ABSTRACT
The price increment unit used in a multigrade liquid fuel-dispensing apparatus comprises a selective gearing arrangement which causes a driven or output shaft to be driven at various preselected speeds less than or greater than the speed of the driving or input shaft, one such preselected speed for each respective grade of liquid fuel being dispensed, above the pricing base grade. When the pricing base grade is selected for dispensing, the output shaft of the unit is locked against rotation. Means are provided for causing a locking of this output shaft to occur also when a different grade of fuel is selected for dispensing, thereby to establish the price of this different grade at the same number of cents per gallon as the pricing base grade.

8 Claims, 10 Drawing Figures
PRICE INCREMENT UNIT FOR LIQUID-DISPENSING APPARATUS

This invention relates to a liquid-dispensing apparatus, and more particularly to a price increment unit useful in a multi-grade liquid fuel dispensing apparatus.

In my U.S. Pat. No. 2,880,908, dated Apr. 7, 1959, there is disclosed an apparatus for dispensing any one of a number of grades of liquid fuel (e.g., gasoline). This apparatus operates to blend together at the dispensing nozzle, in selected proportions, a relatively low-octane or minimum-octane fuel component (herein termed "lo" gasoline) and a relatively high-octane or maximum-octane fuel component (herein termed "hi" gasoline). In addition to the blends, the apparatus is capable of dispensing either the lo gasoline or the hi gasoline separately, so that in general the number of grades which the apparatus is capable of dispensing is two greater than the number of blends. By way of example only, the apparatus may have a capability of dispensing a maximum of nine grades of gasoline, although it could be set up to dispense a lesser number than this, such as eight grades.

For pricing of the various grades of gasoline, the apparatus includes a price increment unit (termed "selective gearing" in the aforementioned patent) which receives as its input the total volume of gasoline dispensed and provides as an output the product of this total quantity by a monetary figure corresponding to the excess of unit price (price increment) of the gasoline grade being delivered over the unit price of the lowest-priced grade of gasoline (which latter was in prior practice the lo gasoline referred to above). The output of this price increment unit (selective gearing) is then added to the output of a variator (which latter provides a price output corresponding to the multiplication of the total volume of gasoline dispensed by the unit price of the lowest-priced grade of gasoline) to provide a total price indication corresponding to the quantity of gasoline delivered multiplied by the unit price assigned to the grade delivered. In order to properly correlate the incremental price with the grade of gasoline delivered, the price increment unit is reset in each operation of the gasoline-dispensing apparatus concurrently with, and in dependence upon, the setting for control of the grade delivered.

The price increment unit is of a type which may be preset by a gasoline vendor as he sets up his pricing structure, to select the incremental prices of the available grades above the "base" or lowest-priced grade. The price increment unit may be of the type described in my aforementioned patent, comprising a camshaft carrying a plurality of angularly spaced cams, one for each blend of gasoline to be dispensed, plus one for the hi gasoline alone, these cams rotating with the shaft to actuate various idler gears in mesh with various driving and driven gears (one such actuation for each position step of the shaft which corresponds to an individual grade of gasoline to be dispensed). The selection of the particular idler gear to be so brought into mesh is made by the vendor, by sliding each cam along the shaft. For a "nine-grade" dispensing apparatus (that is, an apparatus capable of dispensing a maximum of nine grades of gasoline) there would be eight such idler gears.

Although the cams can be slid independently of each other along the camshaft in order to set the price increments, the order along the camshaft is fixed, since the cams cannot slide past each other. It is also pointed out that the price increment unit provides for adding 1/6-cent increments beginning with 1 cent increment to the price per gallon (over and above the "base" price). This means that, with a price increment unit such as disclosed in my prior patent, the grade-price structure necessarily had to be orderly and regular, with the price per gallon increasing steadily and monotonically from the lo gasoline through the various blends, up to and including the hi gasoline. That is to say, all remaining grades necessarily had to be sold at varying prices above that of the (single) "pricing base" grade.

The general type of selective gearing previously described, including cams for selectively actuating idler gears into mesh with driving and driven gears, etc., is highly desirable and practical for use as a price increment unit in a multigrade liquid fuel dispensing apparatus.

Under some conditions, such for example as when the lo gasoline is a lead-free or unleaded gasoline, a somewhat irregular grade-price structure, i.e., one wherein the price does not increase continuously from the lo gasoline up through the various blends, may be desirable. Specifically, it may be desired to sell the lo gasoline at the same unit price as the first or "lowermost" blend. The term "lowermost" blend means that particular one of the blends which has the minimum content of hi gasoline (but greater than zero, of course, since it is a blend). The lo gasoline might be thought of as a "subpremium" or "special" gasoline, under these conditions. As previously described, the setting up of such a noncontinuous or somewhat irregular grade-price structure is impossible when the price increment unit is constructed and adjusted according to the teachings of my prior patent.

The camshaft of the price increment unit also carries a cam (not slidable along the shaft) for the "base" or lowest-priced grade of gasoline, this cam rotating with the shaft to lock the output or driven shaft of the unit against rotation, rather than to actuate an idler gear into mesh.

According to this invention, the price increment unit is set up or adjusted to make the first or lowermost blend the pricing base grade, so that when this grade is selected for dispensing, the output shaft of this unit is locked; further, means are provided for causing a locking of this same output shaft to occur also when the lo gasoline alone is selected for dispensing. In this way, the lo gasoline is established at the same price as the pricing base grade, that is, at the same price as the first or lowermost blend.

A detailed description of the invention follows, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view, with certain parts partly broken away and in section, of a price increment unit according to the invention;

FIG. 2 is an end view looking at one end of the price increment unit;

FIG. 3 is an end view looking at the other end of the unit;

FIG. 4 is a cross section taken along line 4—4 of FIG. 1;

FIG. 5 is a cross section taken along line 5—5 of FIG. 1;

FIG. 6 is a sectional view generally similar to FIG. 4, but showing the parts in a different operating position;

FIG. 7 is a face view, on an enlarged scale, of a clip member used in the invention;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 5;

FIG. 9 is a sectional view taken along line 9—9 of FIG. 5, but showing the parts in a different operating position; and

FIG. 10 is an isotropic view of an assembled pair of arms used in the price increment unit.

A multigrade liquid fuel dispensing apparatus to which the price increment unit of the present invention is applicable, and of which the said unit may form a part, is disclosed in my aforementioned patent, and also in my U.S. Pat. No. 3,232,484, dated Feb. 1, 1966. For purposes of brevity, the description of the overall arrangement and mode of operation of such apparatus will not be repeated herein. Reference may be made to either of the previously mentioned patents for a full description of the apparatus. Only enough of the overall apparatus will be described herein to set forth how the price increment unit of the present invention functions in such apparatus.

As described in both of my aforementioned patents, an output corresponding to total gallons dispensed is derived from a summing differential and is applied as input to a price increment unit (termed "selective gearing" in the said patents). This input to the price increment unit is represented by a shaft rotation, and the price increment unit provides an output which is also represented by a shaft rotation. As will be described in detail hereinafter, the price increment unit effects the multiplication of the total gallons dispensed by an amount (price increment) corresponding to the excess of the
price per gallon of a grade being dispensed over the price per gallon ascribed to the "base" or lowest-priced grade. As also described in my reference patents, another output from the summing differential, also corresponding to total gallons dispensed, is delivered to a varistor in which is set the price per gallon ascribed to the base or lowest-priced grade of gasoline (which may be thought of as a pricing base gasoline). The output of this varistor then represents the total gallons of both lo and hi gasolines multiplied by the unit price of the base or lowest-priced grade of gasoline.

Again in accordance with the disclosure in my above patents, the price per gallon ascribed to the price increment unit provides one input to a summing-type differential, the other input to which is the output from the varistor, this last-mentioned differential provides its output to a price counter; the price counter is arranged to exhibit through a window arrangement in the apparatus housing the total price of the grade of gasoline dispensed.

The present invention concerns itself with the price increment unit mentioned, and other items directly and intimately associated therewith. Other portions of the dispensing apparatus form no part of the present invention, so need not be described herein. As previously mentioned, the overall arrangement and mode of operation of the dispensing apparatus are described in detail in my aforementioned patents.

Referring now to the individually engaged drawings, a m fabricated unit 116 of my U.S. Pat. No. 2,880,908, carries a helical gear which meshes with a helical gear 11 pinned to an input shaft 2 to drive through this shaft the price increment unit designated generally by numeral 3. The rotation of the vertical shaft mentioned corresponds to total gallons being delivered, so that the rotation of shaft 2 also corresponds to total gallons being delivered; the gearing arrangement just described comprises an input or driving arrangement for the unit 3.

The output of unit 3 is through an output shaft 4 having a bevel pinion 5 secured thereto. Pinion 5 meshes with another bevel gear (not shown) such as the gear 126 of my U.S. Pat. No. 2,880,908, which provides an input to the aforementioned summing-type differential, wherein the output of unit 3 is added to the output from the varistor previously mentioned to provide a total output representative of the total price of the grade of gasoline being dispensed. An escapement-type pawl and ratchet mechanism, comprising a double-ended pawl 6 pivotally mounted on the supporting frame and cooperating with a ratchet wheel 7 integral with pinion 5, limits the rotation of output shaft 4 to one direction only.

The price increment unit 3 comprises a selective gearing arrangement constructed and arranged to add half-cent increments beginning with a 1-cent increment to the price per gallon, and for this purpose driving gears 8 secured to the input shaft 2 are properly graduated in numbers of teeth with, as will be understood, provision for meshing with other (driven) gears having proper numbers of teeth for the priceings desired. For securing the gears 8 to shaft 2, this shaft may be formed with a pair of "flats" which extend throughout its length between the end members of the supporting frame, the drive being by means of hub opening of each gear 8 having matching flats. The longitudinally extending array of spaced gears 8 may be held longitudinally on shaft 2 by means of rigid spacers 9 between adjacent gears, and a strong coiled compression spring 10 between the two adjacent central gears of the array may urge each half of the array toward a respective opposite end member of the frame. The price increment unit 3 has a capability of adding increments of one through twelve cents in half-cent steps, which means that there are 23 gears 8.

Twenty-three pairs of spaced, parallel arms 11 are journaled on a pivot shaft 12, each pair of arms mounting for rotation therewith a respective idler gear 13 each of which operates between a respective one of the driving gears 8 and a respective one of the driven gears 14, to be later referred to. All of the idler gears 13 have the same number of teeth. Each of the idler gears 13 is adapted to be selectively brought or actuated into mesh with a corresponding one of the driving gears 8 and also with a corresponding one of the driven gears 14. The driven gears 14 are all secured to the output shaft 4.

Between each pair of arms 11 there is mounted a leaf spring 15 (see FIG. 4), which has a looped central portion 16 surrounding the pivot shaft and pivoted end 17. The leaf spring 15 is arranged into engagement with respective opposite sides of a plate-like lug 17 opposite ends of which are secured to respective ones of the two paired arms 11, and, between one of its end portions and central portion 16, an outwardly bowed portion 18 which can serve as a cam follower. Each leaf spring 15 provides a bias which tends to disengage a corresponding idler 13 from the corresponding gears 8 and 14, but when the portion 18 of a spring 15 is pushed inwardly or upwardly in FIG. 4 by means of a cam hereinafter described, the end of spring 15 remote from portion 18 pushes against lug 17 to rotate the corresponding pair of arms 11 in the counterclockwise direction (viewed in FIG. 4) about pivot shaft 12, thereby to actuate the corresponding idler gear 13 into engagement with its respective driving gear 8 and driven gear 14.

A camshaft 19 extends parallel to shaft 12 and has spined thereon a group (eight in number, for a total capacity of eight grades of gasoline in addition to the pricing base or lowest-priced grade) of cam collars 20 which are individually provided with integral cam projections 21 arranged to engage, respectively, corresponding pairs 18 of the leaf springs 15. The cams 20, together with another cam 22 which will be later particularly referred to, are spaced at 40° intervals about the shaft 19, so that when this shaft is rotated in 40° steps there will at any one time be engaged with a follower (leaf spring 15) only one of the cams 21 or 22. The cams 21 and 22 all rotate with the shaft 19. See FIG. 5.

The eight cam collars 20 (but not the cam 22, which latter is pinned to shaft 19, as illustrated) are arranged to be manually slid or adjusted lengthwise along the spined shaft 19. For this, each cam collar 20 is fixedly secured, as by means of opposite, paired integral shoulders provided on each collar, between the outstanding arms of a respective U-shaped member 23, the bases of all the members 23 being slidably mounted on a common elongated support plate 24 whose upper edge may be seen in FIG. 1. Detenting means for each member 23 are provided effective at half-cent intervals along the support plate 24, each of these detenting means comprising a generally U-shaped spring 25 having its two ends secured respectively to the two arms of a corresponding "U" and having an outwardly extending central portion adapted to snap into one of 23 holes (see FIG. 1) provided at half-cent intervals along the support plate 24. Thus, each one of the members 23 may be releasably retained at a selected location along support plate 24. There are of course eight members 23, one for each of the eight cam collars 20.

As previously mentioned, each of the idler gears 13 is adapted to be selectively (the selection being made by the location of the cam collars 20 along the shaft 19, as well as by the rotational position of the shaft itself) brought or actuated into mesh with a corresponding one of the driving gears 8 (previously described) and also with a corresponding one of the driven gears 14. These latter are all secured to the output shaft 4. For securing the gears 14 to shaft 4, this shaft may be formed with a pair of flats which extend throughout its length between the end members of the supporting frame, the central hub opening of each gear 14 having matching flats. The longitudinally extending array of spaced gears 14 may be held longitudinally on shaft 4 by means of rigid spacers 26 between adjacent gears, and a strong coiled compression spring 27 between the two adjacent central gears of the array may urge each half of the array toward a respective opposite end member of the frame. There are of course 23 gears 14, corresponding to the 23 gears 8.

The steps in the gearing of the price increment unit 3 are such that half-cent increments may be added, beginning with a 1-cent increment to the base price per gallon. The arrangement is such that when any collar 20 is manually positioned to
At the tail end of arms 31 (this is, at the end thereof opposite to the shaft 12 end), a plate-like dog 32 is secured between the two spaced, parallel arms. Upon rotation of the arms 31 in the counterclockwise direction (viewed in the direction of FIG. 3, or in the same direction as that indicated by section lines 4—4), the dog 32 engages between teeth of a gear 33 secured to the output shaft 4 to lock this shaft in fixed position when a pricing base gasoline is being delivered, the delivery of this base gasoline corresponding to the position of shaft 19 at which cam 22 engages the cam follower portion of the spring 15 which is between arms 31. Without this locking arrangement, the shaft 4 would be free to rotate out of control, and thus involve improper or dangerous operation with respect to the differential to which this shaft is geared. What the locking amounts to is, in effect, a zero input to this summation-type differential from the input or driven shaft 4, despite the rotation of the input or driving shaft 2. In FIGS. 4 and 5 the price increment unit 3 is illustrated in the above-described "output-locked" position, which is its position when the pricing base gasoline is being dispensed. It will be appreciated, from what has been stated above, that in this latter position a "zero" price increment is provided by the price increment unit 3.

A timing mark is provided on the timing gear 28, to indicate from the exterior of the unit 3 the angular position of this gear (and of shaft 19, to which cam 22 and gear 28 are both pinned) at which cam 22 engages the spring 15 which is between arms 31. This mark may comprise a hole 34 in the gearwheel 28, which comes into alignment with a hole 35 in the right-hand end member of the frame when gear 28 is rotated to a position such as to cause engagement of cam 22 with the spring 15 which is between arms 31.

According to the present invention, the first or lowermost blend is made the pricing base gasoline, rather than the low gasoline itself being such base. This means that, according to the present invention, the locking of output shaft 4 in the above-described manner is made to occur upon the rotation of the grade selecting shaft (previously referred to) to a position such as to select this lowermost blend for dispensing. It is stated here, by way of example, that if a total of eight grades of gasoline could be dispensed by the apparatus, this base gasoline (blend) would have a composition of 6 parts to gasoline and 1 part of hi gasoline or six-sevenths lo and one-seventh hi.

To make the first or lowermost blend the pricing base, the price increment unit 3 is initially adjusted in the following way. The grade-selecting shaft (previously referred to) is rotated to a position appropriate for the dispensing of the first or lowermost blend. Then, idler gear 29 is removed from its shaft 30 (so as to uncouple the gearing between the grade-selecting shaft and camshaft 19), following which the camshaft 19 is rotated to a position (as indicated by the alignment of the timing holes 34 and 35) such as to bring the locking cam 22 to its operative position, illustrated in FIGS. 1 and 5. Thereafter, the idler 29 is replaced on its shaft 30 (to recouple the gearing between the grade-selecting shaft and camshaft 19).

Once the positional adjustment described in the preceding paragraph has been made, the "pricing base" position of the camshaft illustrated in FIGS. 1 and 4 corresponds to the first or lowermost blend position of the grade-selecting shaft, that is, to the position appropriate for the dispensing of this blend by the dispensing apparatus. To change from this position to the position appropriate for the dispensing of solely lo gasoline, a 40° counterclockwise (viewed as in FIG. 4, or from the right-hand or FIG. 3 end of the price increment unit) rotation of camshaft 31 which is the right-hand (in FIG. 1) collar 20a (with its projection 21a, FIG. 4) becomes the one which would correspond to the lo gasoline, which is to say that when the grade-selecting shaft is rotated to a position appropriate for the dispensing of solely lo gasoline, the cam projection 21a would be in a position to be operative with respect to a cam follower portion 18 of one of the springs 15. This is the position illustrated in FIG. 6.
According to this invention, the collar 20a is slid along support plate 24 all the way to the right, as illustrated in FIG. 1, so that it is immediately adjacent the nonadjustable cam 22 and in a position otherwise appropriate for the adding of a 12-cent increment. However, it does not when operative add this increment, but instead produces a locking of output shaft 4, for a zero increment, as will be explained. The locking of the output shaft 4, for a zero increment, causes the unit price of the base gasoline to be exactly the same as that of the pricing base gasoline (which latter, as previously described, has been made the first or lowermost blend).

A clip member 36, shown in face view in FIG. 7, is inserted between the two arms 31 which carry the locking dog 32, as illustrated in FIGS. 5 and 9. Member 36 extends at a small angle with respect to the vertical when mounted, and is located between the locking gear 33 and input shaft 2. At its lower end, clip 36 has a narrow bifurcated tang portion 37 (bifurcated by means of a slot 38) which is adapted to enter the space between the two arms 31, the bifurcated construction and the slot serving to make this part of the clip somewhat resilient such that the clip can be readily pushed down from above unit 3 to cause its lower end to enter into the space between arms 31. At its lower end, one of the two times of the tang 37 (to wit, the time which is adjacent the right-hand one 11a of the two most right-hand arms 11) is formed with a beveled surface 39 terminating in an upwardly facing abutment 40. As illustrated, this abutment 40 is adapted to engage the lower edge face of the left-hand (in FIG. 1) one of the two arms 31.

At its upper end, clip 36 is of increased width, the boundary between this upper (wider) portion and the tang portion 37 being defined by a narrow downwardly facing abutment 41 at one side of the clip and a wider downwardly facing abutment 42 at the other side of the clip. The abutment 41 is adapted to engage the upper edge face of the right-hand (in FIG. 1) one of the two arms 31. The wider abutment 42 is adapted to engage the upper edge face of the left-hand one of the two arms 31, and also to extend over into the path of movement of the right-hand one 11a of the two most right-hand arms 11. It will be recalled that this latter movement is generally upwardly, or counterclockwise in FIG. 4. The distance between abutments 40 and 42 is quite closely equal to the dimension, measured in a substantially vertical direction, of the arms 31, since abutment 40 engages the lower edge face of one of these arms and abutment 42 engages the upper edge face of this same arm.

When the dispensing apparatus is adjusted by means of the grade selecting shaft to dispense solely base gasoline, the camshaft 19 in the price increment unit described is rotated to an angular position such as to bring the cam projection 21a on cam collar 20a (the most right-hand cam collar in FIG. 1) into engagement with the cam follower-spring which is between the most right-hand pair of arms 11, including arm 11a (this has been described previously). This is illustrated in FIGS. 5 and 9. This causes this most-right-hand pair of arms 11 to rotate about shaft 12 in a counterclockwise direction (viewed as in FIG. 6), resulting in a generally upward movement of the main body of this pair of arms. As arm 11a moves upwardly, it comes into contact with the abutment 42 of clip 36, moving this clip upwardly. See FIG. 9. As viewed in FIG. 9, the engagement of abutment 40 thereon with the lower edge face of the left-hand one of the pair of arms 31 causes the arms 31 to move upwardly, also. The movement of arms 31 upwardly (which is to say, the rotation of these arms in the counterclockwise direction about shaft 12) causes the dog 32 to engage the teeth of gear 33 to lock the output shaft 4, just as happens when arms 31 are rotated counterclockwise by the action of cam 22. Thus, when the dispensing apparatus is adjusted to dispense solely base gasoline, the output shaft 4 is locked by the operation of cam projection 21a, clip 36, etc., in the manner just described. This provides a zero price increment from unit 3 under these conditions, just as in the case of dispensing of the pricing base gasoline and that the unit price of the lo gasoline is established at the same moneta-
3. Arrangement according to claim 1, wherein said locking means comprises a toothed gear secured to said driven shaft, a rigid dog member adapted to be moved into and out of the space between two adjacent teeth of said gear, and means responsive to the rotation of said selecting shaft to said first position to move said dog member into said space.

4. Arrangement defined in claim 3, wherein the means utilizing in part said locking means comprises a separate means responsive to the rotation of said selecting shaft to said second position for causing movement of said dog member into said space.

5. Arrangement of claim 4, wherein said first and said second preselected angular positions comprise adjacent step positions in the stepwise rotation of said selecting shaft.

6. Arrangement according to claim 1, wherein said locking means comprises a toothed gear secured to said driven shaft, a rigid dog member adapted to be moved into and out of the space between two adjacent teeth of said gear, and cam means driven by said selecting shaft, and responsive to the rotation of said selecting shaft to said first position, for moving said dog member into said space.

7. Arrangement defined in claim 6, wherein the means utilizing in part said locking means comprises a separate cam means driven by said selecting shaft, and responsive to the rotation of said selecting shaft to said second position, for causing movement of said dog member into said space.

8. Arrangement of claim 7, wherein said first and said second preselected angular positions comprise adjacent step positions in the stepwise rotation of said selecting shaft.

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