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AUTOMATIC CONTROL.

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*Fig. 1.*

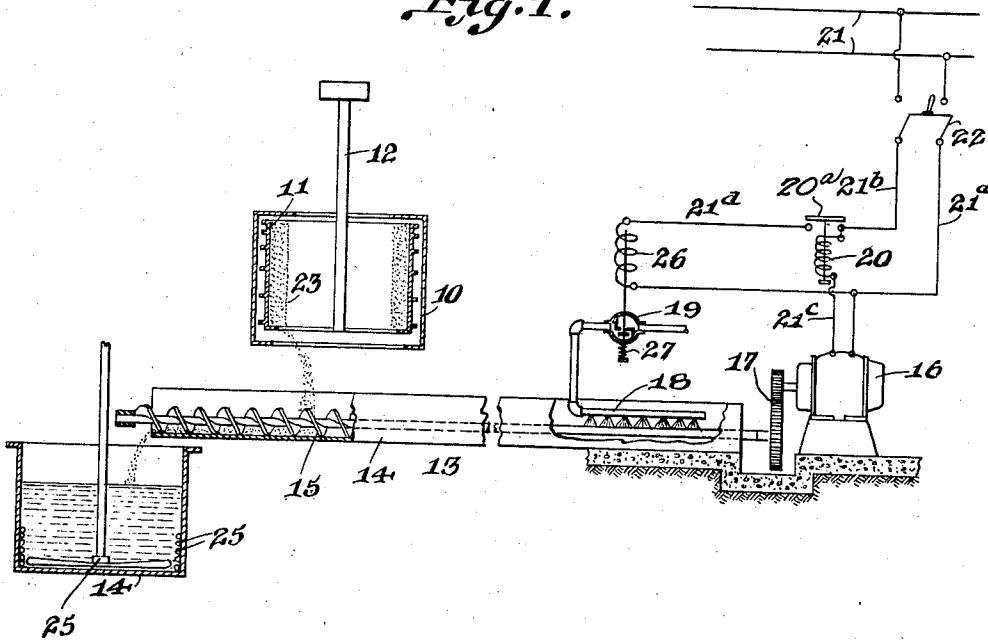


*Fig. 2.*

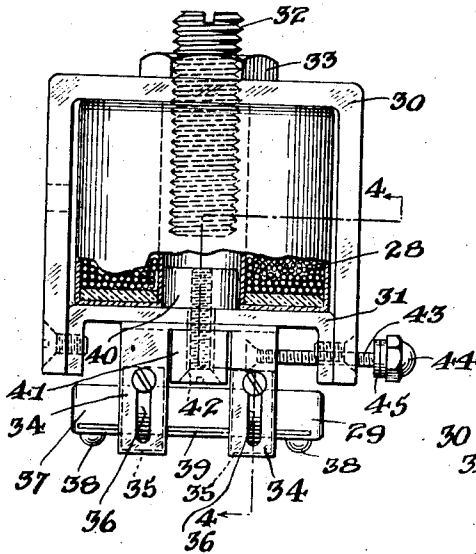


*Fig. 3.*

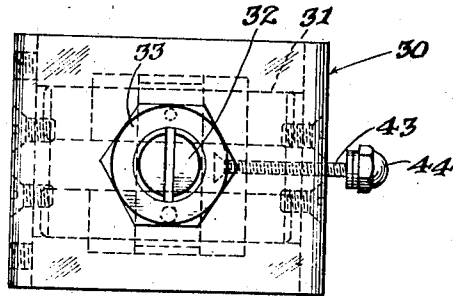
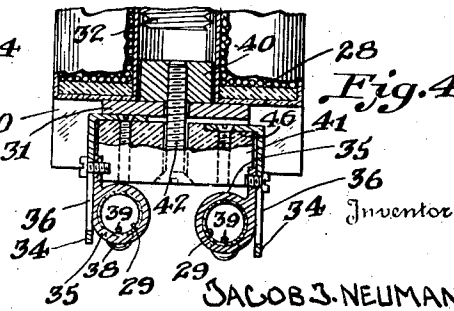


*Fig. 4.*



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## UNITED STATES PATENT OFFICE

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## AUTOMATIC CONTROL

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4 Claims. (Cl. 127—22)

The present invention relates to an automatic sweetwater control to screw conveyor under extractor machine.

In the process of refining sugar the raw sugar is processed thru primary centrifugal extractor machines. This sugar is discharged from these machines in a semi-dry state into screw conveyors. These conveyors then convey the sugar to a melter tank where the sugar is melted by mixing with water and heating.

In the process it is necessary that a fixed density be maintained. Now, if it were possible to run this hot water into the screw conveyor instead of adding it at the melter, some very definite advantages would be obtained.

First, the sugar would be mixed thoroughly in the screw with the water and thereby relieving the duty on the melter.

Second, the sugar being mixed with the hot water in the screw will run freely and require less than one tenth of the power to operate the screws.

In the past, it has been attempted to accomplish this by manual control but with very unsatisfactory results due to the fact that at times insufficient water was applied and then the power would be greater than with no water application, as the sugar would get into a form similar to a baker's dough or paste, then at other times, too much water would be applied, which is very unsatisfactory for the processes succeeding the melting.

An object of the present invention is, therefore, to provide means for adding water to the sugar in the conveyor in amount sufficient to make it run freely and begin the dissolving.

Another object is to control the addition of water by the load imposed on the conveyor motor.

A further object is to make such control automatic to free it from human error and to reduce the number of attendants required.

Another object is to maintain a substantially constant density in the solution delivered to the melter.

A still further object is to provide an electric controlling apparatus by means of which the other objects are carried out.

Yet another object is to use in this electric apparatus a magnetic relay possessing the following features: adjustable to operate at various current values; an adjustable core to alter the magnetic flux; a by-pass device for temporarily short circuiting the magnetic flux; an arrangement whereby two circuits may be controlled

simultaneously by the relay; a further arrangement for controlling two circuits wherein one is opened or closed before the other.

In the drawing wherein the same numbers refer to like or corresponding parts,

Figure 1 is a side elevation of a unit employing the present invention, with the circuits shown in diagram and parts in section.

Figure 2 is an enlarged detail side elevation of the relay control for the sweetwater, with part of the coil broken away.

Figure 3 is a top plan view of the same relay, and

Figure 4 is a sectional fragment taken on the line 4—4 of Figure 2.

In Figure 1, the centrifugal extractor 10, having a revolving basket 11 driven through a shaft 12, is suspended over the screw conveyor 13 which carries sugar to the melter tank 14. The screw conveyor 13 is composed of a tube 14 within which is mounted the screw 15 driven by the motor 16 through the reducing gears 17.

In the upper end of the conveyor tube 14 is located a spray head 18 for the purpose of adding melting water to the sugar in the conveyor 13. The spray 18 is connected with a water source through the magnetic valve 19 which is controlled by the relay 20 in the circuit of the motor 16. Electric current for the motor 16 is drawn from the supply line 21 thru the leads 21<sup>a</sup> and 21<sup>b</sup> and controlled by the motor switch 22.

In operation the extractor 10 builds up a wall of sugar 23 on the sides of its basket 11. This accumulation is removed and permitted to fall into the conveyor 13 where it is mixed with water entering through the spray 18 and carried to the melting tank 14. At the melting tank 14 the sugar and water are heated by steam or other coils 24 and agitated by a motor driven paddle 25 to complete the dissolving, after which the solution is removed and the sugar continued through the remaining steps of the process.

This invention concerns particularly the automatic control of the melting water sprayed into the conveyor 13. As the sugar accumulates in the extractor 10 the switch 22 is closed starting the motor 16 and driving the screw 15. The relay 20 is normally closed energizing the solenoid 26 of the water valve 19 and closing the same. This relay 20 has a predetermined operating range so that at low current values in the motor circuit the switch 20<sup>a</sup> remains closed but at a definite higher value the switch 20<sup>a</sup> opens. As the dry sugar enters the conveyor 13 the screw 15 meets increased resistance and the

motor 16 draws more current. The added current flowing through the relay 20 causes the opening of the circuit through the solenoid 26 allowing the valve 19 to open under the force of its spring 27 thus admitting water to the conveyor 13. As water is mixed with the sugar the resistance of the screw 15 drops with a consequent drop in current passing through the motor 16. As the current drops below the minimum required to open the relay 20, it closes again completing the circuit through the solenoid 26 and closing the valve 19.

The relay 20, which is in the motor circuit, is of the electromagnetic type, the primary circuit being through the coil 28, and the secondary being controlled by a mercury switch 29, as shown in detail in Figures 2, 3 and 4.

The coil 28 is held in a soft iron cap 30 by a bottom plate 31 of some non-magnetic material such as brass. The top of the cap 30 is drilled and tapped over the hollow core portion of the coil 28 to receive the threaded soft iron core piece 32 which is thereby adjustable in the core to vary the effect of the magnet. A locking nut 33 is provided to hold the core piece 32 in adjustment.

The mercury switch 29 is suspended at the bottom of the magnet by the usual form of brass bracket 34, carrying clips 35 adjustable with respect to the magnet by movement in the slots 36 of the bracket 34. The mercury switch 29 employed comprises a glass tube 37 having a mercury well 38 at each end, and a wire 39 of a magnetic material bridging the wells 38. The magnetic field is concentrated beneath the coil 28 by the use of a small iron core piece 40 in the lower part of the hollow core and resting on the plate 31. A bar 41, likewise of a magnetic material, is held against the underside of the plate 31 by bolting to the small core piece 40 by a steel screw 42, the magnetic field being thus concentrated in the bar 41.

By adjusting the magnet strength, by moving the core piece 32, and also by moving the mercury tube 29 to or away from the bar 41, the point at which the valve 19 is opened and water admitted to the conveyor 13 may be varied. For accomplishing a temporary shorting of the magnetic flux a threaded soft iron plunger 43 is passed through the side of the cap 30 and the plate 31 extending inward towards the bar 41. At the outside of the cap 30, the plunger 43 is provided with a non-magnetic head 44 affording a means for rotating the plunger 43 to cause it to short circuit more or less of the magnetic flux to the cap 30 thus raising the minimum current required to lift the wire 39. Its purpose is to short circuit a portion of the magnetic flux. When motors and conveyors start up they are cold and draw more current for several hours until warmed up. By pushing in the plunger 43 a portion of the magnetic flux is bypassed between the cap 30 and the bar 41 and the switches 29 are thus not operated as would normally be the case when a current passed which is in excess of that for which the core piece 32 has been adjusted. After the machine is warmed up and drawing normal current the operator pulls out the plunger 43. Spacing washers 45 are placed between the head 44 and the cap wall 30 to limit the extent of inward movement of the plunger 43. The washers 45 are added in sufficient number to permit the plunger 43 to be pushed in enough to bypass a portion of the flux

just sufficient in quantity to prevent the relay 20 from operating at the normal current during the warm up period. If too much were bypassed the relay 20 might fail to operate even at a serious overload.

Figures 3 and 4 show a modification in which two mercury switches 29 are used. The relay 20 in such a case may be used as a two pole single throw switch and so may control two circuits. The circuits will be controlled simultaneously if similar mercury tubes 37 are used and they are held at the same distance from the bar 41. It may be of value to have one circuit open before the other, in which case the bar 41 will be provided with a stepped portion 46 as shown in Figure 4 so that one of the supporting brackets 34 will be lower than the other and the mercury tube 37 will be correspondingly removed from the magnetic field with the result that a stronger field will be required to open it.

The relay 20 is adjusted as follows: With the coil 28 in the motor circuit connected to the leads 21<sup>b</sup> and 21<sup>c</sup>, the core piece 32 is screwed out almost to the top. With the motor 16 running and normal current flowing, screw down the core piece 32 until the wire 39 is lifted, then retract the core piece 32 a turn or so to allow a slight excess of current without operating the relay 20. This margin of excess is best determined by trial for the individual case. When the core 32 is properly adjusted the lock nut 33 is tightened to prevent further motion.

It is obvious that various changes and modifications may be made in the details of construction and design of the above specifically described embodiment of this invention without departing from the spirit thereof, such changes and modifications being restricted only by the scope of the following claims.

What is claimed is:

1. An automatic sweetwater control for an electric motor driven conveyor and screw having an electromagnetic valve for said sweetwater and a relay to control said valve in series with said motor, said relay including a primary coil in series with the motor, and a magnetic mercury switch suspended beneath said coil and adapted to be opened when sufficient magnetic flux is induced in said coil, said switch controlling said electromagnetic sweetwater valve to open the same when due to increased resistance in the conveyor screw the motor draws a current higher than that normally drawn.
2. In a sugar refining apparatus a source of sugar, an electric motor driven screw conveyor for the sugar, a water delivery means in the conveyor for adding melting water to the sugar, a receiver for the sugar and water mix, an electrically controlled valve for the water delivery, an electromagnetic relay for said valve control, said relay comprising a primary circuit coil in series in the conveyor motor circuit, an adjustable core piece in the coil for varying the magnetic flux of the coil, a magnetic switch controlling the secondary circuit and adapted to be opened by the force of the coil, and a bypassing means for temporarily short circuiting the magnetic flux when the conveyor motor is cold and draws a current higher than the normal.
3. In a sugar refining apparatus, a sugar source, a mixing member, means conveying the sugar from the source to the mixing member, operating means for said conveying means, water discharging means associated with said convey-

ing means, and control means connected with said operating means and said water discharging means to automatically turn on or cut off the water discharge means dependent upon the resistance of the movement of the sugar on said conveying means.

4. In a sugar refining apparatus, a sugar source, a mixing member, means conveying the sugar from the source to the mixing member,

operating means for said conveying means, water discharging means associated with said conveying means, and electrically operated control means connected with said operating means and said water discharging means to automatically turn on or cut off the water discharge means dependent upon the resistance of the movement of the sugar on said conveying means.

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