Aug. 18, 1942. T. M. GUNN 2,293,257

LIQUID STREAM PROPORTIONING DEVICE

Filed Oct. 22, 1938 3 Sheets-Sheet 1

Fig. 1.

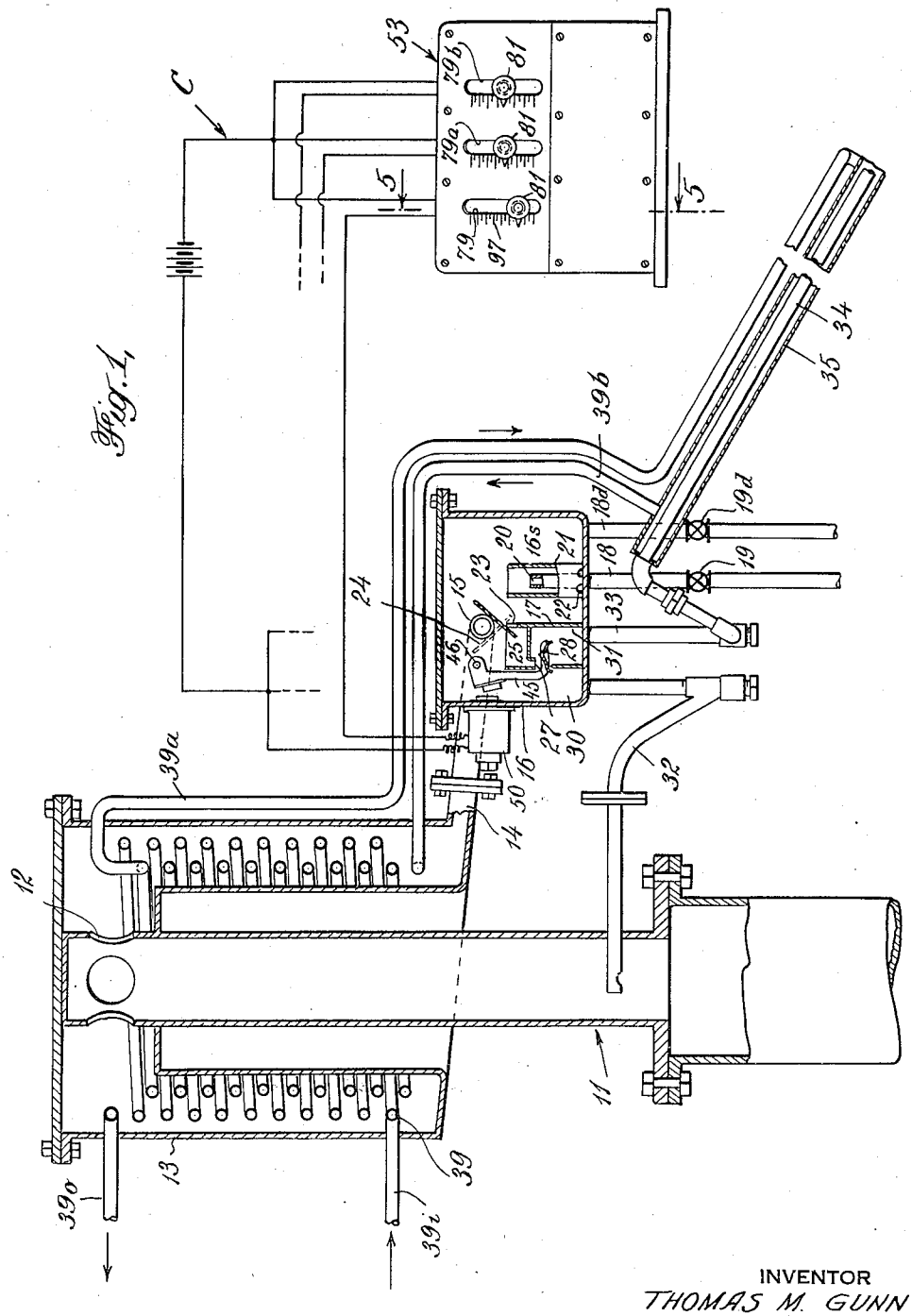

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Fig. 2,

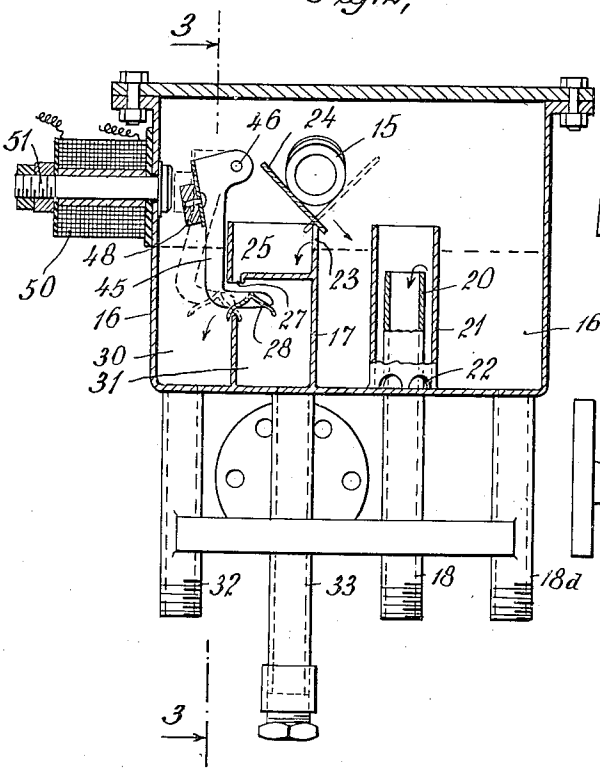

Fig. 3,

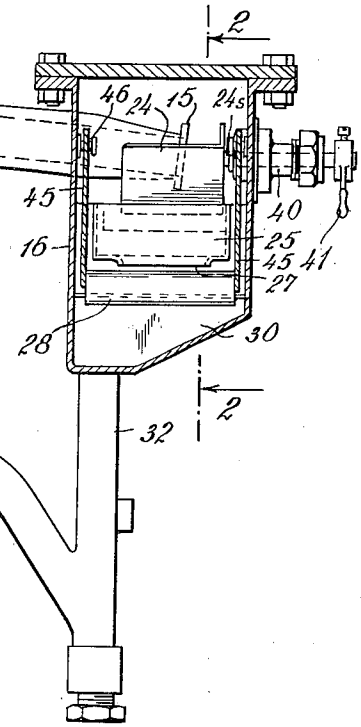

Fig. 4,

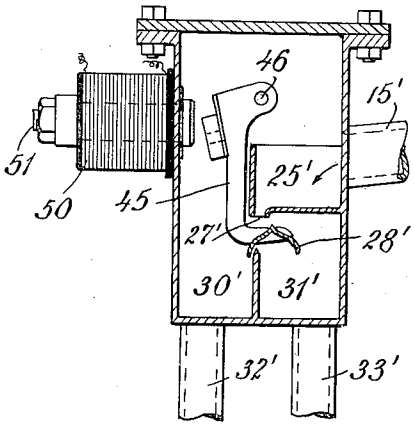

Fig. 8,

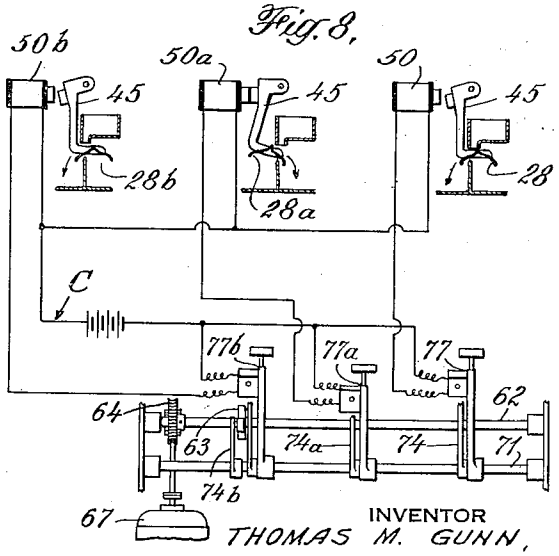

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Fig. 5,

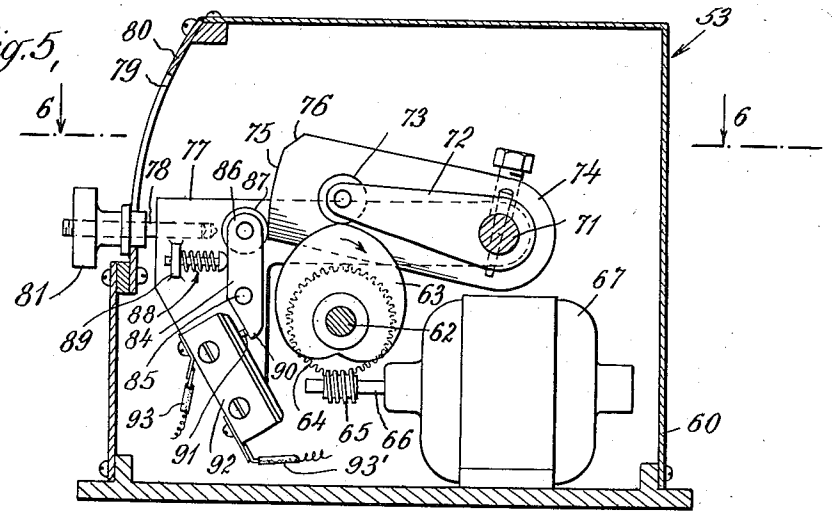


Fig. 6,

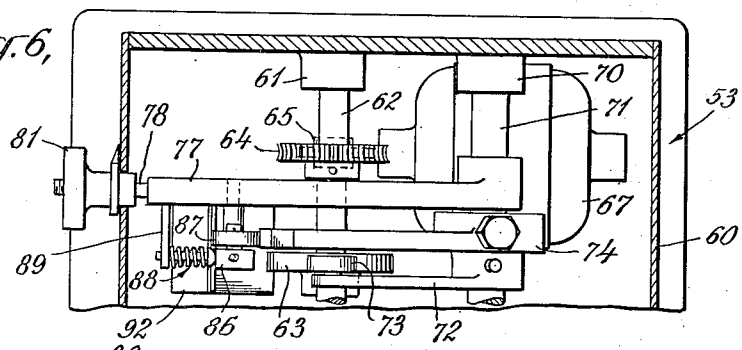
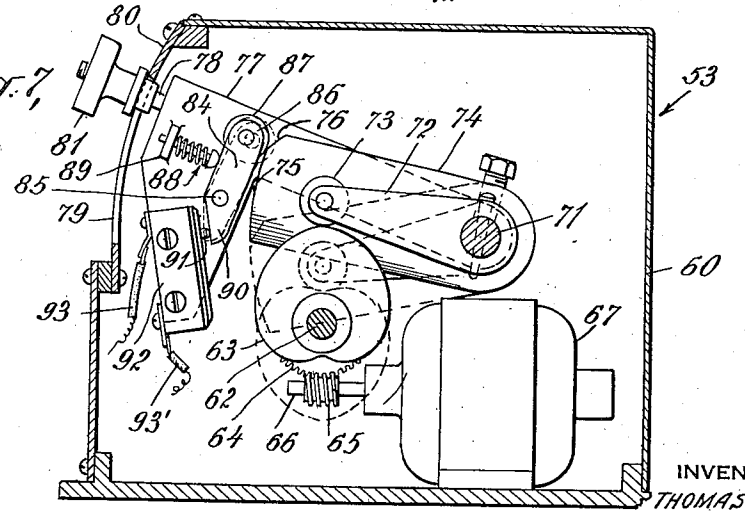


Fig. 7,



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UNITED STATES PATENT OFFICE

2,293,257

LIQUID STREAM PROPORTIONING DEVICE

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Application October 22, 1938, Serial No. 236,437

6 Claims. (Cl. 137—78)

This invention has to do in a general way with devices for accurately dividing a free flowing stream of liquid into two separate streams each of which carries a predetermined proportion of the main stream. The device of the present invention, which has numerous applications in plant and laboratory operations that will be apparent to those skilled in the art, was designed especially for use in the operation of a still unit wherein it may be desired to return various proportions or all of the condensate to the tower or column as reflux, changing the conditions of operation as need be.

In accomplishing the division of a flowing stream such as is obtained, for example, in a distilling unit of the general character above referred to it has heretofore been common practice to use a dividing weir box so built that the condensate passes over a weir in which the stream is split by a partition into two streams, one going to reflux and the other to draw-off. By adjusting the position of the partition the proportion of liquid going to either side thereof may be varied. Devices of the above character, which are made in various forms, are subject to certain inaccuracies. The stream over the weir may not be uniform because of an out of level condition of the device or because of end contraction of the stream passing over the weir or because of fluid friction on the sides of the weir box. When the flow over the weir is small, these effects are exaggerated and capillarity creates an increasing effect, distorting the stream. Errors arising out of the above causes, particularly in the event the stream is small as in cases of laboratory or semi-plant size equipment, sometimes become so great as to defeat the purpose of the apparatus.

In my copending application, Serial Number 165,339, filed September 23, 1937, I have described a device for effecting the proportionate division of a small stream of liquid by intermittently directing all of the stream into two separate paths or conduits. This division of the stream is effected by using a deflector member which, in the device of my copending application, is mechanically swung back and forth by a cam and rocker mechanism associated with the deflector.

It is a primary object of the present invention to provide an improved liquid stream proportioning device of the general character disclosed in my copending application which has several advantages over my prior invention.

It is one important feature of this invention that the deflector member is electromagnetically actuated, and through such action I am able to make the deflector unit compact and light in construction so that it may be supported on any conventional piece of apparatus without necessitating changes or alterations in design to carry additional weight. Thus the proportioning device can be located at a point on the tower of a distilling unit in such manner that the reflux can be delivered into the column or tower by gravity, thereby avoiding the necessity of a reflux pump.

The elimination of mechanical parts attached to the proportioning device, as well as the elimination of the reflux pump, reduces the mass of material with which the stream must come in contact and thus permits more nearly adiabatic conditions to be maintained where such conditions are desirable and assures the liquid measured by the device being actually returned as reflux rather than a mixture of liquid and vapor.

It is a further object of the device contemplated by this invention to provide adjustment means whereby the relative amounts of the stream going into the two sub-streams can be readily and accurately changed from time to time to meet varying conditions. It is another important feature of this device that the control or adjustment for varying the stream division may be located at some remote point and further that a single unitary control can be used in connection with a battery of stream proportioning units, the operation of which can be controlled independently of one another. The details in the construction of certain preferred embodiments of my invention, together with other objects attending its production will be best understood from the following description of the accompanying drawings which are chosen for illustrative purposes only and in which:

Figure 1 is a fragmentary view with parts in section showing the upper end of a column and condenser unit with one preferred embodiment of my invention associated therewith;

Figure 2 is an enlarged sectional elevation of the stream-deflecting unit shown in Figure 1, such section being taken along the line 2—2 of Figure 3;

Figure 3 is a sectional elevation along the line 3—3 of Figure 2;

Figure 4 is a sectional elevation taken in the same general plane as Figure 2 but showing a modified form of stream-deflecting unit;

Figure 5 is a sectional elevation taken in the plane represented by the line 5—5 of Figure 1 and illustrating a preferred form of automatically controlled switch which may be used to en-

ergize intermittently the electromagnet which actuates the stream deflector;

Figure 6 is a plan section taken in the plane represented by the line 6—6 of Figure 5;

Figure 7 is a sectional elevation similar to Figure 5 but showing the switch-control in its other extremity of adjustment; and

Figure 8 is a diagrammatic view illustrating the manner in which a battery of stream proportioning devices may be controlled from a single time-switch unit.

More particularly describing the invention as herein illustrated with particular reference to Figure 1, reference numeral 11 indicates the upper end of a tower or column from a still, not shown, the top of the column having outlet ports 12 communicating with the interior of condenser cell 13. The condenser cell 13 has a discharge connection 14 which communicates through a nozzle 15 with the interior of what I may term a stream-proportioning box 16.

The particular box 16 shown in Figure 1 is designed especially for use in steam-distilling operations where it is desired to effect a separation between the condensed water and the condensed distillate prior to division of the distillate stream. For the purpose of effecting such separation the condensate entering the box through the nozzle 15 is diverted into a settling chamber 16s formed by a partition member 17 across the box. This settling chamber has a discharge conduit 18 provided with a valve 19, the upper end 20 of such conduit extending well up into the settling chamber and being surrounded by seal-sleeve 21 which has inlet ports 22 situated adjacent the bottom of the chamber. This settling chamber is of such capacity as to permit separation of the water from the distillate and the valve 19 is adjusted so that the water may be constantly drawn off, the distillate flowing through a notch 23 in the partition 17 into a head chamber 25. It is from this head chamber that the proportionate division of the stream takes place. The details in its construction and operation will be hereinafter more fully described in connection with Figures 2 and 3. Suffice it to say at this time that the liquid entering the head chamber 25 discharges through a port 27 onto a deflecting member 28 which is actuated back and forth to direct the flow into separate chambers 30 and 31. The chamber 30 in the set-up as shown receives reflux condensate which is conducted through conduit 32 back into the tower 11 and the chamber 31 receives draw-off condensate which is conducted through conduit 33 into a jacket draw-off conduit 34. The jacket 35 surrounding the draw-off conduit 34 is part of the coolant circulating system.

This last-mentioned circulating system is comprised of a cooling liquid coil 39 situated in the condensate chamber 13, such coil having an inlet 39i. At the top of the chamber 13, the cooling coil connects with a conduit 39a which in turn leads into the lower portion of the jacket 35 from which the cooling liquid discharges into a conduit 39b which leads to the condenser chamber and finally has its outlet through the connection 39o. It is to be understood, of course, that the condenser and cooling circulating system just described forms no part of the present invention but serves merely to illustrate more clearly one environment in which the invention may be used.

The separating chamber 16s is provided with a drain connection 18d which has a valve 19d whereby its contents may be completely drained from time to time.

In the event steam is not being used in the distilling operation it is not necessary to divert the condensate into the separating chamber 16s, and to take care of this situation the diverting plate 24 is mounted upon a shaft 24s which in turn is supported in a packing gland 40 and is provided at its outer end with a handle 41 whereby the plate 24 may be adjusted to the two alternative positions shown. This deflector plate adjustment (24s—41) is best illustrated in Figure 3.

Referring now to Figures 1 to 7 inclusive for the details in the mechanism for actuating the deflector plate 28, reference numeral 45 indicates an open frame pivotally supported by the upper side members of the box 16 as indicated at 46 for swinging movement from the full line position shown in Figure 2 into the broken line position shown in that figure. The upper end portion of the frame 45 is provided with a cross member 48 of magnetically responsive material such as soft iron, and the frame and deflector unit with the cross member 48 are so formed and arranged as to normally assume a position by the action of gravity corresponding to that shown in full lines where the discharged liquid from the port 27 is directed into the reflux chamber 30. For the purpose of drawing the frame and its deflector member from the full line position of Figure 2, I provide the upper portion of the end of the box 16 with an electromagnet 50 which is supported thereon in any suitable manner, such as by means of a bolt 51. This electromagnet is connected in an electric circuit which, as illustrated in Figures 1 and 8, includes a control time-switch unit generally indicated by reference numeral 53.

The details in the construction of a preferred form of time-switch unit contemplated for use in this invention are illustrated in Figures 5 to 7 inclusive, where reference numeral 60 indicates the switch box or housing which contains the switch or switches and the switch control mechanism. Mounted across the box 60 and supported in journals indicated at 61 is a rotatable cam shaft 62 which carries a cam 63. The cam shaft 62 is shown as being provided with a worm gear 64 which engages a worm 65 mounted upon the shaft 66 of a motor 67.

Also mounted across the box 60 in journals 70 is what I may term a "rocker shaft" 71. Keyed to this shaft is a cam follower 72, the free end of which is provided with a roller 73 engaging the cam 63. Also keyed to the shaft 71 is a "rocker arm" 74 or a plurality of such rocker arms (74a and 74b of Fig. 8) the free end or ends 75 of which are curved on an arc concentric with the rocker shaft 71, the portion thereof indicated at 76 being cut away. Mounted upon the shaft 71 for free swinging movement about the axis of the shaft and of the rocker 74 is a switch-supporting arm 77 the free end of which is provided with a threaded pin 78 extending through a slot 79 in a curved face plate 80 on the box. The extending end of the pin 78 is provided with a thumb nut 81, and through the medium of this thumb nut and its associated pin 78 the switch-supporting arm 77 may be set at any point through the length of the slot 79 from the position shown in Figure 5 to that shown in Figure 7.

Mounted upon the face of the switch-supporting arm 77 in opposed relation to the curved free end 75 of the rocker is a switch-actuating lever member 84 which is carried by a pivot pin 85.

The end 86 of this lever member is provided with a roller 87 adapted to engage the end 75 of the rocker, the lever being biased toward the rocker by a pin-compression-spring assembly 88 carried by a lug 89 on the face of the arm 77. The other end 90 of this lever member is positioned so as to engage and depress the actuating pin 91 of a switch member generally indicated by reference numeral 92. The switch member 92 is preferably a one-way type of short throw switch such as a switch of the "micro type," and when closed (by depression of the pin 72 with the arm 90 in the present embodiment) it establishes contact between the conductors 93 and 93'.

With the parts arranged in the manner shown in Figure 5 it will be seen that the roller 87 is engaged by the nose 75 on the rocker, such engagement moving the lever 84 against the action of the compression spring 88 a sufficient distance to permit the opening of the switch 92. As the cam rotates in the direction of the arrow A, the follower arm and the rocker will both ride downwardly by their own weight, and with the adjustment shown when the cam has rotated through 180° the rocker will have dropped to a point at which the roller 87 will momentarily be forced backward into the notch 76, thus permitting the switch button 91 to be momentarily depressed by the action of the compression spring 88.

In the upper position of adjustment shown in Figure 7, where the thumb screw and pin 78 are located in the uppermost portion of the slot 79, it will be seen that the roller 87 is only momentarily engaged by the nose of the rocker when the cam is in the position shown in the full lines in Figs. 5 and 7. For the remainder of the cam travel, in the adjustment of Fig. 7, the rocker is out of engagement with the roller and the switch is held closed by the action of the compression spring assembly.

For the adjustment shown in Figure 5 the electromagnet 50 which is energized by closure of the switch 92 is momentarily energized to swing the deflector member (Figure 2) to the broken line position during only a small fraction of the interval of one cam rotation. For the position shown in Figure 7 the circuit through the electromagnet is broken to release the deflector member and permit its assuming the position shown in full line of Figure 2 during only a small fraction of one cam rotation. Thus for the adjustment of Figure 5 substantially all of the liquid entering the head chamber 25 will be deflected into the reflux chamber 30 and for the adjustment shown in Figure 7 substantially all of the liquid stream will be deflected into the draw-off chamber 31. For adjustments between these two extremes it will be seen that any desired division of the fluid stream can be made, and the face of the slot plate 80 is shown as being provided with graduations indicated at 97 whereby the operator can set the adjustment or adjustments for making any desired separation or division of the stream or streams.

As has been previously pointed out, it is one important feature of this invention that an entire battery of deflector members may be operated and controlled from a single control box. In this regard it will be noted that the face plate 80 of the switch control mechanism 53 in Figure 1 is shown as being provided with three slots 79, 79*a* and 79*b*, through each of which extends a pin and thumb nut assembly of the type hereinabove described. The switch-carrying arms associated with these pin and thumb nut assemblies are all associated with corresponding rocker arms on the shaft 71, the switch arm in each case being freely supported by the shaft 71. Such an arrangement is diagrammatically illustrated in Figure 8, which shows the two shafts, 62 and 71, the switch-supporting arms being indicated in such figure by reference numerals 77, 77*a*, and 77*b* and the corresponding rocker arms being indicated by reference numerals 74, 74*a* and 74*b*. The three deflector members which are actuated by these switches are indicated in Figure 8 by numerals 50, 50*a*, and 50*b*. The electric circuit whereby the magnets are energized through their respective switches is indicated in both Figures 1 and 8 by the letter C.

The modified form of flow box shown in Figure 4 is designed for use in operations where steam distillation is not employed. The construction and operation of the deflector unit shown in Figure 4 is identical with that shown in Figure 2, and the elements thereof are indicated with the same reference numerals distinguished by the prime mark. In the form of box shown in Figure 4 the condensate enters the head chamber 25' directly through a condensate inlet connection 15'. The deflector member 28' is actuated in the same manner as the deflector member 28 to divert the entire stream discharged into two receiving chambers 30' and 31' from which it is discharged through conduits 32' and 33' respectively.

It is to be understood that while I have herein described my invention in connection with a distillation unit for the purpose of effecting a division of the condensate between a reflux stream and a draw-off stream, the invention is not in any way limited to this particular field of use but will find numerous other applications which will be apparent to those familiar with the art. It is also to be understood that while I have herein described and illustrated one preferred form of deflector mechanism and one preferred form of time-switch and time-switch adjustment, that the invention is not limited to the precise details of construction herein described and illustrated but includes within its scope whatever changes and modifications fairly come within the spirit of the appended claims.

I claim:

1. In combination with a plurality of stream-proportioning devices, each of which has a deflector member shiftable to and from two alternate positions for directing each stream to be proportioned along two separate paths, means for independently actuating said deflector members embodying: means normally biasing each deflector toward one of its positions; an electromagnet associated with each deflector and operable when energized to swing the corresponding deflector to its other position and unitary means for periodically energizing said magnets independently of one another comprising a rocker shaft, rockers on said shaft corresponding in number to the number of electromagnets, a switch associated with each rocker and adapted to be intermittently actuated thereby, means supporting each switch in predetermined angular relation to the region of movement of the corresponding rocker, a circuit connecting each switch with the corresponding electromagnet and a source of electrical energy, cam means operable to impart continuous rocking movement to said rocker shaft, and adjustment means for independently moving the switch support with respect to the rocker arm.

2. In a stream proportioning device, a sealed

container, a division plate therein, discharge means above said plate, deflector means including a baffle for directing a stream from said discharge means to one side or the other of said plate, said deflector means being attached for pivotal movement at a position high in said container, an armature on said deflector means acting normally as a weight to bias said deflector means to cause the same to direct a stream to one side of said plate, electro-magnetic means mounted outside said chamber and having a core extending therein to cooperate with said armature, and means for intermittently energizing said electro-magnetic means to bias the deflector means to discharge to the other side of said plate.

3. In a stream proportioning device, a sealed container, a division plate therein, discharge means above said plate, deflector means including a baffle for directing a stream from said discharge means to one side or the other of said plate, said deflector means being attached for pivotal movement at a position high in said container, an armature on said deflector means acting normally as a weight to bias said deflector means to cause the same to direct a stream to one side of said plate, said armature being mounted adjacent said pivot point, electro-magnetic means mounted outside said chamber and having a core extending therein to cooperate with said armature, and means for intermittently energizing said electro-magnetic means to bias the deflector means to discharge to the other side of said plate.

4. In a stream proportioning device, a sealed container, a division plate therein, discharge means above said plate, deflector means including a baffle for directing a stream from said discharge means to one side or the other of said plate, said deflector means being attached for pivotal movement at a position high in said container, an armature on said deflector means acting normally as a weight to bias said deflector means to cause the same to direct a stream to one side of said plate, electro-magnetic means to cooperate with said armature, and means for intermittently energizing said electro-magnetic means to bias the deflector means to discharge to the other side of said plate.

5. In combination, a plurality of stream proportioning devices, each of which has a deflector means shiftable to and from two alternate positions for directing each stream to be proportioned along two separate paths, electro-magnetic means associated with each of said deflector means for independently shifting the same, independently adjustable timing means associated with each of said electro-magnetic means, and a single means for operating all of said time control devices.

6. In combination, a plurality of stream proportioning devices, each of which has a deflector means shiftable to and from two alternate positions for directing each stream to be proportioned along two separate paths, electro-magnetic means associated with each of said deflector means for independently shifting the same, independently adjustable timing means associated with each of said electro-magnetic means, and a single means for operating all of said time control devices, said timing means being adjustable during operation of said last named means.

THOMAS M. GUNN.