April 5, 1960 E. T. YOUNG ET AL 2,931,538

MEANS FOR BLENDING, PROPORTIONING, METERING AND DISPENSING TWO LIQUIDS

Filed March 10, 1955 5 Sheets-Sheet 1

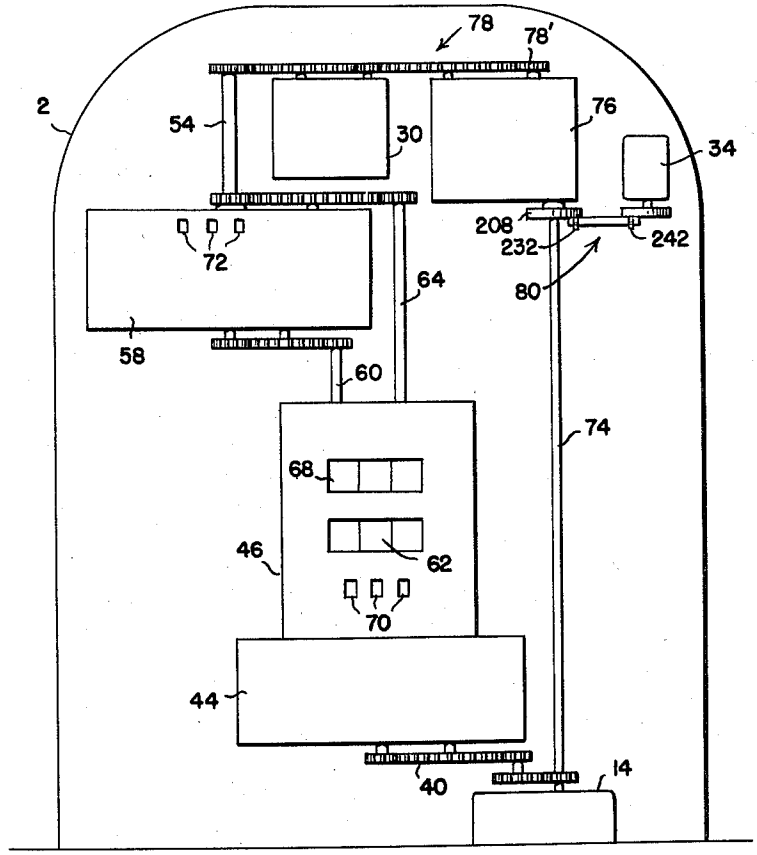


FIG. 1.

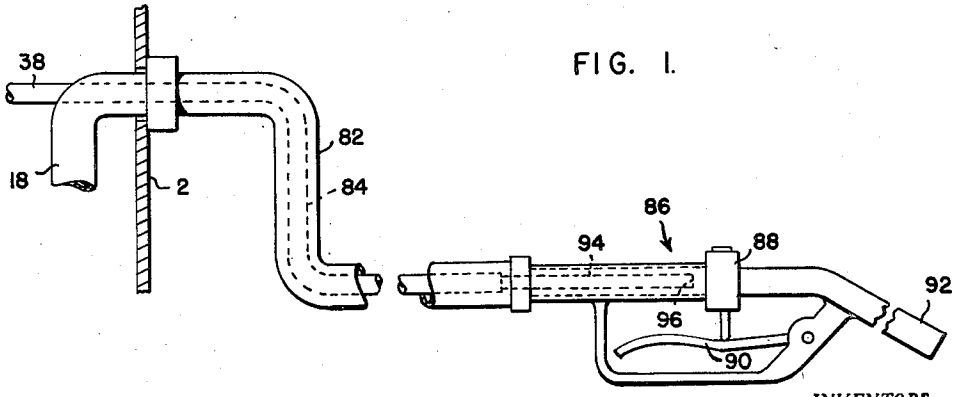


FIG. 8.

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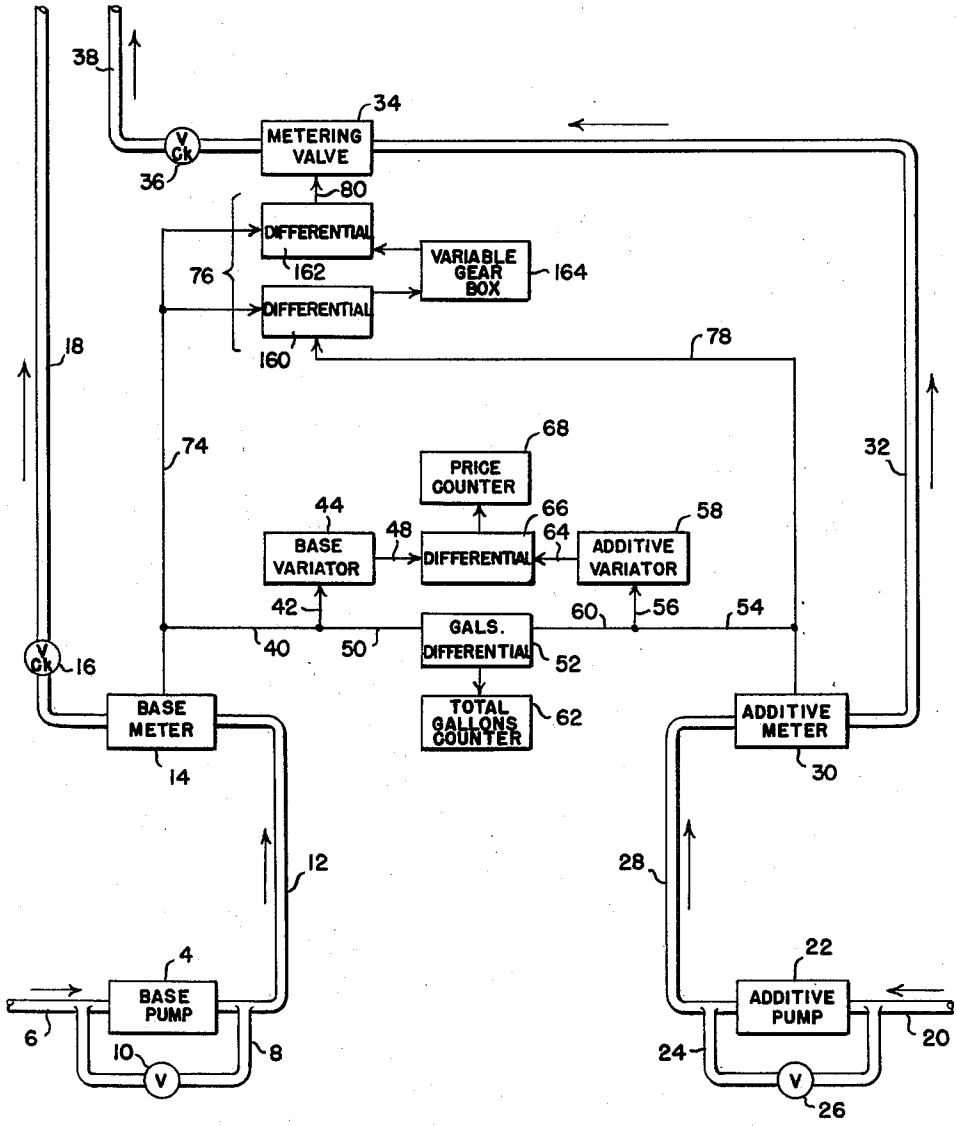


FIG. 2.

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MEANS FOR BLENDING, PROPORTIONING, METERING AND DISPENSING TWO LIQUIDS

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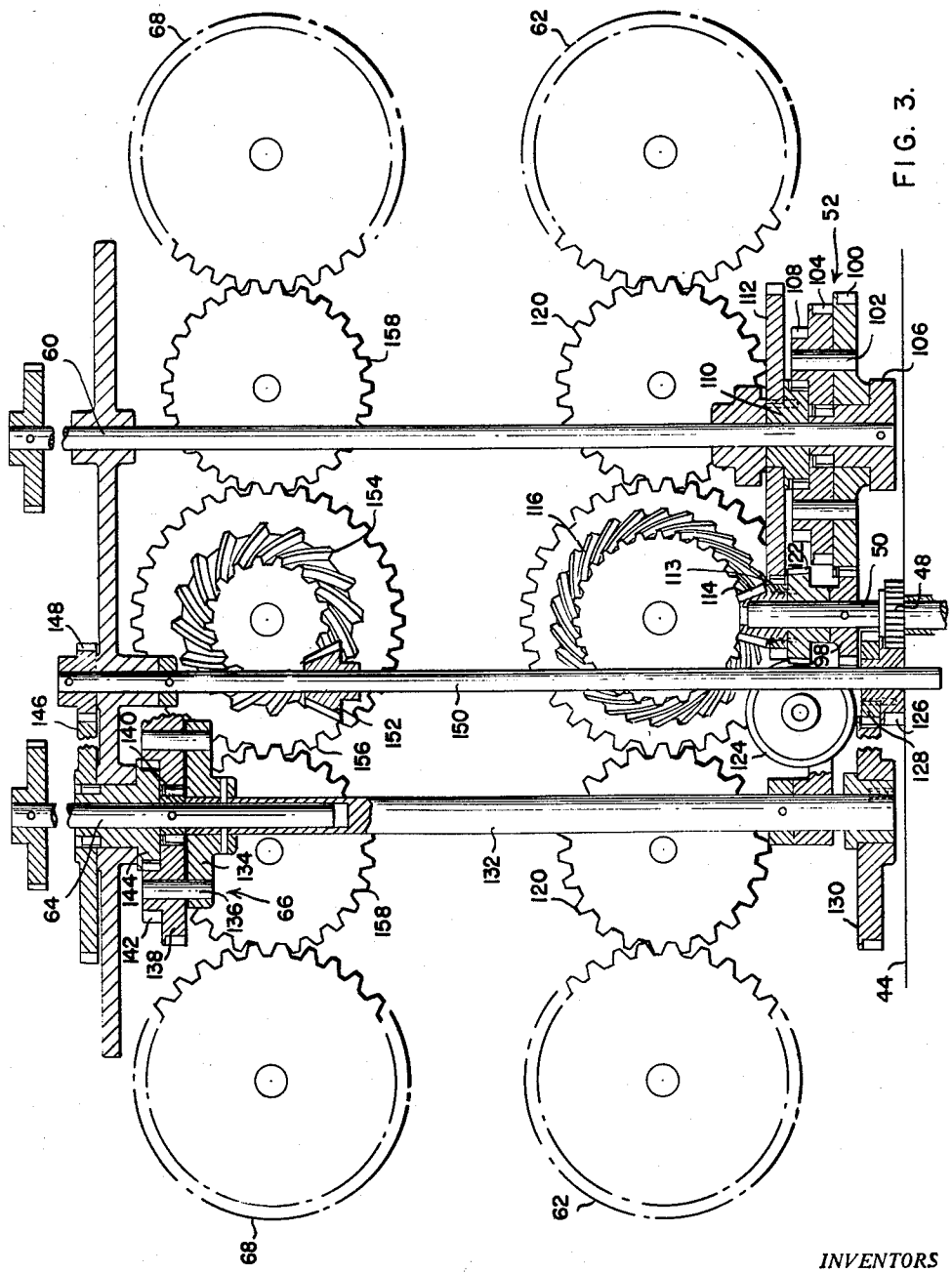


FIG. 3.

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MEANS FOR BLENDING, PROPORTIONING, METERING AND DISPENSING TWO LIQUIDS

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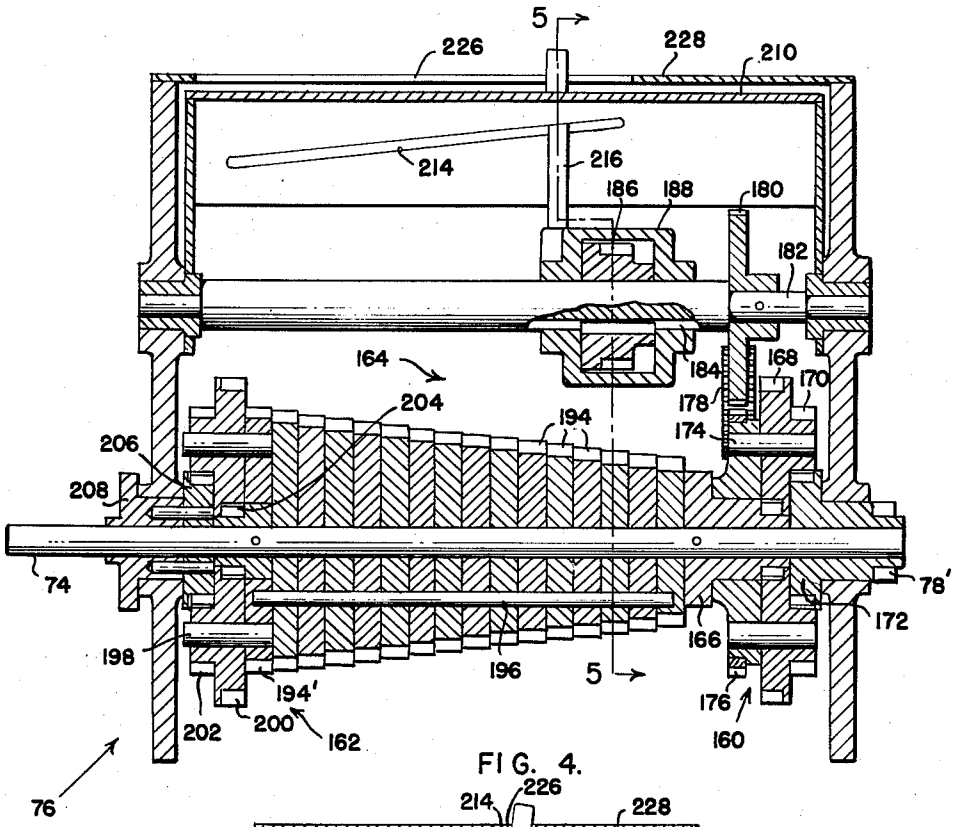


FIG. 4.

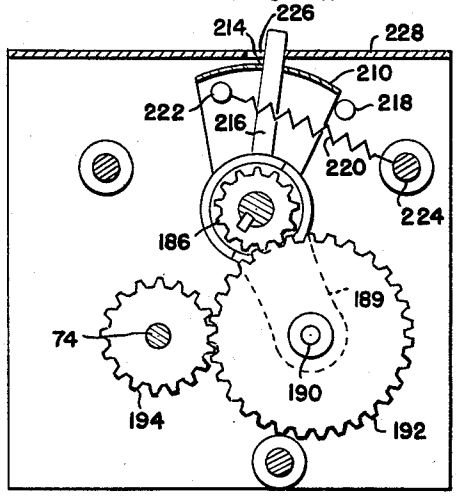


FIG. 5.

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MEANS FOR BLENDING, PROPORTIONING, METERING AND DISPENSING TWO LIQUIDS

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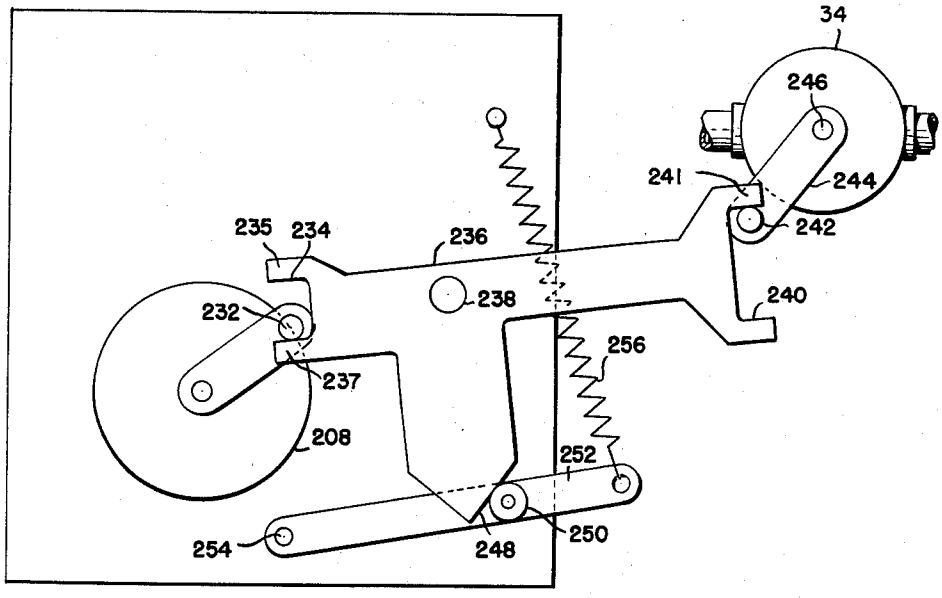


FIG. 7.

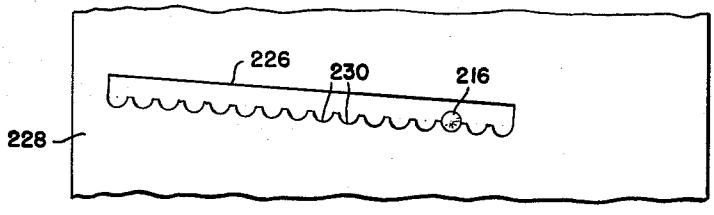


FIG. 6.

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United States Patent Office

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2,931,538

MEANS FOR BLENDING, PROPORTIONING, METERING AND DISPENSING TWO LIQUIDS

Einar T. Young, Newtown Square, and Alfred H. Marsh, Swarthmore, Pa., assignors to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey

Application March 10, 1955, Serial No. 493,362

8 Claims. (Cl. 222—26)

This invention relates to metering means particularly adapted for the metering of base and additive components of a motor fuel.

At the present time, automotive fuels are quite generally sold by oil companies in various grades characterized by different octane ratings and differing in compositions particularly in the proportions therein of materials such as tetraethyl lead imparting to them antiknock properties. The fuels of higher octane ratings sold by a particular company carry higher prices than those sold by the same company but of lower octane rating. Usually, a single company will sell only two grades, commonly designated "regular" and "high test" gasolines.

The present trend in automotive engineering is to supply engines with higher and higher compression ratios, the higher the compression ratio, the higher the octane rating of the fuel which should be used consistent with avoidance of "knock" when the engine is operating under conditions of high power output.

As newer cars replace older ones in general use, the gasolines which are sold have been required to have higher and higher octane ratings, the octane ratings of the "regular" gasolines being increased while the octane ratings of the "high test" gasolines have been correspondingly increased. Few cars, however, require for operation under normal conditions of use the high octane ratings of the "high test" gasolines, but a substantial number of cars require, for completely knockless operation, gasolines having an octane rating somewhat exceeding that of the usually sold "regular" gasolines. The majority of cars, however, particularly older ones in use, do not require even the octane rating of the "regular" gasolines. The purchaser of gasoline has usually, at a particular gas station, only two choices of the gasoline which he may purchase, and for what he considers satisfactory operation of his car he may be required to purchase at a premium price the available "high test" gasoline, even though the actual requirements for car operation satisfactory to him would dictate a gasoline of octane rating intermediate between the "regular" and "high test" grades. The oil companies, however, must, in order not to lose business and good will, supply a "high test" gasoline which will operate satisfactorily under the most demanding driving conditions in those cars having the highest engine compression ratios. The resulting situation is unsatisfactory to both the oil companies and their customers. The ideal situation would be that of having available to a particular car owner the particular grade of gasoline which his car and his driving habits would demand consistent with

economy. With a particular make of car, one owner may desire a gasoline which will give him completely knockless operation under all driving conditions, and he may demand such operation even though the conditions in which knocking might occur are very infrequent. Another owner of an identical car may have a quite different attitude, accepting knock under the few conditions for which it occurs but desiring for what he considers best economy of operation a less expensive gasoline which in his own views is quite satisfactory for the general conditions under which he drives. Some drivers keep careful check on the driving miles per gallon which they obtain; other drivers do not. In the sale of gasoline, however, the oil companies must satisfy all of these classes of car owners and drivers and must choose the ratings of their gasolines to secure the optimum customer reactions.

Mention has been made of the fact that, usually, a particular gas station will sell no more than two grades of gasoline. Under present conditions, these grades are sold from separate pumps drawing their supplies from separate tanks. An attempt to retail more than two grades, in general, involves a prohibitive investment in separate tanks and pumps operating individually at low demand rates.

It is the general object of the present invention to provide a gasoline dispensing system more adequately satisfying the requirements of the motoring public. In accordance with the present invention a single so-called "pump" is provided for dispensing gasolines of various grades. As will become evident hereafter, the metering means provided in accordance with the invention may supply a large number of different grades of gasoline, while at the same time it is susceptible, if desired, to have its capabilities lessened to provide a relatively few grades depending upon the desires of the patrons of the station in which it is used.

In brief, the invention provides a "pump" which may draw its supplies from two tanks. One of these tanks may contain what will be hereafter referred to as a "base" gasoline which may have a minimum octane rating, and correspondingly low price, the octane rating being the economical minimum for which there may be any demand. The second tank may contain an "additive" which in itself may be a gasoline having an octane rating far exceeding the most extreme demands. This additive, in view of its rating, would command a quite high price. For example, by way of illustration, the base might consist of a gasoline having an octane rating of 90, which, alone, could be sold at a minimum competitive price per gallon. The additive, on the other hand, might have a very high octane rating of 130. Such an octane rating far exceeds any present demands, and may be adopted solely to minimize the quantity of additive for which demand would be made in order to avoid frequent refilling of its supply tank.

In accordance with the invention, the purchaser of gasoline may specify the "grade" of gasoline he desires. This might be in terms of approximate octane rating, or more practically, in terms of some arbitrary grade number which the gasoline vendor could publicize as having a certain range of octane rating or some guaranteeable minimum octane rating. The vendor can then set an adjustable device which will give to the purchaser the grade of gasoline which he demands. The mech-

anism provided in accordance with the invention then operates to supply to the tank of the car a mixture of the base and additive corresponding to the requested grade.

This mixing of base and additive, if a particular percentage mixture was to be delivered, might involve difficulties in guaranteeing that the purchaser would secure precisely the mixture which he requested. The authorities quite properly demand that the purchaser should not pay for what he does not receive. Inherent and unavoidable errors in proportioning might, from this standpoint, demand that the gasoline proportioning and delivery mechanism should always give at least what the customer demands and pays for. However, the oil companies operate on a low margin of profit, and the factor of safety in satisfying legal requirements in this fashion would seriously affect the profits involved if the mechanism operated in the region of giving more than necessary in value of gasoline.

In accordance with the present invention, these difficulties are removed by insuring that the purchaser of gasoline pays for what he obtains even though what he obtains may not be determinable with high precision. In accordance with the invention, a particular price per gallon is assigned to the base and a particular price per gallon is assigned to the additive. Both the base and the additive are then separately metered to give precise indications of the amounts thereof respectively supplied and the prices are, in effect, individually computed and added to give the total price of the sale. Actually delivered to the customer will then be a mixture which might have no precisely predeterminable composition of base and additive. Of two customers requesting the same grade of gasoline, one may receive actually in a particular sale a greater proportion of additive to base than the other. The price for a given number of gallons of gasoline mixture will be greater for the first customer than the second; but both will receive precisely what they pay for within the limits of legal tolerance. In accordance with the invention, however, the two mixtures thus provided and nominally of the same grade will be tolerably close and will have at least the octane rating nominally assigned to the grade. Actually, as will be apparent from the following description of the mechanism, the error in proportioning of the base and additive may be quite small and, from the standpoint of satisfaction of the customer, he could not possibly distinguish between the two slightly different mixtures that might be delivered to him on separate occasions when he requested the same grade. Furthermore, the difference in price he will be charged on separate occasions for the same quantity of gasoline of the same grade will be held to, at most, one or two cents.

In the foregoing matters of possible deviations from a theoretically precise proportioning, there is taken into account the fact that practical devices such as may be used for delivering gasoline must be relatively inexpensive and rugged, and must operate under varying temperature conditions, etc., so that the apparatus is far from being of laboratory quality capable of precision operation. As will appear hereafter, the mechanism provided in accordance with a preferred form of the invention satisfies practical requirements without involving refinements which would greatly increase its cost and, possibly, decrease its reliability of operation.

The broad objects of the present invention relate to the attainment of the foregoing objectives, and these and detailed objects particularly relating to matters of construction and operation will become apparent from the following description read in conjunction with the accompanying drawings, in which:

Figure 1 is a diagrammatic view showing a preferred type of assembly of various elements within a gasoline dispensing "pump";

Figure 2 is a block diagram illustrating the liquid and mechanical connections of various elements involved in a preferred form of mechanism;

Figure 3 is a sectional view of mechanism particularly arranged for adding and indicating the quantities and prices of mixtures of the base and additive delivered to a customer;

Figure 4 is a sectional view showing a variable gear box and setting mechanism for determining the grade of gasoline to be delivered to a customer;

Figure 5 is a section taken on the broken surface indicated at 5—5 in Figure 4;

Figure 6 is a fragmentary plan view looking at the top of Figure 4 and showing, in particular, the setting lever and associated parts;

Figure 7 is a fragmentary view showing, in particular, a valve operating mechanism; and

Figure 8 is a diagrammatic view showing, in particular, a preferred arrangement of filling hose and control valve.

Reference may first be made particularly to Figures 1 and 2 showing the structural and operational association of the elements involved in carrying out the invention.

There is indicated at 2 the upper portion of the usual casing of a gasoline "pump," such a casing, in general, involving a base portion in which there is located a gasoline pump and its driving motor together with a gasoline meter. In the upper portion of such a casing there is provided computing mechanism comprising a so-called variator and counters. Heretofore, the variator received an input from the gasoline meter and involved adjustable mechanism for setting a price per gallon exhibited through a window or windows in the "pump." The input from the meter passed through the variator to operate a counter indicating the number of gallons of gasoline delivered. A second output from the variator operated a second counter indicating the total price as computed from the meter input and the price per gallon setting. Both the total gallons and total price were exhibited through windows in the housing. Such meters also contained counters to indicate the total amount of sales through the pump and were provided with mechanisms for resetting to zero the exhibited indications of total gallons and total price of a sale. Reference is made to these conventional mechanisms since in accordance with the invention variators of conventional type are used and the counting arrangements are, in general, conventional with mechanical modifications as will be described.

Passing to the matters of the present invention, the "pump" may have substantially conventional external appearance, and has located in its base a base pump 4 driven by a motor in conventional fashion and arranged to receive through pipe 6 from a supply tank the base gasoline referred to above. In the usual fashion, the base pump 4 is provided with a bypass 8 in which is located a loaded relief valve so that if the delivery hose outlet is shut off the base pump may continue to operate, recirculating the base gasoline through the valve 10 from its outlet to its inlet. Delivery of gasoline from the base pump takes place through a pipe 12 which delivers the gasoline through the base meter 14 which meter may be of conventional type. Such meters record accurately the gasoline delivered therethrough to the precision required by the authorities, but may have a characteristic of recording less than the amount of gasoline flowing therethrough under conditions of low rate of flow. Such errors which are not detrimental to the customer are permitted by the authorities, but are, of course, detrimental to the vendor. As will appear hereafter, a particular preferred type of operation is involved in accordance with the invention with the objective of maintaining a meter of this type operating either at a high rate of flow or at rest in successive intervals to avoid loss to the vendor in connection with the delivery of additive.

From the base meter 14 the gasoline passes to the

delivery hose through piping 18 in which there is located a conventional check valve 16.

A pump 22 for the additive draws its supply of additive from a tank through pipe connection 20. This pump 22 may be of the same type as the base pump 4 and has provided in association with it a bypass 24 incorporating a relief valve 26. Since, as will appear, the quantity of additive required to be bumped is generally substantially less than the amount of base simultaneously pumped to provide the desired mixture, the additive pump may provide flow of additive to several gasoline dispensers and may be operated in response to a demand at any one of them. It may, therefore, not be incorporated in the usual "pump" since it and its driving motor would serve to increase the necessary size of this device. The additive pump 22 delivers additive through line 28 to the meter 30 which may be of the type serving to meter the base. The additive meter 30 is incorporated in the gasoline "pump" inasmuch as it has mechanical connections with other elements therein. Delivery from the meter 30 takes place through piping 32 which includes a metering valve 34 and beyond it a check valve 36, from which piping 38 extends to the delivery hose the construction of which will be described later.

The metering valve 34 is used to control the delivery of additive in proper proportion to the base and is operated as will be later described. This valve may be located as shown in Figure 2 or may be located in connection 28 in advance of meter 30. Or it may be located in the line of flow of the base either in advance of or following meter 14 with mere reversal of direction of its control as will be obvious hereafter.

The solid connecting lines provided with arrows in Figure 2 indicate mechanical connections and these connections are more fully indicated structurally in Figure 1, some of the connections, however, being internal ones within elements hereafter described. The base meter 14 is connected to the base variator 44 (for example, of the type shown in Patent 2,111,996) through mechanical connections indicated at 40 and 42. These connections are conventional, the variator containing the usual settable means for introducing a price and providing an output at 48 to a totalizer indicated generally at 46 in Figure 1 but containing various elements which are separately indicated by boxes in Figure 2. An output connection 50 which physically passes through the base variator is actually a direct connection between the base meter and mechanism for indicating quantity, the inuput in the present instance being to a quantity differential indicated in Figure 2 at 52.

The additive meter 30 provides an ouput at 54 which, by way of a connection 56, feeds an additive variator 58 in which the price per gallon of the additive is inserted to give an output at 64 corresponding to the total price of the additive. A connection at 60 provides to the differential 52 to the output of the additive meter 30. The variators 44 and 58 may be of conventional form and need not be described in detail.

As will appear hereinafter, the inputs from the base meter and additive meter corresponding to the quantities of base and additive, respectively, are fed into a differential 52 which is physically illustrated in Figure 3. This dfferential sums the two quantities and provides an output to the total quantity counter 62 (Figure 1).

The differential 66 is also shown in its physical form in Figure 3 and receives the outputs from the base variator 44 and additive variator 58, these outputs representing the prices of the base and additive which are delivered. These prices are added by the differential and fed to the price counter 68. The total gallons delivered and the price are exhibited through windows in the gasoline "pump" as are also the base price per gallon (at 70) and the additive price per gallon (at 72). Both of these indications will, of course, be associated with suitable descriptive legends on the face of the "pump."

The foregoing indications are all that are required for exhibition to the customer who will be interested in the base price, the additive price, the total gallons, and the total price. Where particular qualities of gasoline are offered, there may also be an indication of the grade, though this, in general, is unnecessary. From the description of the mechanism involved in setting the grade, it will be apparent that the indication may be presented in any one of many arbitrary fashions.

What has been so far indicated in general fashion is all that is involved in indicating to the customer the amount of gasoline he has received and its total price. As will be evident from what has been described, he secures the total of the quantity measured by the base and additive meters, and he will pay the price which is the sum of the prices of the base and additive which he actually receives. What will now be described is the operation involved in securing, at least to a practically close approximation, a proportioning of the base and additive in a predetermined ratio.

The base meter and additive meter, respectively, provide inputs through mechanical connections 74 and 78 to a variable gear-differential assembly which is indicated generally by the numeral 76 and illustrated in detail in Figures 4 and 5. At the present time, it will suffice to say that for a given manual setting of the device 76, it provides an output 80 which controls the metering valve 34 for the additive to maintain its delivery approximately in predetermined proportion to the delivery of base. Assuming that the delivery ends of the connections 18 and 38, as shown in Figure 2, are freely open to the tank of the customer's automobile, it will be evident that the metering valve 34 will control the flow of additive through connection 32 from the additive meter, thereby affecting the operation of the additive meter to provide what amounts to a feedback from the output 80 of the device 76 to one of its inputs 78. This feedback arrangement constitutes one of the important aspects of the present invention which serves to control the desired proportioning of the constituents of the delivered gasoline.

Figure 8 illustrates the desirable arrangement for the direct delivery of the gasoline mixture to the fuel tank of a vehicle. The pipes 18 and 38 are illustrated as connecting at the exterior of the pump housing 2 with a pair of concentric hoses 82 and 84, 82 being exterior and 84 interior. Connected to the delivery end of hose 82 may be the conventional manually controllable delivery nozzle 86 which involves a valve 88 operable by a lever 90 to control delivery through the nozzle proper 92. In accordance with the present invention, the inner hose 84 which delivers additive is connected to a tube 94 in the nozzle 86 which terminates at 96 closely adjacent to the valve 88 to prevent preadmixture in advance of the valve of the base delivered through hose 82 and additive delivered through hose 84. This arrangement in conjunction with the check valves 16 and 36 which prevent reverse flow insures a minimum of commingling of the two constituents prior to actual delivery so that a purchaser does not receive as the result of already mixed constituents in a substantial length of hose a proportioning of the constituents which he does not desire. It will be obvious, of course, that the two delivery conduits could be connected to individual valves controlled simultaneously by a lever such as 90 and delivering to a common outlet. Such refinement, however, is unnecessary through the use of the arrangement just described which permits the utilization of a conventional hose nozzle.

It will, of course, be evident that there may be used in connection with the hose the usual controlling arrangements, for example, such that as the hose is removed from its support the pump motors are started, or providing for automatic closure of the hose valve when the

level of gasoline in the automobile tank rises to a predetermined level, etc.

As will appear hereafter, while the hose valve 88 controls the flow of both constituents, nevertheless, the proportioning is properly controlled by the metering valve 34, and this is the case whether or not the valve 88 is fully open or whether it is so controlled as to throttle the delivery.

Attention may now be directed to Figure 3 which shows details of the differentials 52 and 66 and their connections. As indicated in Figure 1, the connections 40 between the base meter and the lower portion of the variator consist of gears, and the connection 50 in Figure 2 actually consists of a shaft 50 passing through the base variator and driven by these gears and illustrated at the lower portion of Figure 3. Pinned to this shaft is a pinion 98 which meshes with a gear 100 which is freely journalled concentrically with a shaft 60 and supports on a plurality of pins carried with it pinions 104 which mesh with a sun pinion 106 pinned to the shaft 60. Each of the pinions 104 is integrally formed with a second pinion 108, and these pinions 108 mesh with a central pinion 110 which is secured to a gear 112 meshing with a spur gear 113 which is provided with a helical bevel pinion 114 meshing with a driven gear 116 which through spur gearing indicated at 120 serves to drive the counters 62 indicative of total gallons delivered. Considering the operation of the differential 52, one of its inputs through shaft 50 is of gallons of base as measured by base meter 14. The other input to this differential is through shaft 60 which operates in proportion to the gallons of additive measured by the meter 30. Through the suitable choice of gear ratios, as will be evident to anyone skilled in gear design so that these ratios need not be specifically described, the inputs at shafts 50 and 60 are added by the differential to provide an output through the gear 112 and pinion 114 to produce on counters 62 a proper indication of the total gallons of base and additive delivered.

For the information of the gasoline station owner, it is desirable to have a permanent record of all gallons delivered through the dispenser, and for this purpose a helical gear 122 secured to the pinion 113 serves to drive a counter 124 which indicates total gallons. Similar total counters may be connected to the outputs from the base meter and additive meter so as to give a check on the collections by the gasoline station attendants.

The base price input is through the pinion 48 shown at the bottom of Figure 3, which pinion meshes with pinion 126 journalled on vertical shaft 150. To the pinion 126 there is secured a second pinion 128 meshing with gear 130 secured to vertical shaft 132 to which is secured member 134 supporting pins 136 on which are journalled pinions 138 meshing with sun pinion 140 pinned to the shaft 64 which is mounted to rotate within a bore in the upper end of shaft 132. Each of the pinions 138 is integrally formed with a second pinion 142, these pinions 142 meshing with a gear 144 which is journalled upon the shaft 64 and is also journalled in an upper bearing plate of the framework. At its upper end the gear 144 carries a gear 146 which meshes with a pinion 148 pinned to the upper end of a shaft 150. A spiral bevel pinion 152 secured to shaft 150 meshes with a bevel gear 154 to which is secured a spur gear 156 driving through spur gears 158 the total price counters 68.

The devices last described serve to sum the total prices of the base and additive delivered to the customer, the inputs to the differential gearing originating at pinion 48 and shaft 64 and being added in the differential gearing to provide a total output through shaft 150 to the counters 68.

Reference may now be made particularly to Figures 2, 4 and 5 for the mechanism which serves to control the delivery of a substantially predetermined mixture of the base and additive. In Figure 2, the assembly 76 is indicated as comprising a pair of differentials 160 and 162 and a variable gear box designated 164. All three of these devices are assembled in the single unit shown in Figures 4 and 5, the two differentials and the variable gear box being indicated generally in Figure 4 at 160, 162 and 164.

Input shaft 74 driven by the base meter 14 extends through the assembly shown in Figure 4 and has pinned thereto a pinion member 166 which meshes with a plurality of pinions 168 which are individually integrally formed with smaller pinions 170. The pinions 170 mesh with pinion 172 journalled on the shaft 74 and forming part of the mechanical input 78 from the additive meter 30, the input being to gear teeth 78' forming part of the pinion 172. The paired pinions 168 and 170 are mounted on pins 174 secured in a gear 176 which through idler 178 drives a gear 180 which is pinned to a shaft 182 mounted in the supporting frame. The shaft 182 is splined at 184 to pinion 186 which is mounted in a support 188 which may be slid along the shaft 182. The support 188 is provided with an arm 189 which provides a pivotal mounting at 190 for a gear 192 which is constrained to move lengthwise of shaft 182 with the support 188. The gear 192 is arranged to mesh with any selected one of a group of gears 194 the largest of which is specially designated as 194'. All of these gears are journalled for free rotation on the shaft 74 and are constrained to move together by a pin 196 passing through all of the gears of the group.

The largest gear 194' carries pins 198 on which are journalled integrally formed pinions 200 and 202. The former of these pinions mesh with a pinion 204 which is pinned to the shaft 74. The latter pinions 202 mesh with a central pinion 206 which is journalled in the frame and carries a disc 208 which, as will presently be described, forms part of the control 80 for the metering valve 34, as indicated in Figure 2.

Journalled on the shaft 182 is a stirrup 210 which is provided with a slot 214 through which passes a lever 216 connected to the support 188 and adapted to be manipulated to rock this support to move the gear 192 into and out of mesh with gears 194. The stirrup 210 engages a fixed pin 218 under the action of a spring 220 reacting between a pin 222 carried by the stirrup and a fixed pin 224. The action of spring 220 is such as to cause the gear 192 to move into mesh with a selected gear 194 but the stop 218 limits the approach of the gears so as to avoid binding, the slot 214 sloping to insure proper mesh for any selected gear condition.

A coverplate 228 is provided with a slot 226 and through this the lever 216 projects to the exterior of the gasoline "pump." At the side of the slot 226 corresponding to gear meshing the slot is provided with a series of notches 230 in which the lever 216 may rest to determine a particular gear selection. These notches may be properly designated in accordance with the grades of a gasoline to be delivered so that the operator at a glance may slide the lever 216 after producing unmeshing of the gears to a particular notch position whereupon by release of the lever the spring 220 will permit the desired gear meshing to occur. In the event that it is desired not to provide the large number of selections of which the mechanism is capable, there may be provided a blanking out plate secured to the cover 228 to permit meshing to occur only in certain selected gear positions.

The differential and variable gear box arrangement described provides for control of the proportioning of the base and additive constituents of the delivered gasoline as follows:

Assume first, for purposes of understanding, that the disc 208 is held stationary and consider the inputs at 74 and 78'. For particular inputs at 74 and 78' the differential gearing at 160 would produce a particular rate of rotation of gear 192.

On the other hand, the particular input on the shaft 74 would tend also to produce through the meshing of gear

192 with a particular one of gears 194 particular rotation of the gear 192. It will be evident, however, that if the disc 208 was held stationary as assumed, free operation could exist only if the gear 192 was constrained by both inputs to rotate at the same rate. In general, however, arbitrary inputs could not produce this result and, therefore, now assuming disc 208 free to rotate, it would be driven as the result of the inputs and particular selection of meshing of the gear 192 with one of the gears 194. As will be evident from detailed consideration of the gearing in Figure 4, for a particular setting of the change gear arrangement involving the meshing of gear 192 with a selected one of gears 194, the disc 208 can be stationary only for a particular ratio of the inputs to the gearing from the base meter and the additive meter. For any deviations from such a predetermined ratio, the disc 208 will rotate either forwardly or backwardly and such movements are utilized to control the metering value 34 to increase or decrease the flow of additive to maintain the desired ratio of delivery. It may be noted that the gear ratios are desirably so chosen that when gear 192 meshes with the smallest of the gears 194 the disc 208 is stationary for a stationary condition of input gear 78'. This setting, then, provides for zero addition of additive, i.e. delivery of base only when that is called for.

It may be noted that if the disc 208 was locked in position, the gearing would impose constraint on the meters causing them to control the flow of base and additive. However, the meters conventionally employed are not designed to withstand high pressure gradients across them and still record flows accurately, and it is desirable, therefore, to permit the additive meter 30 to operate freely, providing the control of flow of the additive through a throttling valve such as indicated at 34 operated by movement of the disc 208.

It will be obvious that the metering valve 34 could be controlled by some continuously operating direct connection (through gears, sprocket wheels and chain, or the like) from the disc 208 to secure control of flow, but an alternative method of operation is preferred. Militating against the utilization of direct control, there is the characteristic of operation of the type of meter conventionally used at 30, which type of meter is, nevertheless, desirable since it has been found highly satisfactory in the presently used type of dispensing operation and is acceptable to the authorities. The undesirable characteristic is that low rates of flow through such a meter are not accurately measured, the meter indicating less than the actual rate of flow. If the meter 30 was permitted thus to operate, there might occur a serious loss to the gasoline station owner due to the fact that there might be considerable call for rather low percentages of the additive and due to the low rates of flow then involved considerable quantities of the additive might pass the meter 30 without being detected. The loss of this respect could be particularly serious in view of the relatively high price of the additive.

Accordingly, there is preferably adopted an arrangement in which the flow of additive is always either at a high rate or is cut off entirely. When cut off entirely there would be no leakage past the meter 30. On the other hand, at full flow rate the meter 30 will properly register the delivery. Accordingly, the operation which is desirable involves a pulsating type of delivery of the additive, there being short periods of full delivery rate interspersed with periods of no delivery rate, the periods being automatically proportioned so that on the average the required amount of additive is delivered.

To achieve these ends the desirable arrangement for control corresponding to 80 of Fig. 2 is that illustrated in Fig. 7. Pin 232 is carried by the disc 208 and is arranged to move within and act upon a cut-away region 234 in one arm of a triple armed lever 236 mounted on a fixed pivot 238. This arrangement provides a pair of projections 235 and 237 engageable by the pin 232.

A second arm of the lever 236 is provided with projections 241 and 240 embracing pin 242 on arm 244 carried by the stem 246 of the valve 34 which may take the form of a stopcock or involve a vane movable across the valve passage, or the like. The third arm of the lever 236 is provided with a pointed end 248 cooperating with a roller 250 on a lever 252 mounted on a fixed pivot 254 and urged upwardly as viewed in Figure 7 by spring 256.

With the parts in the positions illustrated in Figure 7, the valve 34 is closed, the projection 241 engaging the pin 242 and the lever 236 being held in this position releasably by the detent action of roller 250 on lever 236. Assume now that the gear box setting calls for the delivery of additive. The disc 208 and pin 232 will then move clockwise and will rock the lever 236 without moving the pin 242 until the point 248 of lever 236 passes to the right of roller 250, tensioning the spring 256 in this action. As soon as the last mentioned condition occurs, the roller 250 will act to snap the pin 242 to position to produce full opening of the valve. With the valve remaining open, the pin 232 may continue to move clockwise even beyond the projection 237 until the quantity of additive delivered makes up the deficiency determined by the volume of base delivered. When this occurs, the disc 208 and pin 232 will begin to move counterclockwise and when the pin 232 engages projection 235 rocking of the lever 236 clockwise will occur until point 248 passes to the left of roller 250 whereupon by camming action the lever 236 will be snapped to its extreme clockwise position, snapping the valve 34 to fully closed position. Before this occurs some excess of additive will have been delivered and disc 208 will continue to move until the excess is balanced by delivery of base, whereupon reversal of rotation occurs. Briefly stated, the deviation of the disc 208 from a mean position is constantly a measure of the excess accumulated displacement of one meter over the other taking into account the setting of the gear change mechanism, the direction of the deviation depending upon the sign of the excess.

It will be evident that by suitable proportioning of the parts, the device may be made quite sensitive though consistent with not too rapid frequency of cycling. The proportioning at any instant may be in error to the extent of the delivery or non-delivery of additive through a cycling period, but there may be provided by this arrangement a considerable number of cycles involving the on and off positions of the valve even during the delivery of a single gallon and, since the inherent error is not cumulative, the error in proportioning in the delivery of, say, five gallons will be quite low percentagewise. Thus, while the customer may not obtain precise nominal proportioning of the base and additive, he will nevertheless pay only for what he received due to the fact that both the base and additive are metered and the accumulating mechanism accurately reflects the quantity and price of what is delivered. While, obviously, the opening and closing of valve 34 may be made highly sensitive to slight movements of disc 208 thereby to limit the instantaneous error to a very small value, this would be attended by a high frequency of cycling. To avoid wear, therefore, it is desirable to permit a tolerable instantaneous error with reduction of cycling frequency. It may be noted that "cycling," i.e. delivery of slight excesses and deficiencies of additive will normally occur even if the connection 80 is continuous and direct in controlling the valve. The considerations just mentioned apply, however, the frequency of cycling and magnitude of the instantaneous error depending upon the degree of valve control imparted by a particular movement of disc 208.

As has been noted above, when the gear 192 meshes with the smallest diameter gear 194, the operation will be such that substantially only the base is delivered, the stable condition thus resulting involving a stationary condition of the disc 208. If base alone is called for and the valve 34 is initially open, there will be some

slight amount of additive added to the base before the movement of disc 208 closes the valve, the valve then remaining closed.

The arrangement which has been described takes care of all of the varying conditions of operation which may be imposed by the operator's manipulation of delivery valve 88. Usually, as the automobile tank approaches full condition, the operator will desire to cut down the rate of flow of gasoline into the tank by producing partial closing of valve 88. This, however, will not affect the operation: as the delivery of base is thus throttled (along with throttling by valve 88 of delivery of the additive), the mechanism of Figure 4 will, nevertheless, control the additive to maintain proper average delivery thereof. It is for this reason, in particular, that the dual differential devices 160 and 162 are provided since, obviously, it would not suffice merely to control the rate of delivery of additive without taking into account the rate of delivery of base as well.

It will be obvious from what has been described that operation may be carried out to "fill the tank," to deliver a certain quantity of gasoline, or to deliver a certain value of gasoline, the accumulators 62 and 68 exhibiting entirely conventional readings. Furthermore, there may be added in precisely the same fashion as to present gasoline "pumps" automatic devices for stopping delivery upon attainment of a predetermined quantity or value.

What is claimed is:

1. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, means receiving inputs from both of said metering means and responsive to relative changes in said inputs for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of one of said liquids, a variator settable for a price assigned to one of said liquids receiving an output from the metering means for said liquid and providing an output corresponding to the value of said liquid delivered, a variator settable for a price assigned to the other of said liquids receiving an output from the metering means for the last mentioned liquid and providing an output corresponding to the value of the last mentioned liquid delivered, and means summing said variator outputs and exhibiting the total value of both liquids delivered.

2. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, means receiving inputs from both of said metering means and responsive to relative changes in said inputs for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of the liquid other than that metered by the last mentioned metering means, a variator settable for a price assigned to one of said liquids receiving an output from the metering means for said liquid and providing an output corresponding to the value of said liquid delivered, a variator settable for a price assigned to the other of said liquids receiving an output from the metering means for the last mentioned liquid and providing an output corresponding to the value of the last mentioned liquid delivered, and means summing said variator outputs and exhibiting the total value of both liquids delivered.

3. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, and means receiving inputs from both of said metering means for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of one of said liquids.

4. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, and means receiving inputs from both of said metering means for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of the liquid other than that metered by the last mentioned metering means.

5. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, and means receiving inputs from both of said metering means for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means acting to control delivery of one of said liquids in cycles involving periods of delivery and of interruption of flow of the last mentioned liquid, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of one of said liquids.

6. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, and means receiving inputs from both of said metering means for approximately controlling the ratio of quantities of said liquids simultaneously delivered, the last mentioned means comprising a valve operated cyclically between open and closed positions to control delivery of one of said liquids, the last mentioned means comprising a pair of differentials and a variable gear assembly, one of said differentials receiving inputs from both of said metering means and providing an output to said variable gear assembly, and the other of said differentials receiving one input from one of said metering means and another input from said variable gear assembly and providing an output controlling the flow of one of said liquids.

7. Apparatus for the simultaneous vending of two liquids comprising individual means metering the deliveries of said liquids, each of said individual metering means having an output element measuring the flow metered thereby, means connected to said output elements and responsive to relative changes in the outputs of said elements for controlling the ratio of quantities of said liquids simultaneously delivered, and means also connected to said output elements and settable for prices assigned to said liquids to exhibit the total value of both liquids delivered.

8. Apparatus for the simultaneous vending of two liquids comprising individual means metering the de-

liveries of said liquids, each of said individual metering means having an output element measuring the flow metered thereby, means including change speed gearing connected to said output elements and responsive to relative changes in the outputs of said elements for controlling the ratio of quantities of said liquids simultaneously delivered, and means also connected to said output elements and settable for prices assigned to said liquids to exhibit the total value of both liquids delivered.

References Cited in the file of this patent

UNITED STATES PATENTS

1,961,350 Grunsky ---------- June 5, 1934
1,964,028 Boynton et al. ---------- June 26, 1934
1,985,918 De Lancey ---------- Jan. 1, 1935
2,262,031 Meyer ---------- Nov. 11, 1941
2,641,271 Pressler ---------- June 9, 1953
2,743,843 Bliss ---------- May 1, 1956

FOREIGN PATENTS

463,025 Italy ---------- Apr. 12, 1951