed, or through gears so as to drive them at different speeds in the desired ratio. The proportioning devices may be driven by power supplied from an external source; for example, an electric motor, or they may be actuated by the

application of pressure to the oil supplied to the inlet sides of the proportioning devices. This pressure may be applied for example by gravity where the storage receptacles A and B are elevated relative to the storage tanks C, D, E, F, and G, or air pressure may be applied to the receptacles A and B. Where it is desired to actuate the proportioning devices, by the pressure supplied at the inlet connections so that the proportioning elements will function similar to meters, the proportioning devices advantageously may take the form of a pair of the well known gear pumps or other well known types of positive displacement rotary pumps or meters, the elements of each pair being of such relative size and connected directly or through gears so as to maintain a fixed ratio of transmission. As the details of various types of positive displacement proportioning pumps and meters are known to the art and the present invention is not dependent on the use of any particular type, the proportioning devices are only conventionally illustrated in the drawings.

The apparatus illustrated in Figure 2 is generally similar to that indicated in Figure 1 except that no storage tanks are provided for the intermediate grades of oil and the proportioning devices 9, 14, 15, 26 and 27 are arranged to discharge directly into connections 13, 24, 25, 41 and 42, respectively. In the apparatus illustrated in Figure 2 the storage receptacles A and B are provided with valve controlled connections 53 and 54 respectively which are adapted to supply air pressure to the upper surfaces of the liquids in the storage receptacles. In this arrangement pressure relief valves 55 and 56 are substituted in place of the vents 1 and 2 shown in Figure 1.

In the operation of the apparatus illustrated in Figure 1, any one of the intermediate storage tanks C, D, E, F, and G is filled by opening the valve in the discharge connection leading from the proportioning device to the desired storage tank and by supplying actuating power to the corresponding proportioning device. Where the storage receptacles A and B are elevated with respect to the intermediate storage tanks and the proportioning devices are of the type which may be actuated by the application of pressure to the oil supplied to the inlet sides of the proportioning devices it is only necessary to open any one of the control valves 12, 16, 17, 28, or 29, in order to supply liquids in the desired predetermined ratio to any one of the storage tanks C, D, E, F, or G, respectively.

In the arrangement illustrated in Figure 2, where no intermediate storage receptacles are provided, the proportioning devices preferably are of the type that may be actuated by the application of pressure to the oil at the inlet side of the proportioning elements, as otherwise it would be necessary to supply power simultaneously to the proportioning device 9 as well as to the proportioning device 14 in order to dispense an appropriately blended oil through connection 24. Similarly, it would be necessary to supply power simultaneously to each of the proportioning devices 9, 14 and 26 in order to dispense an appropriately blended oil through connection 41. However, if the proportioning devices are of the type that may be actuated by the application of pressure to the oil at the inlet side of the proportioning elements, it is only necessary to open any one of valves 31, 32, 33, 34, or 35, in order to automatically dispense an oil of the appropriate blend from the desired discharge

connection. For example, opening of valve 33 will cause the proportioning device 9 to dispense an appropriate blend of the oils from storage receptacles A and B. Similarly, opening of valve 31 will cause proportioning devices 9 and 14 to operate simultaneously to dispense an oil of the appropriate blend through connection 24, and opening of valve 32 will automatically cause proportioning devices 9, 14 and 26 to operate simultaneously to dispense an appropriate blend through connection 41.

It is one of the advantages of the apparatus illustrated in Figures 1 and 2 that each of the proportioning devices may be adapted to transmit the two oils supplied to it in equal proportions and that when so arranged and where the oil stocks supplied to storage receptacles A and B correspond respectively to S. A. E. numbers 10 and 70, blends corresponding to S. A. E. numbers 20, 30, 40, 50 and 60 may be compounded from these stocks and dispensed through valves 31, 32, 33, 34, and 35, respectively, by the operation of the apparatus as above described. This arrangement has the advantage that only one style or size of proportioning device is required to produce all of the blends necessary to supply the usual trade requirements. It will of course be appreciated that if the trade requirements in a particular locality do not warrant the manufacture of all of the different grades, a portion of the apparatus may be eliminated. For example, when it is desired to produce blends corresponding to all of the other intermediate grades except S. A. E. numbers 50 and 60, the storage receptacles E and G and proportioning devices 15 and 27 together with their corresponding inlet and discharge connections may be eliminated.

Similarly, if the trade requirements of a particular dealer do not warrant the production of blends corresponding to S. A. E. numbers 20 and 60, for example, storage tanks F and G and the corresponding proportioning devices 26 and 27 together with their associated inlet and discharge connections may be eliminated and the proportioning devices 14 and 15 synchronized to the required transmission ratio to produce directly blends corresponding to S. A. E. numbers 30 and 50, respectively from the lubricating stock supplied from A and the blend supplied from C in the one instance and from the lubricating stock supplied from B and the blend supplied from C in the other instance. Thus the proportioning device 14 may be synchronized to transmit through its discharge connection a blend composed of 35% of oil supplied from connection 7 and 65% of oil supplied from connection 13, while proportioning device 15 may be synchronized to supply through discharge connection a blend consisting of 65% of oil supplied from connection 13 and 35% of oil supplied from connection 8.

Similarly, proportioning devices 26 and 27 may be directly connected through connections 37 and 40 to connections 7 and 8, respectively, and the transmission ratio of these proportioning devices established, for example, to produce blends corresponding to S. A. E. numbers 30 and 50, respectively, while proportioning devices 14 and 15 may remain as shown with transmission ratios established to produce blends corresponding to S. A. E. numbers 10 and 60 respectively, for example.

In the apparatus illustrated in Figure 3 stor-

age receptacles A and B communicate through connections 7 and 8 with manifolds 41 and 42, respectively. The inlet side of one of the elements of each of the proportioning devices, 43, 44, 45, 46, and 47, is connected to manifold 41 while the inlet side of the other element of each of the proportioning devices is connected to the manifold 42. In the arrangement shown in this figure each of the proportioning devices has a different liquid transmission ratio. For example, the elements of proportioning device 43 may be synchronized to transmit to discharge connection 48, a blend consisting of 80% of oil supplied from receptacle A and 20% of oil supplied from receptacle B. Proportioning device 44 may be arranged to transmit to discharge connection 49, a blend comprising 65% of oil supplied from receptacle A and 35% of oil supplied from receptacle B. Proportioning device 45 may be arranged to transmit to discharge connection 50 a blend consisting of 50% of oil supplied from receptacle A and 50% of oil supplied from receptacle B. Proportioning devices 46 and 47 may be arranged to transmit to discharge connections 51 and 52, respectively, blends of oils from receptacles A and B in proportions corresponding inversely to the proportions transmitted by proportioning devices 44 and 43, respectively. With the arrangement above described and with oils corresponding to S. A. E. numbers 10 and 70 in storage receptacles A and B respectively, oils having physical properties corresponding to the recognized S. A. E. numbers 20, 30, 40, 50 and 60 may be compounded and dispensed directly through connections 48, 49, 50, 51, and 52. It will of course be appreciated that where the trade requirements do not provide a sufficient demand for one or more of the intermediate grades, the corresponding proportioning device together with its inlet and discharge connections may be eliminated.

In the apparatus illustrated in Figure 3 storage receptacles A and B are shown as provided with connections 53 and 54 for supplying air under pressure and with relief valves 55 and 56. It will of course be understood, if receptacles A and B are elevated with respect to the exit end of the discharge connections, that these receptacles may be provided with vents as illustrated in Figure 1 and the oil permitted to feed by gravity through the corresponding manifolds 41 and 42. Likewise, proportioning devices 43 to 47 in this arrangement may be driven by the application of external force. For example, where the storage receptacles A and B cannot advantageously be elevated and where a source of compressed air or other gaseous medium is not readily available, the proportioning devices may comprise pairs of positive displacement proportioning pumps synchronized together and each pair of pumps may be driven by the application of power from an external source, for example an electric motor, so that oil will be drawn from receptacles A and B, through discharge connections 7 and 8, manifolds 41 and 42, and the corresponding inlets to any one of the desired proportioning devices. Similarly, it will be obvious that the proportioning devices may be arranged to discharge into corresponding intermediate storage tanks, as in the arrangement illustrated in Figure 1, so that a limited supply of the various intermediate grades of oil will be available at all times.

The apparatus illustrated in Figure 4 illustrates a practical compact arrangement of the apparatus illustrated in Figure 3 which is par-

ticularly adapted for small scale installations such as might be required by the small service station operator. In the arrangement shown in Figure 4 the corresponding parts are numbered the same as in Figure 3 and the arrangement shown is such that if oils corresponding to S. A. E. numbers 10 and 70 are supplied to storage receptacles A and B respectively, oils corresponding to S. A. E. numbers 10, 20, 30, 40, 50, 60, and 70 may be dispensed directly as desired through discharge valves 30, 31, 32, 33, 34, 35, and 36 respectively. In a relatively small installation of this character the entire assembly including the storage receptacles A and B and the proportioning devices 43 to 47 may advantageously be inclosed in a metal box, and means, for example a steam coil, provided for heating the equipment to provide for free flow of the heavier oils and insure easy operation of the proportioning devices in cold weather.

In the apparatus illustrated in Figure 4, as in the case of the apparatus illustrated in Figure 3, it will be obvious that the number of proportioning elements may be decreased or increased and the transmission ratios of the various proportioning devices varied in accordance with the number and kinds of oil it is desired to dispense taking into consideration the lubricating oil stocks available. Other modifications of the apparatus of the invention will be apparent to those skilled in the art from the foregoing description.

Figures 5 and 6 illustrate, respectively, a reciprocating and a rotary type of proportioning device. In the reciprocating type of proportioning device illustrated in Figure 5 pistons 66 and 67 driven by motor 68 through a common crankshaft operate to draw the liquids to be blended through inlet connections 60 and 61, respectively, and to discharge them through the single outlet connection 62. In the apparatus illustrated in this figure the diameter of piston 67 is considerably less than that of piston 66. The size of the cylinder in which the piston 67 operates is reduced by sleeve 65. A similar reduction in the displacement of the right hand proportioning element could be obtained by reducing the throw of the crank 64 as compared to the throw of the crank 63.

In the proportioning device illustrated in Figure 6 the rotating members may be of the well known lobe or well known gear type. In the apparatus illustrated the ratio of the relative speeds of rotation is controlled by the ratio of the meshing gears 73 and 74. In this type of proportioning device the rotating element may be driven by motor 75 so as to draw the liquids to be blended through inlet connections 70 and 71 and to discharge the blended liquids through the common connection 72. In the gear type of rotary proportioning device illustrated in Figure 6, the motor 75 may be dispensed with entirely if the liquid is supplied under pressure to either or both of connections 70 and 71.

I claim:

1. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of pairs of positive displacement proportioning elements the elements of each pair being synchronized to transmit liquids in a different predetermined fixed ratio, a manifold communicating with one of said storage receptacles and with the inlet side of one of the elements of each of the pairs of proportioning elements, a second manifold communicating with the other storage receptacle and with the inlet side of the other element of each of the pairs of proportioning elements,

and separate means for uniting liquids discharged from each of said pairs of proportioning elements.

2. In an apparatus of the class described the combination comprising two storage receptacles each provided with a valve controlled discharge connection, a plurality of pairs of positive displacement proportioning elements the elements of each pair being synchronized to transmit liquids in a different predetermined fixed ratio, a manifold communicating with one of said storage receptacles and with the inlet side of one of the elements of each of the pairs of proportioning elements, a second manifold communicating with the other storage receptacle and with the inlet side of the other element of each of the pairs of proportioning elements, and a plurality of valve controlled discharge connections each adapted to receive both liquids discharged by one of said pairs of proportioning elements.

3. In an apparatus of the class described the combination comprising two storage receptacles each provided with a valve controlled discharge connection, a plurality of pairs of positive displacement proportioning elements the elements of each pair being synchronized to transmit liquids in a different predetermined fixed ratio, said proportioning elements being operable by the introduction of liquid supplied under pressure to the inlet sides thereof, a manifold communicating with one of said storage receptacles and with the inlet side of one of the elements of each of the pairs of proportioning elements, a second manifold communicating with the other storage receptacle and with the inlet side of the other elements of each of the pairs of proportioning elements, means adapted to apply pressure to said storage receptacles, and a plurality of valve controlled discharge connections each adapted to receive both liquids discharged by one of said pairs of proportioning elements.

4. In an apparatus of the class described the combination comprising two storage receptacles each provided with a valve controlled discharge connection, a plurality of pairs of positive displacement proportioning elements the elements of each pair being synchronized to transmit liquids in a different predetermined fixed ratio, said proportioning elements being operable by the introduction of liquids under pressure to the inlet sides thereof, a manifold communicating with one of said storage receptacles and with the inlet side of one of the elements of each of the pairs of proportioning elements, a second manifold communicating with the other storage receptacle and with the inlet side of the other element of each of the pairs of proportioning elements, and a plurality of valve controlled discharge connections each adapted to receive both liquids discharged by one of said pairs of proportioning elements, said storage receptacles being elevated with respect to the exit ends of said discharge connections.

5. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of pairs of positive displacement proportioning elements the elements of each pair being synchronized to transmit liquids in a different predetermined fixed ratio, said proportioning elements being operable by the introduction of liquids under pressure to the inlet sides thereof, a manifold communicating with one of said storage receptacles and with the inlet side of the elements of each of the pairs

of proportioning elements, a second manifold communicating with the other storage receptacle and with the inlet side of the other element of each of the pairs of proportioning elements, means for supplying liquid from said storage receptacles to the inlet sides of the proportioning elements under pressure, and a plurality of valve controlled discharge connections each adapted to receive both liquids discharge by one of said pairs of proportioning elements.

6. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a discharge connection adapted to receive liquid transmitted by said proportioning elements, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, and a connection between the discharge connection of the first proportioning device and the inlet of the other element of the second proportioning device.

7. In an apparatus of the class described the combination comprising two storage receptacles each provided with a valve controlled discharge connection, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a valve controlled discharge connection adapted to receive liquid transmitting by said proportioning elements, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device and a branch connection between the discharge connection of the first proportioning device and the inlet of the other element of the second proportioning device.

8. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in equal proportions and a discharge connection adapted to receive liquid transmitted by said proportioning elements, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, and a connection between the discharge connection of the first proportioning device and the inlet of the other element of the second proportioning device.

9. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first, a second and a third proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a discharge connection adapted to receive liquid transmitted by said proportioning elements, con-

nections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, connections between the discharge connection of the first proportioning device and the inlet of the other proportioning element of the second proportioning device and the inlet of one element of a third proportioning device, and a connection of the second proportioning device and the inlet of the other element of the third proportioning device.

10. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first, a second and a third proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in equal proportions and a discharge connection adapted to receive liquid transmitted by said proportioning elements, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, connections between the discharge connection of the first proportioning device and the inlet of the other proportioning element of the second proportioning device and the inlet of one element of a third proportioning device, and a connection between the discharge connection of the second proportioning device and the inlet of the other element of the third proportioning device.

11. In an apparatus of the class described the combination comprising two storage receptacles each provided with a valve controlled discharge connection, a plurality of proportioning devices including a first, a second and a third proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a valve controlled discharge connection adapted to receive liquid transmitted by said proportioning elements, branch connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a branch connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, branch connections between the discharge connection of the first proportioning device and the inlet of the other proportioning element of the second proportioning device and the inlet of one element of a third proportioning device, and a branch connection between the discharge connection of the second proportioning device and the inlet of the other element of the third proportioning device.

12. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a valve controlled discharge connection adapted to receive liquid transmitted by said proportioning elements, said proportioning elements being operable by the introduction of liquid under pressure to the inlet sides thereof, connections be-

tween the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, a branch connection between the discharge connection of the first proportioning device and the inlet of the other element of the second proportioning device, and means for applying pressure to liquid in the storage receptacles.

13. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquid in a predetermined fixed ratio and a valve controlled discharge connection adapted to receive liquid transmitted by said proportioning elements, a plurality of intermediate storage tanks each arranged to communicate through said discharge connections with one of said proportioning devices, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, a connection between the intermediate storage tanks communicating with the first proportioning device and the inlet of the other element of the second proportioning device, and separate valve controlled connections communicating with each of said storage

receptacles and with each of said intermediate storage tanks.

14. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first, a second and a third proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a discharge connection adapted to receive liquid transmitted by said proportioning elements, a plurality of intermediate storage tanks each arranged to communicate through said discharge connections with one of said proportioning devices, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, connections between the intermediate storage tank communicating with the first proportioning device and the inlet of the other proportioning element of the second proportioning device and the inlet of one element of a third proportioning device, a connection between the intermediate storage tank communicating with the second proportioning device and the inlet of the other element of a third proportioning device, and separate valve controlled discharge connections communicating with each of said storage receptacles and each of said intermediate storage tanks.

CLIVE MORRIS ALEXANDER. 35

CERTIFICATE OF CORRECTION.

Patent No. 2,051,932.

August 25, 1936.

CLIVE MORRIS ALEXANDER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 9, claim 5, for the word "discharge" read discharged; line 38, claim 7, for "transmitting" read transmitted; same page, second column, line 12, claim 9, after "connection" insert the words between the discharge connection; line 17, claim 10, for "proportion" read proportioning; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of November, A. D. 1936.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

tween the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, a branch connection between the discharge connection of the first proportioning device and the inlet of the other element of the second proportioning device, and means for applying pressure to liquid in the storage receptacles.

13. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first and a second proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquid in a predetermined fixed ratio and a valve controlled discharge connection adapted to receive liquid transmitted by said proportioning elements, a plurality of intermediate storage tanks each arranged to communicate through said discharge connections with one of said proportioning devices, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, a connection between the intermediate storage tanks communicating with the first proportioning device and the inlet of the other element of the second proportioning device, and separate valve controlled connections communicating with each of said storage

receptacles and with each of said intermediate storage tanks.

14. In an apparatus of the class described the combination comprising two storage receptacles, a plurality of proportioning devices including a first, a second and a third proportioning device each comprising two positive displacement proportioning elements synchronized to transmit liquids in a predetermined fixed ratio and a discharge connection adapted to receive liquid transmitted by said proportioning elements, a plurality of intermediate storage tanks each arranged to communicate through said discharge connections with one of said proportioning devices, connections between one of the storage receptacles and the inlets of one of the proportioning elements of the first and the second of said proportioning devices, a connection between the other storage receptacle and the inlet of the other proportioning element of the first proportioning device, connections between the intermediate storage tank communicating with the first proportioning device and the inlet of the other proportioning element of the second proportioning device and the inlet of one element of a third proportioning device, a connection between the intermediate storage tank communicating with the second proportioning device and the inlet of the other element of a third proportioning device, and separate valve controlled discharge connections communicating with each of said storage receptacles and each of said intermediate storage tanks.

CLIVE MORRIS ALEXANDER. 35

CERTIFICATE OF CORRECTION.

Patent No. 2,051,932.

August 25, 1936.

CLIVE MORRIS ALEXANDER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 9, claim 5, for the word "discharge" read discharged; line 38, claim 7, for "transmitting" read transmitted; same page, second column, line 12, claim 9, after "connection" insert the words between the discharge connection; line 17, claim 10, for "proportion" read proportioning; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of November, A. D. 1936.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.