

March 29, 1960

TOMIJI TARUKAWA
APPARATUS FOR AUTOMATICALLY MIXING
SEVERAL KINDS OF STOCK-MATERIALS

2,930,595

Filed May 9, 1958

5 Sheets-Sheet 1

Fig. 1.

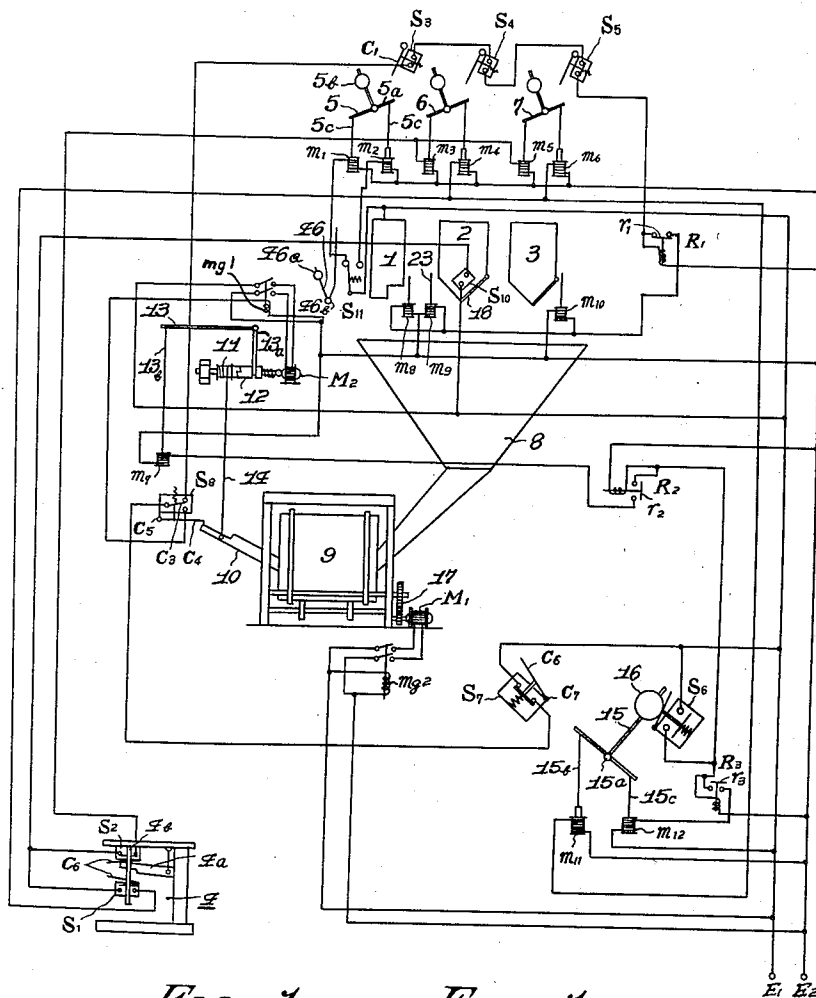
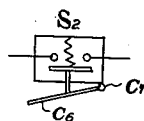
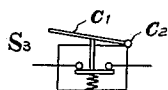


Fig. 1a.

Fig. 1b.



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5 Sheets-Sheet 2

Fig. 2.

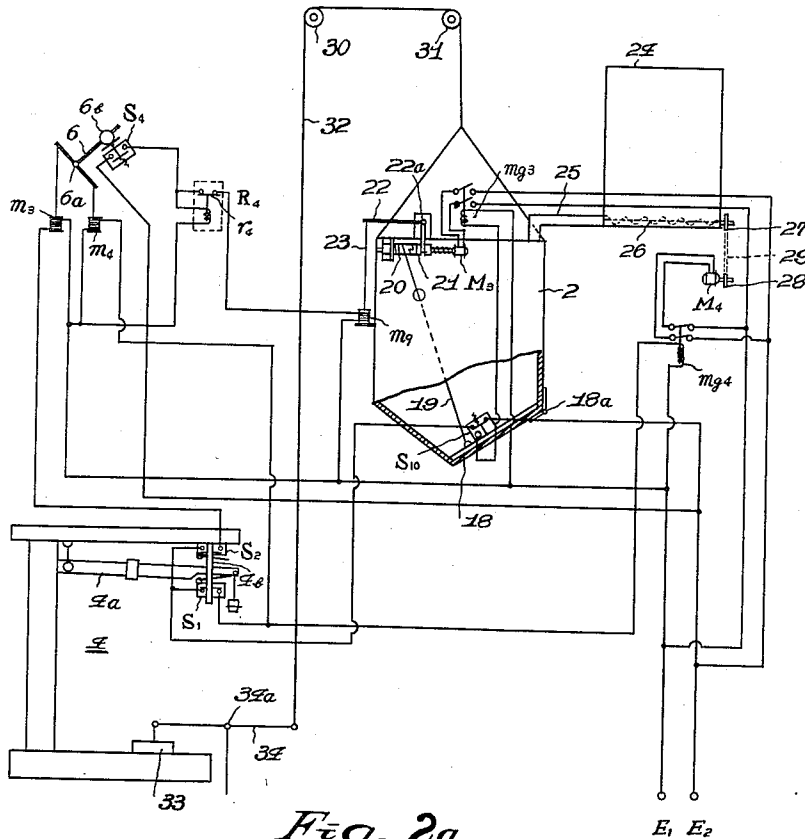
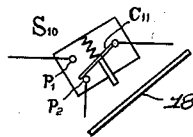


Fig. 2a.



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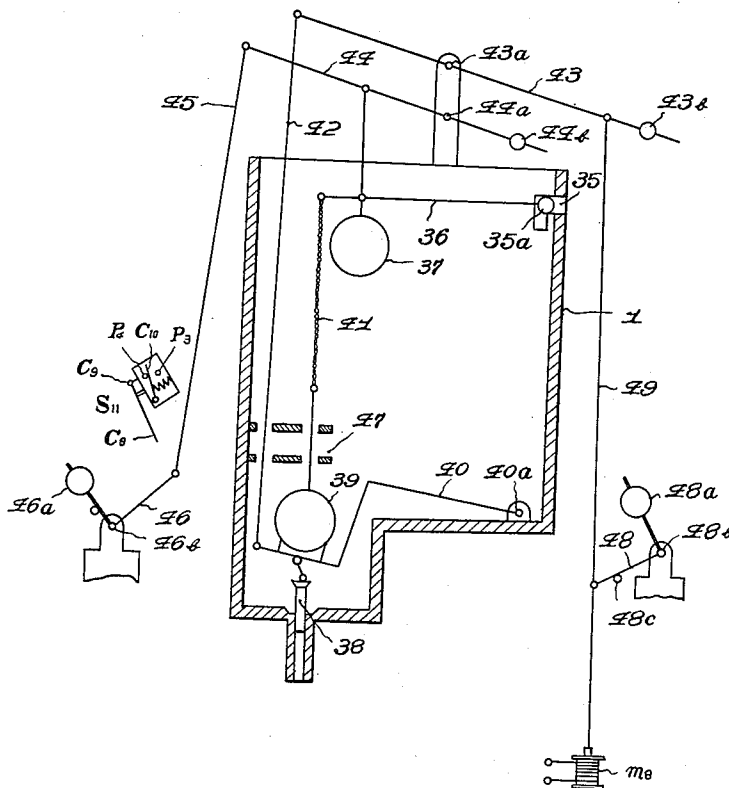
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5 Sheets-Sheet 3

Fig. 3.



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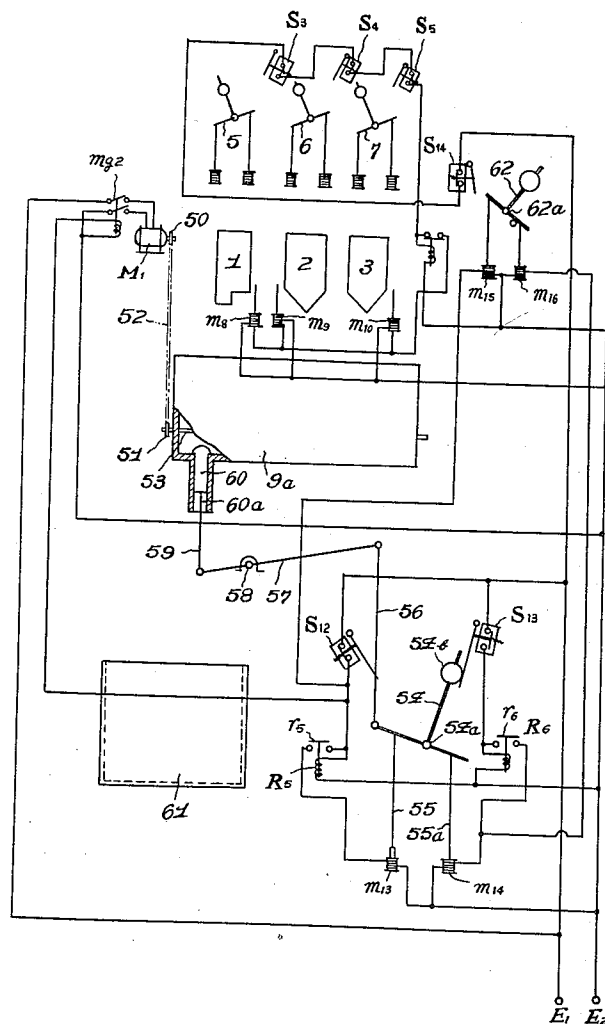
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2,930,595

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5 Sheets-Sheet 4

Fig. 4.



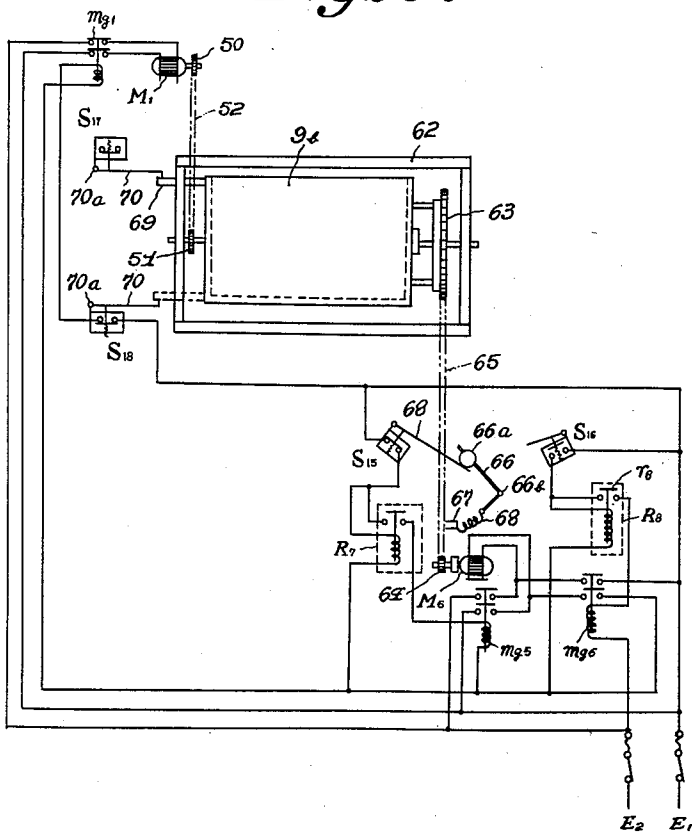
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5 Sheets-Sheet 5

Fig. 5.



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APPARATUS FOR AUTOMATICALLY MIXING SEVERAL KINDS OF STOCK-MATERIALS

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Application May 9, 1958, Serial No. 734,233

Claims priority, application Japan May 13, 1957

6 Claims. (Cl. 259—2)

This invention relates to an improved automatic mixing apparatus capable of thoroughly mixing several kinds of stock-materials, and more particularly to an apparatus of the type comprising several kinds of automatic measuring tanks and a mixer, said tanks and mixer being combined so that discharging of the stock-material from said tank into said mixer may be carried out simultaneously and automatically only when all the measuring tanks have been charged with desirable amounts of the stock-materials, respectively, and mixing of the mixture in the mixer, discharging of the mixture out of the mixer, and charging of the stock-materials into the measuring tanks may be successively repeated.

An essential object of this invention is to provide an improved apparatus capable of mixing several kinds of stock-materials in an effective and accurate manner.

Said object and the other objects of this invention have been attained by the apparatus which comprises several kinds of measuring tanks, each being provided with a charge device for charging said tank with a predetermined amount of a stock-material and with a discharge device for discharging the charged material out of said tank; a mixing device for mixing the mixture charged therein from said measuring tanks, said mixing device being provided with a discharge device for discharging the mixture out of said mixing device; said members being combined so that discharging of the stock-materials out of the measuring tanks may be simultaneously carried out only when the charged materials in all of the measuring tanks have reached predetermined amounts, respectively, and charging of the stock-materials into the measuring tanks, discharging of said materials out of said tanks into the mixing device, stirring action in the mixer, and discharging of the mixed mixture out of the mixer may be successive and automatically repeated.

The novel features of this invention are set forth with particularity in the appended claims. The present invention, however, both as to constructions and operations together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which the same or similar members are indicated by the same references, and in which:

Fig. 1 is a schematic side view of an example of the present invention.

Fig. 1a is a schematic side view of the switch S_3 in the example in Fig. 1.

Fig. 1b is a schematic side view of the switch S_1 or S_2 in the example in Fig. 1.

Fig. 2 is a schematic side view of one embodiment of the measuring tank adapted to be used for the present invention, which is particularly applicable for measuring a powdery stock-material.

Fig. 2a is a schematic side view of switch S_{10} seen in Fig. 2.

Fig. 3 is a schematic side view of another embodiment of the measuring tank adapted to be used for the present

2

invention, which is particularly applicable for measuring a stock-liquid.

Fig. 4 is a schematic side view of another example of the present invention.

Fig. 5 is a schematic side view of only the improved device of a further example of the present invention.

The embodiment of Fig. 1 relates to the case in which one kind of powdery stock-material and two kinds of stock-liquids are to be mixed. Referring to Fig. 1, the stock-material measuring device consists of a measuring tank 1 for measuring a desirable amount of a stock-liquid and other measuring tanks 2 and 3 for measuring desirable amounts of two kinds of powdery stock-materials.

The charging and discharging operations of the stock-materials into or out of the measuring tanks 1, 2 and 3 and the constructions of said tanks will be described more concretely in connection with the embodiments of Figs. 2 and 3.

Switch S_3 is constructed as shown clearly in Fig. 1a so that it may be opened when it is pushed at its movable piece C_1 pivoted at a pivotal shaft C_2 . Switches S_4 , S_5 , S_6 and S_7 also have the same construction as the switch S_3 . Switches S_1 and S_2 are constructed as shown in Fig. 1b so that they may be closed when they are pushed at their movable piece C_6 pivoted at a pivotal shaft C_7 . The switch S_3 is combined with a bell-crank 5 pivoted turnably at its pivotal shaft 5a and having a ball 5b at its center arm so that when said bell-crank is turned clockwise, the movable piece C_1 of said switch may be pushed by the ball 5b. Turning of the bell-crank 5 is induced by electromagnets m_1 and m_2 , the movable iron cores of which are, respectively, connected to side arms of the bell-crank 5 through strings 5c and 5c. Similarly, the switches S_4 and S_5 are, respectively, combined with the bell-cranks 6 and 7 so that they may be operated by two pairs of electromagnets m_3 , m_4 and m_5 , m_6 . The switches S_7 and S_8 are combined with a bell-crank 15 pivoted turnably at a pivotal shaft 15a and having a ball 16 on its center arm so that they may be opened when their movable pieces C_6 are pushed by said ball 16. The side arms of said bell-crank 15 are, respectively, connected to the movable iron cores of the electromagnets m_{11} and m_{12} through strings 15b and 15c so that when the electromagnet m_{11} is excited, said bell-crank 15 may be turned counterclockwise and when the electromagnet m_{12} is excited, the bell-crank 15 may be turned clockwise. Under the tanks 1, 2 and 3 is arranged a hopper 8 to receive the stock-materials discharged from said tanks, the discharge opening of said hopper being inserted into the right side center hole of a rotary type mixer 9 which is driven by an electric motor M_1 through a reduction gear train 17. The circuit of the motor M_1 is connected to the input terminals E_1 and E_2 of an electric source, not shown, through an electromagnetic switch mg_2 so that said circuit may be closed when said switch is excited. The mixer 9 is provided with a discharge conduit 10 which is pivoted to the frame of the mixer so as to be turned up and down, one end of said conduit being inserted into the left side center hole of the mixer. The discharge conduit 10 is connected to the winding drum 11 through a string 14, the upper portion of which is wound around said drum. The winding drum 11 is coupled with the shaft of an electric motor M_2 through a clutch 12 which is connected to an L-shaped crank lever 13 pivoted at a pivotal shaft 13a so that the clutch 12 may be disengaged when said crank lever is turned counterclockwise by pulling the left side arm of said lever through a string 13b, said pulling being induced by the excitation of an electromagnet m_7 the moving iron core of which is connected to the lower end of said string 13b. The electric circuit of the motor M_2 is connected to the input terminals E_1 and E_2 through an electromagnetic switch mg_1 so that

3

said circuit may be closed when said switch is excited. A switch S_8 having a movable piece C_4 pivoted at a pivotal shaft C_5 is constructed so that its movable contact C_3 may be exchanged from the lower stationary contact to the upper stationary contact by the discharge conduit 10 when the movable piece C_4 is pushed by said conduit 10. The switch S_8 is connected to the electromagnetic switch mg_1 so that said switch mg_1 may be excited only when said switch S_8 is released by said conduit 10.

Electromagnets m_8 , m_9 and m_{10} are, respectively, combined with the tanks 1, 2 and 3 so that when said electromagnets are excited, the discharge openings of said tanks are opened in a manner as described later in connection with the embodiments of Figs. 2 and 3. The tank 2 is combined operationally with a weighing beam 4 so that a predetermined weight of said tank may be balanced at said beam 4, said beam 4 being provided with switches S_1 and S_2 which are supported by a supporter 4b at the positions just below and above a balance beam 4a. The switches S_1 and S_2 are constructed as shown in Fig. 1b so that when the tank 2 is empty, the switch S_1 is pushed by the beam 4a so as to be closed, and when the tank 2 has been charged with stock-material, the switch S_2 pushed so as to be closed. The concrete combination of said beam 4 and the tank 2 and their operations will be described later in connection with the embodiment of Fig. 2.

Furthermore, the tank 2 is provided with a change-over switch S_{10} which is closed by the tank door 18 when it is entirely shut, said switch being connected in series to the circuits of the switches S_1 and S_2 . The electromagnet m_4 is connected to the switch S_1 so that when the tank 2 is empty and the door 18 is entirely shut, the electromagnet m_4 is excited through the switches S_1 and S_{10} so as to turn the bell-crank 6 clockwise. The electromagnet m_3 is connected to the switch S_2 so that when the tank 2 has been charged with stock-material and the beam 4a is lifted, the electromagnet m_3 is excited through the switches S_2 and S_{10} so as to turn the bell-crank 6 counterclockwise.

Similarly, the tank 3 is also combined with another weighing beam, not shown, of the same construction as the beam 4 and with electromagnets m_5 and m_6 , but the description as to the connections and operations of said electromagnets m_5 and m_6 and as to said weighing beam are omitted herein, because they are the same as those of the members m_3 , m_4 and 4.

On the other hand, the tank 1 is provided with a change-over switch S_{11} having a movable piece C_8 pivoted at a pivotal shaft C_9 and a movable contact C_{10} capable of being exchanged from one side to the other side when said piece C_8 is pushed by a ball 46a, said switch S_{11} being clearly shown in Fig. 3. The ball 46a is supported by one arm of a bell-crank 46 which is pivoted at a pivotal shaft 46b. The switch S_{11} and the bell-crank 46 are combined with the electromagnets m_1 and m_2 so that when the tank 1 is empty, the bell-crank 46 is turned clockwise for pushing the switch S_{11} to close the circuit of the electromagnet m_2 and when the tank 1 has been charged with stock-material, the bell crank is turned counterclockwise so as to disengage from said switch S_{11} to close the circuit of the electromagnet m_1 . The switches S_3 , S_4 and S_5 are connected in series and in this series circuit is connected a time switch R_1 which operates with a time lag to open the contact piece r_1 , said time lag being selected so that the circuit of the electromagnets m_8 , m_9 and m_{10} may be opened upon the complete discharge of the stock-materials from the tanks 1, 2 and 3 into the hopper 8. In the circuit of the electromagnet m_7 is inserted a time relay R_2 which acts with a time lag to close the contact piece r_2 , said time lag being selected so that the circuit of said electromagnet m_7 may be closed upon the completion of the stirring of the mixture in the mixer 9. In the circuit of the electromagnet m_{12} is inserted a time switch R_3 which acts with a time lag to close the contact

4

piece r_3 , said time lag being selected so that said electromagnet m_{12} may be excited upon the completion of the discharge of the mixture out of the mixer 9. The operation of the above embodiment of Fig. 1 is as follows:

Fig. 1 shows the state in which the tanks 1, 2 and 3 have been fully charged with stock-materials and the balance beam 4a is in its upper position. In this state, the electromagnetic switch mg_2 is in connection with the input terminals E_1 and E_2 so as to be excited, whereby the circuit of the motor M_1 is closed and the motor M_1 is running, thus operating the mixer 9.

On the other hand, the electromagnets m_8 , m_9 and m_{10} are excited by the following circuit.

$E_1-S_7-S_8-S_3-S_4-S_5-r_1-m_{10}-m_9-m_8-E_2$

Accordingly, the discharge openings of the tanks 1, 2 and 3 are opened and the stock-materials are discharged from said tanks into the mixer 9 through the hopper 8. However, since the time switch R_1 is designed so that the contact piece r_1 may be opened upon the complete discharge of the stock-materials in all of the tanks, the circuits of the electromagnets m_8 , m_9 and m_{10} are opened upon said complete discharge. For said object, the exciting circuit of each of the electromagnets m_8 , m_9 and m_{10} may be provided with a time switch for opening said circuit upon the complete discharge of the stock-material in the tank to which said electromagnet belongs.

When the stock-material in the tank 2 has been completely discharged, the balance beam 4a descends, whereby the switch S_1 is closed and the switch S_2 is opened. By the opening of the switch S_2 , the circuit of the electromagnet m_3 is opened. By the closing of the switch S_1 , the electromagnet m_4 is connected to the input terminals E_1 and E_2 through the circuit ($E_1-S_{10}-S_1-m_4-E_2$), said switch S_{10} having been closed by closing the door 18 in such a manner as will be described later in connection with the embodiment of Fig. 2, whereby the electromagnet m_4 is excited and the bell-crank 6 is turned clockwise to open the switch S_4 . The operations of the bell-crank 7 and electromagnets m_5 and m_6 are the same as the above-mentioned operations of the bell-crank 6 and electromagnets m_3 and m_4 , so that the descriptions as to the operations of the weighing beam to be combined with the tank 3 and of connecting lines for connecting said beam to the electromagnets m_5 and m_6 are omitted herein.

On the other hand, by the closing of the switch S_1 , the electromagnet m_{11} is connected to the input terminals E_1 and E_2 through the circuit ($E_2-m_{11}-S_1-S_{10}-E_1$), and the electromagnet m_{11} is excited, whereby the bell-crank 15 is turned counterclockwise and the switch S_7 is opened and the switch S_8 is closed. When the material in the tank 1 is discharged, the bell-crank 46 is turned clockwise to push the switch S_{11} , whereby the contact piece of the switch S_{11} is changed over to the right side and the electromagnet m_2 is connected to the input terminals E_1 and E_2 so as to be excited. By excitation of the electromagnet m_2 , the bell-crank 5 is turned clockwise to push the switch S_3 to be opened.

Accordingly, when all of the tanks 1, 2 and 3 have completely discharged their stock-materials, all of the switches S_3 , S_4 and S_5 are opened.

After a predetermined time lag sufficient to thoroughly mix the charged material in the mixer 9, the time switch R_2 operates, and the following circuit is closed:

E_2 -exciting coil of $R_3-r_2-m_7$

whereby the electromagnet m_7 is excited and pulls one end of the L-shaped crank lever 13. By said pulling, the crank lever 13 is turned counterclockwise so as to disengage the clutch 12 and the string 14 is unwound by the self-weight of the conduit 10 so as to turn down said conduit, whereby the mixture in the mixer 9 is discharged out through the conduit 10. The movable contact piece C_3 of the switch S_8 is changed over to the lower stationary contact by the downward turning of the conduit 10, but

5

since the switch S_7 is in the opened state as already described the exciting circuit of the electromagnetic switch mg_1 is not closed and the motor M_2 is maintained in its stopped state. Since the time lag of the time switch R_3 is selected so that it may operate upon the complete discharge of the mixture out of the mixer 9, the electromagnet m_{12} is excited upon said complete discharge through the contact piece r_3 and the switch S_8 , whereby the bell-crank 15 is turned clockwise and takes the state as shown, thus causing opening of the switch S_6 and closing of the switch S_7 . By the opening of the switch S_6 , the exciting circuits of the time switch R_2 and electromagnet m_7 are opened. By the opening of the electromagnet m_7 , the clutch 12 is engaged. By the closing of the switch S_7 , the following circuit is closed:

$E_1-S_7-C_3$ —under stationary contact of S_8 —exciting coil of mg_1-E_2

whereby the electromagnetic switch mg_1 is closed and the motor M_2 is driven. Accordingly, the conduit 10 is wound up by the winding drum 11 through the string 14. When the conduit 10 is lifted up to the position adapted to push the switch S_8 , the contact piece C_3 of the switch S_8 is changed over to the upper stationary contact by said conduit, whereby the exciting circuit of the electromagnetic switch mg_1 is opened at the switch S_8 and the motor M_2 is stopped.

As already stated, since the operations for charging the tanks 1, 2 and 3 with stock-materials have been started upon the opening of the circuits of the electromagnets m_8 , m_9 and m_{10} , discharging of the materials into the mixer 9 from said tanks is automatically carried out again upon the complete charging of the stock-materials into all of the tanks. In such a manner, as stated above, the automatic charging of the materials into the mixer and automatic discharging of the mixture out of the mixer can be repeatedly carried out.

In Fig. 2 is shown the measuring tank 2 and the devices for charging a predetermined amount of a powdery stock-material into said tank. The tank 2 is provided with a door 18 for opening and closing the discharge opening of the tank, said door being hinged by a hinge 18a. The tank 2 is further provided with a switch S_{10} and a winding drum 20 which is coupled with the shaft of an electric motor M_3 through a clutch 21. This clutch is connected to an L-shaped crank lever 22 pivoted turnably at a pivotal shaft 22a so as to be disengaged when said lever is turned counterclockwise by the pulling of the left side end of said lever by an electromagnet m_9 through a string 23, the lower end of which is connected to the movable iron core of said electromagnet. The switch S_{10} is so constructed, as shown clearly in Fig. 2a, that its movable contact C_{11} can be brought into contact with a contact P_1 from another contact P_2 when it is pushed by the door 18 being in the closed state. Above the tank 1 is arranged an accumulator 24 containing a powdery stock-material. The accumulator is provided with a discharge pipe 25 opening above the tank 2 and with a screw conveyor 26 for feeding the material into said pipe 25, the shaft of said conveyor being driven by an electric motor M_4 through a pulley 27 attached to said shaft, another pulley 28 attached to the shaft of the motor M_4 , and a belt 29 hung on said pulleys.

The tank 2 is suspended by a string 32 hung on pulleys 30 and 31.

The lower end of said string 32 is connected to the right end of a lever 34 pivoted at a pivotal shaft 34a, the left end of said lever being connected to a pad 33 mounted on the weighing platform of weighing scales 4 so as to push said pad. Switches S_1 and S_2 as shown clearly in Fig. 1b are supported by a supporter 4b at the positions above and below the balance beam 4a, said switches being arranged so that when they are pushed by the beam 4a, they may be closed.

The circuit of the motor M_4 is connected to the input

6

terminals E_1 and E_2 through an electromagnetic switch mg_4 , so that said circuit is closed only when said electromagnetic switch is excited. Another electromagnetic switch mg_3 is inserted in the circuit of the motor M_3 so that said circuit may be closed only when said electromagnetic switch is excited. A bell-crank 6 pivoted at a pivotal shaft 6a and having a ball 6b on its center arm is combined with the switch S_4 so that when said bell-crank is turned clockwise, said switch may be pushed by said ball, thus opening said switch. Both ends of the right and left side arms of the bell-crank 6 are connected, respectively, to the movable iron cores of the electromagnets m_4 and m_3 so that when said electromagnets m_3 and m_4 are excited, the bell-crank 6 may be turned counterclockwise and clockwise, respectively.

The operation of the apparatus in Fig. 2 is as follows:

The shown state relates to the case in which the tank 2 is empty, the door 18 is in its closed position, and the balance beam 4a is lowered to close the switch S_1 . In this state, the following circuit is closed:

$E_2-C_{11}-P_1-S_2$ —exciting coil of mg_4-E_1

whereby the electromagnetic switch mg_4 is excited to close the circuit of the motor M_4 . By the closing of the circuit of the motor M_4 , this motor starts and drives the screw conveyor 26, whereby the stock-material in the accumulator 24 is discharged into the tank 2. When the stock-material charged into the tank 2 reaches a predetermined amount, the balance beam 4a is restored to its upper position and the switch S_1 is opened, whereby the circuit of the motor M_4 is opened by the opening of the exciting circuit of the electromagnetic switch mg_4 , and the screw conveyor 26 is stopped so as to cease charging of the stock-material into the tank 2 from the accumulator 24. By the upward movement of the balance beam 4a, the switch S_2 is closed so as to excite the electromagnet m_3 , whereby the bell-crank 6 is turned counterclockwise and the switch S_4 is closed. By the closing of the switch S_4 , the following circuit is closed:

$E_1-m_9-r_4-S_4-E_2$

Accordingly, the electromagnet m_9 is excited and pulls the string 23 to make the crank lever 22 turn counterclockwise, whereby the clutch 21 is disengaged and the string 19 is unwound by the self-weight of the door 18 and the weight of the material mounted on said door. By said opening of the door 18, the material in the tank 2 is discharged out.

With discharge of the stock-material in the tank, the balance beam 4a is lowered to close the switch S_1 , but the exciting circuit of the electromagnetic switch mg_4 is not closed, because the contact piece C_{11} of the switch S_{10} has been changed over to the contact P_2 by the opening of the door 18. Accordingly, the motor M_4 is maintained in its stopped state and charging of the stock-material into the tank 2 is not started.

On the other hand, the following circuit is made upon the opening of the door 18, because the contact piece C_{11} is changed over from the contact P_1 to the contact P_2 :

$E_2-C_{11}-P_2$ exciting coil of mg_3-E_1

By the closing of said circuit, the electromagnetic switch mg_3 is excited to close the circuit of the motor M_3 , whereby the motor M_3 starts, but the clutch 21 is in its disengaged state, so that the motor idles. Upon the complete discharge of the material out of the tank 2, the time switch R_4 operates and the circuit of the electromagnet m_9 is opened, whereby the crank lever 22 is restored so as to bring the clutch 21 to its engaged state. By this restoration of the clutch 21, the winding drum 20 is driven and winds up the string to close the door 18. Upon the complete closing of the door 18, the exciting circuit of the electromagnet mg_3 is opened and the circuit of the electromagnet mg_4 is closed, because the contact piece C_{11} of the switch S_{10} is changed over from

the contact P_2 to the contact P_1 , whereby the motor M_3 is stopped, and the motor M_4 is driven to start charging of the stock-material into the tank 2 from the accumulator 24 as already described.

Upon the complete closing of the door 18, the circuit ($E_2-C_{11}-P_1-S_1-m_4-E_1$) is closed and the electromagnet m_4 is excited, whereby the bell-crank 6 is restored to the shown state by the clockwise turning thereof and the switch S_4 is opened.

The above-mentioned operation is repeatedly carried out. As described above, the charging and discharging of the stock-material into and out of the tank 2 are automatically carried out.

In Fig. 3 is shown a measuring tank 1 which is particularly suitable for stock-liquid. This tank 1 is provided with a charge opening 35 having a charge valve 35a, a control lever 36 connected at its right side end to the rotatable shaft of said charge valve 35a, a discharge valve 38, a float 37, a push float 39, levers 43 and 44 pivoted, respectively, at the pivotal shafts 43a and 44a connecting levers 49, 42 and 45, a discharge valve supporting lever 40 which is pivoted at one end to a pivotal shaft 40a and articulated at another end to the connecting lever 42, a bell-crank 46 pivoted at a pivotal shaft 46b and articulated at the end of one arm thereof to the lower end of the connecting lever 45, and another bell-crank 48 pivoted at a pivotal shaft 48b and articulated at the end of one arm thereof to the connecting lever 49. The same electromagnet m_3 as that of the embodiment of Fig. 1 is connected, at its movable iron core, to the lower end of the connecting lever 49. The bell-cranks 46 and 48 are, respectively, provided with balls 46a and 48a on their arms and levers 43 and 44 are, respectively, provided with balls 43b and 44b on their right side portions.

Operation of the apparatus in Fig. 3 is as follows:

When the liquid in the tank 1 reaches a predetermined amount, the charge valve 35a is closed by the upward turning of the lever 36 caused by ascent of the float 37, whereby charging of the liquid into the tank 1 is stopped. By the upward movement of the float 37, the lever 44 is turned clockwise, whereby the bell-crank 46 is turned counterclockwise and the contact piece C_{10} of the switch S_{11} is changed over from the contact P_3 to the contact P_4 . By this change-over, such an electromagnet m_1 as shown in Fig. 1 is excited so as to turn the bell-crank 5 in Fig. 1. When the electromagnet m_3 is excited in the same manner as described in connection with the apparatus in Fig. 1, the lever 49 is pulled down and the discharge valve 38 is opened through the levers 43, 42 and 40, because the lever 40 supporting the valve 38 is turned up by said pulling. By said downward pulling of the lever 49, the bell-crank 48 is turned counterclockwise until it is stopped by a stop 48c. The balls 46a and 48a act to securely maintain the turned positions of the bell-cranks 46 and 48 and the opened state of the valve 38. By the opening of the valve 38, the charged stock-liquid is discharged out of the tank. Upon the complete discharge, the push float 39 pushes the valve 38 through the lever 40, whereby the valve 38 is closed and lever 49 is pulled up by the levers 43 and 42, said upward movement of the lever 49 causing clockwise turning of the bell-crank 48. On the other hand, the float 37 descends, whereby the lever 36 is turned downward and the lever 44 is turned counterclockwise. By the downward turning of the lever 36, the charge valve 35a is opened to start charging of the liquid into the tank 1. By the counterclockwise turning of the lever 44, the bell-crank 46 is turned clockwise so as to push the switch S_{11} , whereby the contact piece C_{10} is changed over from the contact P_4 to the contact P_3 . In such a state, charging of the stock-liquid into the tank 1 progresses and the above stated operation is repeatedly carried out upon the complete charging of the stock-liquid into the tank 1.

The embodiment of Fig. 4 relates to the case in which the mixture is of the pure liquid state and only the mixer

and connection of the device for discharging of the stock-liquids into the measuring tanks are different from those of the embodiment of Fig. 1. Connections and operations of the bell-cranks 5, 6 and 7, switches S_3 , S_4 and S_5 , electromagnets m_1-m_6 and m_8 , m_9 and m_{10} are almost same as those in the embodiment of Fig. 1, so that the description of said operations and indication of said connection are omitted herein. The switches S_{12} , S_{13} and S_{14} are constructed in the same manner as the switch shown in Fig. 1a.

In the state shown, the following circuit is closed:

$$E_1-S_{12}\text{---exciting coil of } mg_2-E_2$$

whereby the electromagnetic switch mg_2 is excited so as to close the circuit of the motor M_1 . By the closing of said circuit, the motor M_1 starts and drives the stirring shaft 53 in the mixer 9a through a pulley 50 attached to the shaft of the motor M_1 , a pulley 51 attached to said shaft 53 and a belt 52 hung on said pulleys, whereby the liquids in the mixer 9a are mixed. Upon the closing of the switch S_{12} , the time switch R_5 is excited, but its contact piece r_5 is not closed because of its time delay. The time lag of the time switch R_5 is selected so that said switch operates upon the completion of the mixing of the liquid in the mixer 9a. Accordingly, when said time lag has elapsed, the electromagnet m_{13} is connected to the input terminals E_1 and E_2 through the contact piece r_5 and switch S_{12} , whereby the bell-crank 54 pivoted at a pivotal shaft 54a is turned counterclockwise by the pulling of the left side arm of said crank by a string 55 which is connected to said arm and the movable iron core of the electromagnet m_{13} .

By the counterclockwise turning of the bell-crank 54, the switch S_{12} is pushed by the ball 54b supported by the center arm of said crank so as to be opened and the switch S_{13} is released from said ball so as to be closed. By the opening of the switch S_{12} , exciting circuits of the electromagnet m_{13} and the electromagnetic switch mg_2 are opened. Accordingly, the motor M_1 stops and the stirring operation of the mixer 9a is stopped. On the other hand, the discharge valve 60 provided in a discharge opening 60a of the mixer 9a is pushed upward by the counterclockwise turning of the bell-crank 54 through articulated connecting levers 56, 57 and 59, said lever 57 being pivoted at a pivotal shaft 58, whereby the mixed liquid in the mixer 9a is discharged into a container 61.

The time lag of the time switch R_6 inserted in the circuit of the switch S_{13} is selected so that said switch R_6 operates upon an elapse of a time sufficient to discharge completely the liquid from the mixer 9a. Upon the operation of the time switch R_6 , the electromagnet m_{14} is excited through the contact piece r_6 and switch S_{13} , whereby the bell-crank 54 is turned clockwise through a string 55a, and is restored to the state as shown and at the same time as said restoration, the valve 60 is closed by the reverse operation of the connecting levers 56, 57 and 59.

A switch S_{14} is connected in series to the circuit of the switches S_3 , S_4 and S_5 . The switch S_{14} is combined with a bell-crank 62 which is turnably supported by a pivotal shaft 62a so that said switch S_{14} may be opened by counterclockwise turning of said crank, said turning being induced by excitation of an electromagnet m_{15} . Said excitation of the electromagnet m_{15} is induced by the closing of the switch S_{12} , so that discharging of the stock-liquid into the mixer from the measuring tanks is stopped during the stirring operation of the mixer 9a. Upon the complete discharge of the liquid from the mixer 9a, the electromagnet m_{18} is excited at the same time as the excitation of the electromagnet m_{14} through the contact piece r_8 and the switch S_{13} , whereby the bell-crank 62 is restored.

The embodiment of Fig. 5, relates to the case in which the mixed material is in the kneaded state, said embodiment being almost the same as the embodiments of

Fig. 1 or Fig. 4 except the mixing device. Accordingly, only the mixing device is shown.

The mixer 9b is of a special type having a large upper opening and is supported so that discharging of the kneaded mixture in the mixer 9b may be carried out after the mixer is turned by 180° so as to direct the opening downward. For said object, the mixer 9b is rotatably supported by a frame 62 so as to be rotated by an electric motor M₅ through a gear 63 attached to the mixer body, a gear 64 attached to the shaft of said motor and a chain belt 65 hung on said gears. The mixer 9b is provided with a stirring basket therein which is driven by an electric motor M₁ through a pulley 50 attached to the shaft of said motor M₁, a pulley 51 attached to the shaft of said basket and a belt 52 hung on said pulleys. The mixer 9b is further provided with switches S₁₇ and S₁₈, each having a push piece 70 pivoted at a pivotal shaft 70a, said switches being positioned so that said push piece 70 may be pushed by a pin 69 attached to the mixer when the opening of the mixer is directed up and down, respectively, and said switches being constructed so that when said push piece 70 is pushed by the pin 69, said switch S₁₇ may be closed and said switch S₁₈ may be opened.

In the shown embodiment, the electromagnetic switch mg₁ is excited through the switch S₁₈ from the input terminals E₁ and E₂ and the circuit of the motor M₁ is in connection with the input terminals E₁ and E₂, whereby the stirring basket in the mixer 9b is operated. On the other hand, the time relay R₇ is excited from the terminals E₁ and E₂ through a switch S₁₅. The time relay R₇ is designed so that it may operate after a predetermined time required for the thorough stirring of the kneaded mixture in the mixer 9b. Upon the elapse of said time lag, the time relay R₇ operates to close the contact piece r₇, whereby the electromagnetic switch mg₅ is excited through the contact piece r₇ and switch S₁₅. Accordingly, the motor M₅ starts so as to rotate the mixer 9b through the chain belt 65. When a pin 67 attached to the chain belt 65 reaches a certain height, the left arm of a bell-crank 66 is pulled upward by a string 68 which is connected to said arm and pin 67, whereby the bell-crank 66 is turned clockwise around its pivotal shaft 66b, the switch S₁₅ is opened, and the switch S₁₆ is closed. The time when the bell-crank 66 is turned by the pin 67 is selected so that said turning may be induced just upon rotation of the mixer 9b by 180°. In this state, the switch S₁₈ is opened by the pin 69 to open the circuit of the electromagnetic switch mg₁, whereby the motor M₁ is stopped. By the opening of the switch S₁₅, the electromagnetic switch mg₅ is opened and the motor M₅ is stopped so as to stop the mixer in its inverted state for discharging the kneaded mixture therefrom. By the closing of the switch S₁₆, another time relay R₈ is excited. The time lag of the relay R₈ is selected so that said relay may operate upon the complete discharge of the kneaded mixture out of the mixer. Upon the elapse of said time lag, the contact piece r₈ is closed and the exciting circuit of the electromagnetic switch mg₆ is connected to the input terminals E₁ and E₂ through the contact piece r₈ and the switch S₁₆, whereby the motor M₅ is connected to the terminals E₁ and E₂ so as to be rotated in the direction reverse to that of the former case. Accordingly, the mixer 9b is reversely rotated through the chain belt 65, but is stopped upon the restoration of the pin 67 to its initial position because the bell-crank 66 is pulled by the string 68 so as to be turned counterclockwise and the switch S₁₆ is opened, whereby the mixer 9b is restored so as to be charged with the stock-materials from the measuring tanks, not shown. On the other hand, upon starting of the reverse rotation of the mixer 9b, the switch S₁₈ is closed again so as to excite the electromagnetic switch mg₁, whereby the motor M₁ is started again and the mixing operation begins. Upon restoration of the mixer 9b, the movable piece 70 of the

switch S₁₇ is pushed by the pin 69 and the switch S₁₇ is closed, so that when said switch is used for inducing the charging of the stock-materials into the mixer from the measuring tanks in the same manner as in the case in Fig. 1 or Fig. 4, said charging can be automatically carried out upon restoration of the mixer 9b.

In such a manner as stated, the charging of the materials into and discharging of the kneaded mixture out of the mixer can be automatically carried out.

According to this invention, as described above, dischargings of the stock-materials from all measuring tanks are stopped until all said tanks have been charged with stock-materials of predetermined amounts, respectively, and said dischargings are simultaneously carried out into a mixer. The mixture in the mixer is discharged upon the complete mixing thereof, and then charging of the stock-materials into the measuring tanks is carried out. Accordingly, the mixing of several kinds of stock-materials can be very effectively carried out.

While I have described particular embodiments of my invention, it will, of course, be understood that I do not wish my invention to be limited thereto, since many modifications may be made and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

I claim:

1. Apparatus for automatically mixing several kinds of stock-materials, which comprises measuring tanks for several different materials, each measuring tank being provided with a charging device for charging said tank with a predetermined amount of a stock-material and with a discharge device for discharging the charged material out of said tank, and a mixing device for mixing the mixture charged therein from said measuring tanks, said mixing device being provided with a discharge device for discharging the mixture from said mixing device, interlocking control means for said measuring tank charging device so arranged that the stock-materials in the measuring tanks may be simultaneously discharged into said mixing device only when the charged materials in all the measuring tanks have reached the predetermined amounts, said control means being so arranged for charging of the stock-materials into the measuring tanks, discharging of said materials out of said tanks into the mixing device, stirring action in the mixing device, and discharging of the mixed mixture out of the mixer may be successively and automatically repeated.

2. Apparatus for automatically mixing several kinds of stock-materials according to claim 1, in which said interlocking control means include a plurality of quickly turnable devices combined with electric switches which are opened or closed by turning of said devices.

3. Apparatus for automatically mixing several kinds of stock-materials according to claim 1, in which each measuring tank is provided with an electric switch, a quickly turnable device operated by electromagnets which is turnably supported so as to open said switch when turned to one side when said tank is empty and to close said switch when turned to the other side when said tank is charged with a desired amount of the stock-material, and an electromagnetically operated means for discharging the stock-material out of each said tank, said switches of all the measuring tanks being connected in series to the input terminals of an electric source through said electromagnets, and a time switch being connected in series in said electric circuit so as to open said circuit with a time lag required for the complete discharge of the stock-material out of said tanks, a mixing device provided with a hopper to receive the stock-materials from the measuring tanks, and a discharge conduit that may be lowered for emptying said mixing device, said mixing device being combined with a winding device for lifting or lowering said conduit, a weighing beam device provided with electric switches combined with the other electric switches provided at the measuring

11

tanks so that when the stock-materials in said tanks reach the desired amounts discharging of said materials from said tanks may be carried out.

4. A system of automatically mixing several kinds of stock-materials which comprises stock-material discharge tanks for discharging a predetermined amount of each of the stock-materials to be mixed, said predetermined amounts being selected so as to prepare a suitable mixed material, each said tank being provided with a discharge device so as to discharge only a predetermined amount of the stock-material, a mixer arranged to receive the stock-materials discharged from said tanks, the discharge device of said tanks being so arranged that the discharge operation of said tanks will be commenced only upon the complete discharge of the mixed material from said mixer, the discharge device of said mixer being provided with an electric device which makes the discharge operation of said mixer commence upon the complete mixing of the materials in said mixer.

5. A system of automatically mixing several kinds of stock-material which comprises several kinds of measuring tanks, each tank being provided with a charge device for charging a predetermined amount of a stock-material therein and with a discharge device for discharging the charged material therefrom, a mixer arranged to receive the stock-materials discharged out of said measuring tanks and provided with a mixing device therein and a discharge device for discharging the mixed material therefrom, an electric switch device which is so related to the discharge devices of said measuring tanks that only when the materials in all said tanks have reached to predetermined amounts, the discharging operation of said tanks may be simultaneously carried out, an electric device which operates the mixing device of said mixer only when said mixer is charged with the materials from the measuring tanks, and an electric switch device which is so related to the discharge device of said mixer that the discharge operation of the mix-

12

ture in said mixer may be carried out upon the complete mixing of said mixture, the charge device of each measuring tank being provided with an electric device which makes the charging operation into said tank commence upon the complete discharge of the stock-material in said tank.

6. A system of automatically mixing several kinds of stock-materials which comprises several kinds of stock-material storage tanks, each tank being provided with a discharge device for discharging the stocked material therefrom, measuring means for measuring a predetermined amount of stock-material from each said storage tank, a mixer arranged to receive the stock-materials from said tanks, a discharge device for discharging the mixed material therefrom, and an electric switch device which is so related to the discharge device of said mixer and to the discharge devices of said tanks that the discharge operation of said tanks may be commenced upon the complete discharge of the mixed material in said mixer, the discharge device of each tank being provided with a switch acting to stop the discharging operation of said tank upon the discharge of a predetermined amount of the stock-material, and the discharge device of the mixer being provided with an electric device which makes the discharge operation of said mixer commence upon the complete mixing of the materials in said mixer.

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