July 2, 1940. E. ROBERTS 2,206,237

AFFINATION APPARATUS FOR TREATING SUGAR

Filed June 5, 1936 2 Sheets-Sheet 1

Fig. 1.

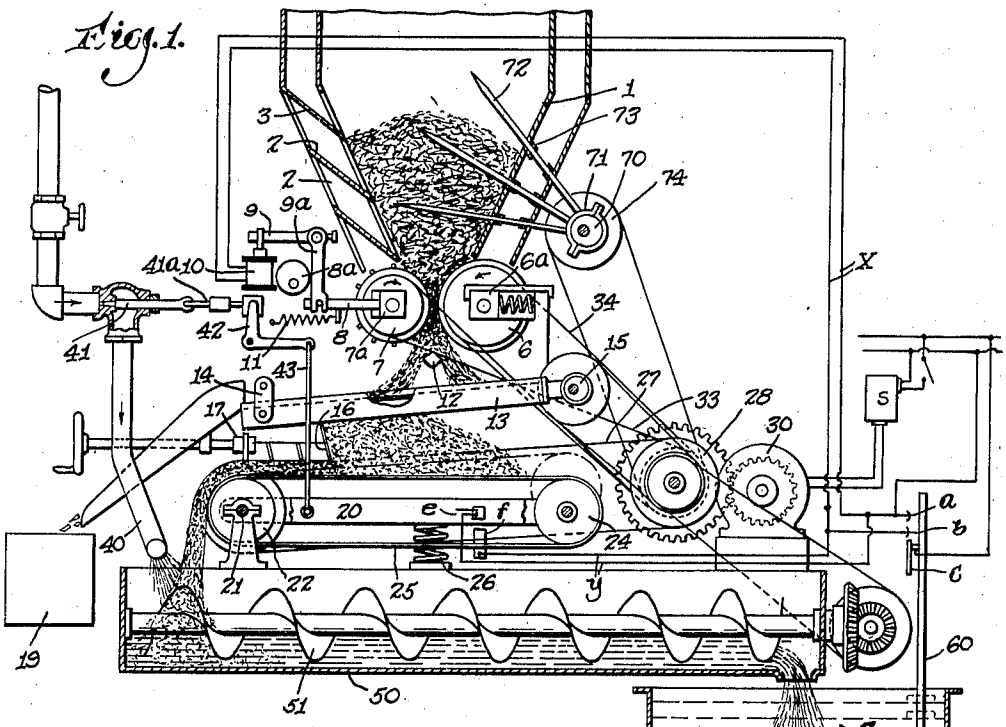
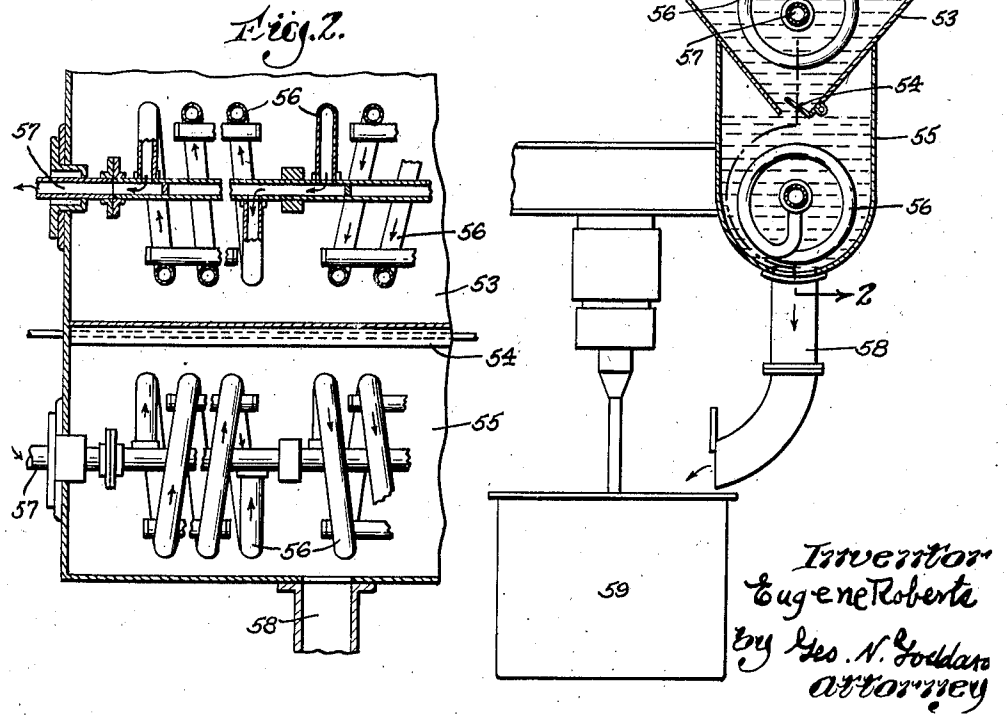


Fig. 2.



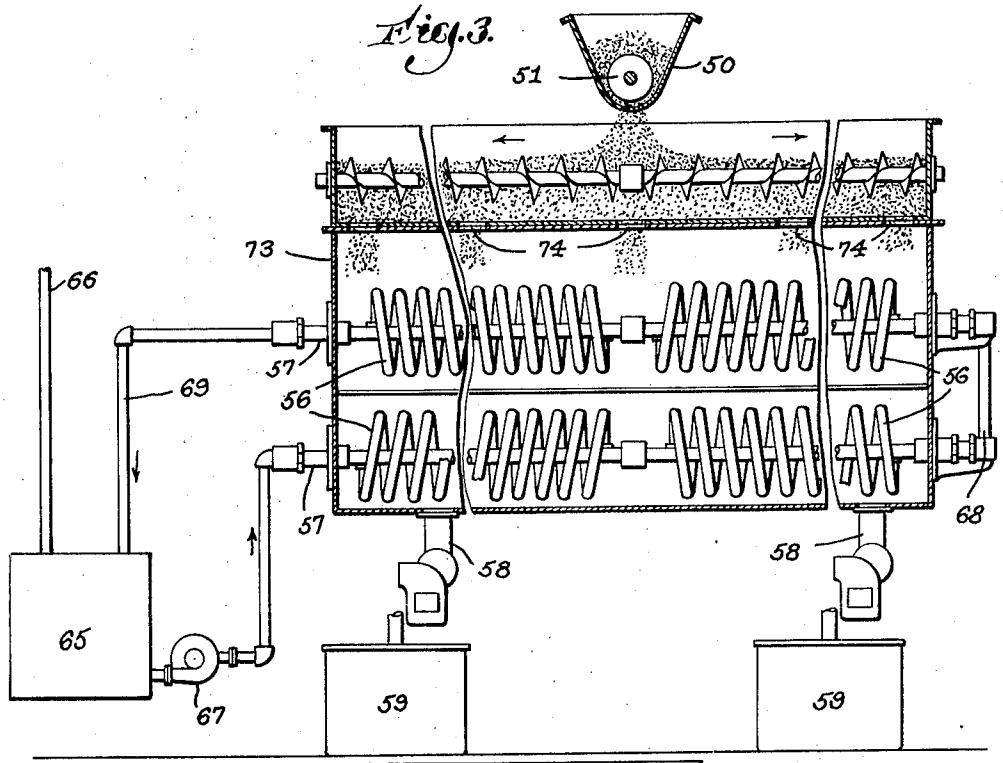
Inventor
Eugene Roberts
by Geo. N. Goddard
Attorney

July 2, 1940. E. ROBERTS 2,206,237

AFFINATION APPARATUS FOR TREATING SUGAR

Filed June 5, 1936 2 Sheets-Sheet 2

Fig. 3.



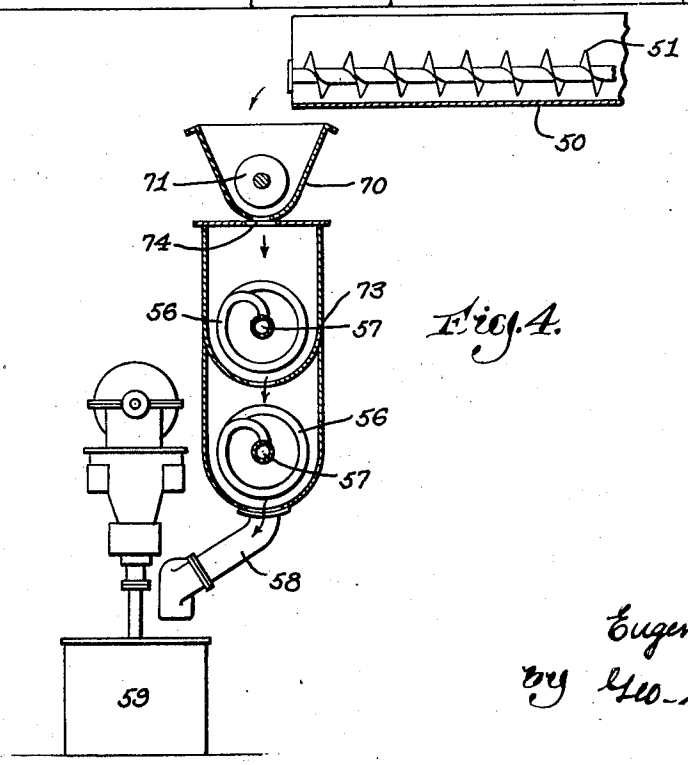


Fig. 4.

Inventor
Eugene Roberts
by Geo. N. Goddard
Attorney

Patented July 2, 1940 2,206,237

UNITED STATES PATENT OFFICE

2,206,237

AFFINATION APPARATUS FOR TREATING SUGAR

Eugene Roberts, Hastings, N. Y., assignor to The Western States Machine Company, Salt Lake City, Utah, a corporation of Utah

Application June 5, 1936, Serial No. 83,634

8 Claims. (Cl. 127—22)

This invention relates especially to the art of refining raw cane sugar and is intended to provide an apparatus for efficiently and economically carrying out an improved process of producing a mixture or "magma" of raw sugar and syrup properly conditioned for effective centrifuging.

Prior to the invention of the improved Stevens affination process described in a copending application, Serial No. 151,772, filed July 3, 1937, which is a continuation-in-part of an earlier application, Serial No. 68,013, filed March 10, 1936, the magma was generally produced by mixing together streams of unsaturated heated syrup and of raw or unrefined sugar, and the condition of the magma supplied to the centrifugals depended wholly upon the carefulness and judgment of the attendant operator. Variations in the ratio of syrup to sugar were inevitable so that magma being delivered to the centrifugals from time to time varied greatly in respect to the ratio of syrup to sugar content and in respect to viscosity of the magma, thus preventing uniformity of centrifuging. Under the Stevens affination process the magma is formed by mixing the raw sugar with a very small proportion of hot syrup in a substantially saturated condition to form a heavy, non-flowing mass, and this mass during passage to the centrifugals is heated without dilution or addition to its bulk to about the initial temperature of the hot saturated syrup, and is delivered in the resulting fluid condition to the centrifugal separators.

Even under the practice of the above described Stevens process the ratio of syrup content to the dry content in the magma is likely to vary somewhat from time to time, thus making it difficult to maintain the maximum efficiency of the process.

The present invention increases efficiency if not already present at this point providing a self-regulating apparatus by which uniformity of consistency is obtained in the magma delivered to the centrifugals therefore avoiding either an excess or a deficiency in the syrup content of the magma. It also provides an improved affination apparatus including a hot mingling tank or trough in combination with distributing means for facilitating control over the flow of the mixture of raw sugar and syrup from the time it is produced until ready for introduction into the centrifugals.

In the accompanying drawings I have illustrated a convenient arrangement of apparatus, by the use of which it is possible to carry out the affination process so as to avoid excess or deficiency of the ratio of syrup content to dry content, while at the same time greatly economizing in the cost of carrying out the affination process, since the apparatus can operate, after being started, under its own regulation without depending upon the faulty regulation occasioned by lack of skill or negligence on the part of the attendant. The adjustments for a given run of sugar can be made by an expert supervisor to produce exactly the optimum conditioning of the magma being centrifuged.

In said drawings

Fig. 1 illustrates a partly diagrammatic arrangement of the improved affination apparatus forming the subject of this invention.

Fig. 2 is a detail view in front elevation, partly in section, showing the magma heating stirrer coils by which the magma is heated to reduce its viscosity without dilution, so that it will readily build up in the centrifugal basket when it is in process of being centrifuged, both for separation or extraction of the syrup from the sugar and for centrifugal washing to remove the adherent film or coating containing by far the greater part of the impurities associated with the sugar crystals or grains.

Fig. 3 is a front elevation in central section showing means for evenly distributing the measured supply of magma for delivery to the hot mingler.

Fig. 4 is a transverse section of the apparatus shown in Fig. 3 illustrating the relation of the distributing scroll to the underneath hot mingler.

In the drawings there is provided a usual storage receptacle or tank 1 provided with openings along the inclined bottom portion, as shown at 2, that are covered by inclined shutters 3. The convergent bottom of the tank forms a contracted nozzle or outlet close to which are located a pair of revoluble feed rolls 6 and 7. One of these feed rolls 6 is journaled in slidable bearing boxes 6a, which are normally spring pressed to their innermost limit of movement but which permit yielding of the roll to allow any hard matter, such as a stone or piece of iron, to pass between the rolls without injury. The opposing roll 7 is journaled in slidable bearing boxes 7a which are provided with connecting rods 8, which is under the control of a regulating means, such as a solenoid 10, the movement of whose plunger controls, in this case, the position of adjustment of the roll 7 by means of a bell crank arm 9, 9a and a coacting spring 11 in a manner presently to be described.

Beneath the gap between the feed rolls 6 and 7 is preferably placed a horizontal magnetized bar

12 to retain any pieces of metal small enough to go through the mesh of the screen or sifter. The raw sugar being delivered by the feed rolls falls in a stream upon the vibratory sifter 13, which is suspended at one end by means of pivotal links 14 and whose other end is supported upon a revoluble eccentric cam 15 to impart the desired vibratory or shaking movement to the sieve. The sugar dropping through the sieve falls upon a travelling conveyor or belt 25. This belt travels around a drum 22 upon the shaft 21 which is mounted in fixed bearings and the outer end of the belt or conveyor passes around the drum 24, which is mounted in a frame 20 fulcrumed coaxially of the shaft 21. This frame is yieldingly supported by a scale spring 26 or its equivalent, which is tensioned so that when there is no load upon the conveyor belt 25 the frame 20 swings upward in its topmost position while, as the conveyor becomes loaded to a greater or less degree according to the quantity of sugar resting upon it, the frame drops to lower positions. Near the offtake end of the conveyor is supported a gauge 16, which is horizontally adjustable by means of an adjusting nut 17, so that the forward or right hand end of the gauge will be located to various positions in advance of the fulcral axis at 21. When the frame swings to its uppermost position the conveyor belt is close beneath the front member of the gauge 16 and little or no sugar can be carried by the gauge, which acts as a scraper to level the stream of sugar carried by the conveyor to uniform thickness, so that the conveyor is delivering a predetermined quantity of sugar which is subject to increase by the dropping of the conveyor belt as the sugar load increases and which is diminished as the conveyor belt or frame 20 rises toward the gauge. A liquid supply pipe 40 delivers through its nozzle at the bottom a spray of syrup, the volume of said syrup being controlled by the regulating valve 41 which, in this case, is shown as of the plunger type, whose shank is connected with a bell crank arm 42, which in turn is connected with the frame 20 of the belt conveyor by means of a connecting link 43. The arrangement is such that as the belt rises under a diminishing load the plunger valve 41 is pushed inwardly toward its seat to correspondingly diminish the flow of the syrup. On the other hand, when the frame 20 drops under an increasing load on the conveyor the valve is opened wider to correspondingly increase the flow of liquid. In this way there is provided a self-regulating coordination between the supply of syrup and the supply of sugar with which it is mixed.

It will therefore be seen that as the stream or flow of dry material delivered into one end of the mixing trough 50 increases or diminishes, there is a corresponding increase or decrease in the quantity of hot syrup delivered into said trough to be mixed with the dry material so that the ratio of dry material to syrup is automatically maintained.

The link 41ª connecting the valve 41 with the bell crank arm 42 is made adjustable as to length by means of a turn buckle so that the valve controlling the flow of hot syrup may be adjusted to give the desired ratio of liquid to solid matter.

A rotary scroll conveyor 51 serves to convey, as well as to mix together, the liquid and solid materials and the resulting heavy mixture is delivered through an opening in the bottom of the mixing trough 50 into the hot mingler trough 53 which has a converging partition providing a delivery slot or nozzle, whose opening is regulated by means of a pivotal, adjustable valve 54. A downward extension 55 of the mingler trough, of narrow proportions forms the final mixing and heating chamber in which the heating of the heavy mixture to a temperature approximately equal to the initial temperature of the hot syrup supplied by the pipe 40 is effected and a magma possessing optimum characteristics for centrifuging is obtained. The preliminary heating, in this case, is effected by a tubular stirrer 56 comprising helical coils mounted on, and communicating with, a central hollow shaft 57 through which a large volume of hot water is circulated through the helical coils, so that the surrounding body of magma is simultaneously stirred and heated. A similar heating and stirring coil 56 is mounted in the bottom extension from which lead the goosenecks or discharge spouts 58, one for each centrifugal of the battery.

In this way magma flowing into and through the tank 53, 56 is conducted directly to the centrifugal in its heated fluent condition without the necessity of any dilution and in consequence thereof the proportion of hot syrup supplied for producing the magma may be very considerably reduced and may be in a completely saturated or nearly saturated condition so that the mixture delivered to the hot mingler trough of the centrifugal apparatus may be of a much higher Brix or percent. dry substance than would be possible were it not subjected to a reheating. Furthermore, if a saturated hot syrup be used there is little if any dissolving of the sugar grains by the hot syrup. This method of reheating is not my invention, but the apparatus by which the mixing of the raw sugar and syrup is effectively controlled and regulated and the mixture is conducted to the centrifugals forms the subject matter of the present invention. The centrifugal machine 59 may be of any suitable gyratory suspension type, but the best results will be effected by the use of centrifugal driving means which are capable of bringing the machine from a state of rest to a speed of approximately 1500 revolutions in substantially less than one minute.

For the most part it is intended that the flow of magma from the mixing trough 50 shall correspond approximately to the capacity of the battery of centrifugal machines forming part of the apparatus, but as one or more of the battery of centrifugals may temporarily be shut down for repairs or temporary treatment while the remainder of the centrifugals are kept in operation to dispose of the supply of magma, provision has been made to prevent the magma from overflowing the hot mingler trough 53 on the one hand, or from reaching too low a level therein on the other hand. This is effected by means of a float gauge 60 which acts to close or to interrupt electric control circuits by which the feeding of the material to the mixing trough 50 is accomplished or regulated.

It will be understood that the width of the space between the delivery rolls 6 and 7 determines the rate of supply or the quantity of dry material fed into the mixing trough 50. To give complete flexibility to the adjustment of the roller 7, the bell crank lever 9 has one arm 9ª that is angularly adjustable about its rock shaft and is held in desired position of adjustment by a set screw 9ᵇ in its hub, so that the adjustment does not alter the position of its horizontal arm to the actuating plunger of the solenoid 10. The slidable bearing box 7ª is normally retracted by a spring 11 to a position that is determined by the adjustment of

a stop member, such for example as an eccentric cam 9ª arranged back of the arm 9ª. The cam 8ª may be set so that when the solenoid is actuated it will close the gap between the forward rollers 7 and 8, or so that it will leave as narrow a gap between the rollers as may be desired.

Obviously, provisions may be made to narrow or to close the feed roll gap whenever for various reasons it may be desirable to do so and either electric currents or compressed air, or purely mechanical means may be used for that purpose. In the drawings I have illustrated an electric circuit x that includes a solenoid 10 having a plunger engaging the horizontal arm 9 of the bell crank lever so that the plunger may be actuated to push inwardly the adjustable feed roller 7 to narrow or cut off the stream of dry material according to the adjustments above described.

This control may be utilized for various purposes. In the drawings I have made provision against overloading the conveyor belt 25 and to prevent overflow of the magma in the hot mingler trough 53. To accomplish these objects the solenoid circuit x is provided with terminal contacts a and b, which are closed by the contact member c secured to a float 60 arranged so that the solenoid circuit is closed by the lifting of the float when it reaches a level substantially below the level of the top of the hot mingler trough 53. To prevent overloading of the conveyor belt 25, a movable terminal contact member e is carried by the scale beam frame 20 normally spaced some distance above the fixed companion terminal f. Should there be an excessive accumulation of material in front of the adjustable gauge 16, the scale beam or frame 20 drops far enough to establish contact between e and f which are in a shunt circuit y leading to the solenoid 10. By this or equivalent arrangement the overflowing of the hot mingler trough and the overloading of the conveyor belt is prevented. This is especially desirable when one or more of the centrifugals forming the battery supplied from the hot mingler are for the time being out of commission so that a decrease in the supply of material being fed from the storage tank is effected.

To keep the dry material in the bottom of the feed trough 1 broken up so as to readily pass between the feed rollers, there is provided a series of stirrer rods which are given a combined rocking and reciprocating movement by means of a revolving eccentric 70 encircled by a head to which the fingers or arms 72 are attached.

The feed rolls, the sifter and the conveyor apron 25, as well as the mixing scroll 51 are driven by means of an electric motor 30 having driving connection with suitable gearing and clutch mechanism mounted on the countershaft 33 from which by belts or otherwise power is transmitted to the different parts of the mechanism. Since any suitable or well known driving arrangement serving this purpose may be used, particular details of construction and arrangement of this part of the mechanism is omitted.

Where only three or four centrifugals are supplied from the same hot mingler the magma, discharged from the end of the mixing trough into the middle portion of the hot mingler trough, will be sufficiently distributed for practical purposes but with an arrangement of apparatus having a larger number of centrifugals in a row the hot mingler will have a correspondingly greater length and therefore an intermediate distributor is preferably used, as shown in Fig. 3 and Fig. 4. With such arrangement, the scroll-containing mixer trough 50, at its discharge end, drops the stream of magma into an intermediate distributing trough 70 located on top of the hot mingler and in parallelism therewith and there is located in the bottom portion of the distributor trough a revoluble conveyor having reversely turned scrolls 71 extending, respectively, from the middle to the ends of the trough 70. The distributor trough 70 is mounted directly on the top 72 of the hot mingler trough 73 and at suitable intervals along the bottom there are provided openings 74 in the distributing trough and in the top of the hot mingler trough through which streams of magma fall into the upper portion of the hot mingler trough 73, whence the magma flows down over the revolving internally heated heat-transferring and stirrer coils 56 to the bottom of the trough 73, whence it is distributed through separate discharge chutes 58 to the individual centrifugals 59 in a sufficiently fluent condition to permit its being sufficiently and rapidly centrifuged.

In Fig. 3 is also shown the make-up tank 65 which was omitted from Fig. 1 because of lack of space and which is provided with a steam supply or reheating pipe 66 and into which leads the return pipe 69, which returns the hot water that was pumped successively through the coils by means of the pump 67 and the lead-in pipe 57 which forms the revolving support for the coil.

What I claim is:

1. In an affination apparatus of the class described, the combination of a sugar supply bin open at its bottom, coacting spaced feed rolls located at the bottom outlet of said trough, a vibrating sieve located beneath said feed rollers, a travelling conveyor beneath said sieve for receiving and delivering a regulated stream of sugar, said conveyor being supported on a pivoted scale beam, a gauge member located above said travelling conveyor forwardly of the pivotal axis of the scale beam and coacting with said pivotally mounted conveyor to vary the quantity delivered in accordance with variations in the quantity delivered by said feed rollers, a valved liquid supply pipe, and means for maintaining at uniform ratio the quantities of sugar and of liquid supplied to a mixing trough, and means for mixing the sugar and liquid to a uniform consistency before conveying the mixture to the centrifugal apparatus.

2. In an apparatus of the type described the combination with a sugar supply chute, a pair of spaced feed rolls arranged beneath the outlet of said chute, a pivotally supported travelling conveyor belt mounted to receive the sugar delivered by said feed rolls, an adjustable gauge member located above said conveyor and coacting therewith to regulate the quantity of sugar delivered by the conveyor, a liquid supply pipe provided with a regulating valve, and means connecting the pivotal conveyor with said valve to coordinate variations in the supply of sugar with corresponding variations in the supply of liquid, and means for mixing to a uniform consistency the regulated supplies of sugar and liquid.

3. In an apparatus of the class described, the combination with a mixing trough containing a revoluble mixing and conveying scroll, means for delivering a regulated supply of sugar into said trough, said means comprising a gauge member and a travelling apron pivotally mounted for movement toward and away from said gauge member, said pivotal movement being responsive

to the quantity of material supported upon the apron whereby variations in the load of material on the apron correspondingly varies the quantity delivered by the apron, a valved syrup supply pipe, the adjustment of whose valve is controlled by the pivotal movement of said apron whereby the ratio of syrup to the sugar is maintained.

4. In an apparatus of the class described, the combination with variably spaced feed rolls for delivering variable quantities of sugar, a pivotally mounted travelling apron arranged to receive the sugar delivered by said feed rolls, means for regulating the quantity of sugar delivered by said travelling apron to a mixing receptacle, means for supplying a predetermined but variable amount of syrup to said mixing trough, means for coordinating variations in the supply of syrup with variations in the supply of sugar, and means for varying the spacing of said feed rollers to prevent excess delivery of material thereby to the apron.

5. In an apparatus of the class described, the combination with variably spaced feed rolls for delivering variable quantities of sugar, a pivotally mounted travelling apron arranged to receive the sugar delivered by said feed rolls, means for regulating the quantity of sugar delivered by said travelling apron to a mixing receptacle, means for supplying a predetermined but variable amount of syrup to said mixing trough, means for coordinating variations in the supply of syrup with variations in the supply of sugar, and means for varying the spacing of said feed rollers to prevent excess delivery of material thereby to the apron, said means comprising roller-shifting means energized through the medium of the pivotal movement of the apron when under excessive load.

6. In an apparatus of the class described, the combination with variably spaced feed rolls, a carrier apron for receiving and conveying to a mixing apparatus a regulated supply of sugar, a syrup supply pipe provided with a regulating valve in coordinated relation to the carrier apron to maintain a substantially uniform ratio of syrup to sugar for delivery to the mixing trough of a centrifugal apparatus, and means for preventing an excessive accumulation of the mixture in said trough comprising a feed roller-shifting mechanism and an energizing float member that is rendered operative by the rise of material in said trough above a predetermined level.

7. In an apparatus for preparing mixtures of sugar crystals and syrup for centrifuging, the combination with an elongated hot mingler a trough provided with bottom discharge chutes leading to individual centrifugals and an intermediate parted partition, revoluble internally heated stirring and heating means mounted in said trough both directly above said discharge chutes and above said partition for stirring and heating mixture passing toward the discharge chutes, a longitudinal distributing trough mounted directly above said hot mingler trough in parallelism therewith and having communication through its bottom with said hot mingler trough at intervals along its length, and a conveyor mounted in said distributing trough and operative to conduct mixture received adjacent the center thereof toward the opposite ends and to distribute the mixture over the various communicating openings.

8. In an affination apparatus for treating raw sugar and the like, the combination of a sugar supply bin open at its bottom, a trough for receiving sugar from said bin, a liquid supply pipe for introducing syrup into said trough, valve means for varying the flow of liquid through said pipe, means for varying the amount of sugar delivered from said bin to said trough, and means connected with said valve means and responsive to variations in the weight of sugar flowing from said bin toward said trough for correspondingly changing the set of said valve means.

EUGENE ROBERTS.

CERTIFICATE OF CORRECTION.

Patent No. 2,206,237. July 2, 1940.

EUGENE ROBERTS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, lines 39 and 40, for the words "if not already present at this point" read --by--; page 3, first column, line 2, for "cam 9^{a}" read --cam 8^{a}--; page 4, second column, line 13, claim 7, strike out the article "a"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of September, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.