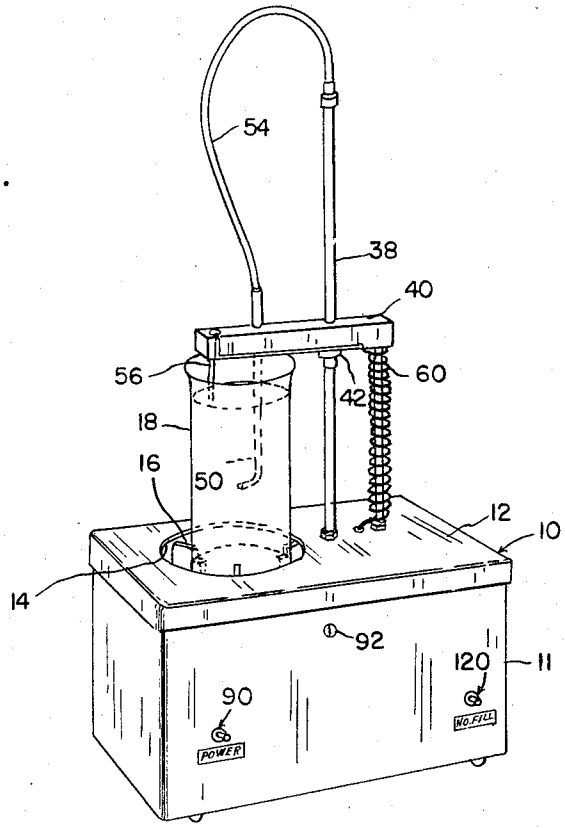
Oct. 7, 1958 H. L. JAMESON ET AL 2,855,098

APPARATUS FOR REMOVING CLAY FROM A FOUNDRY SAND SPECIMEN

Filed Oct. 30, 1956 3 Sheets-Sheet 1

FIG.1.



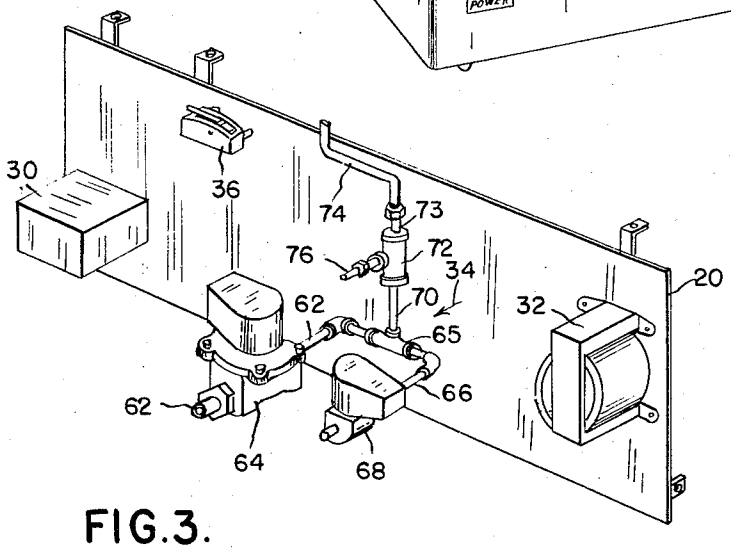


FIG.3.

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APPARATUS FOR REMOVING CLAY FROM A FOUNDRY SAND SPECIMEN

Filed Oct. 30, 1956 3 Sheets-Sheet 2

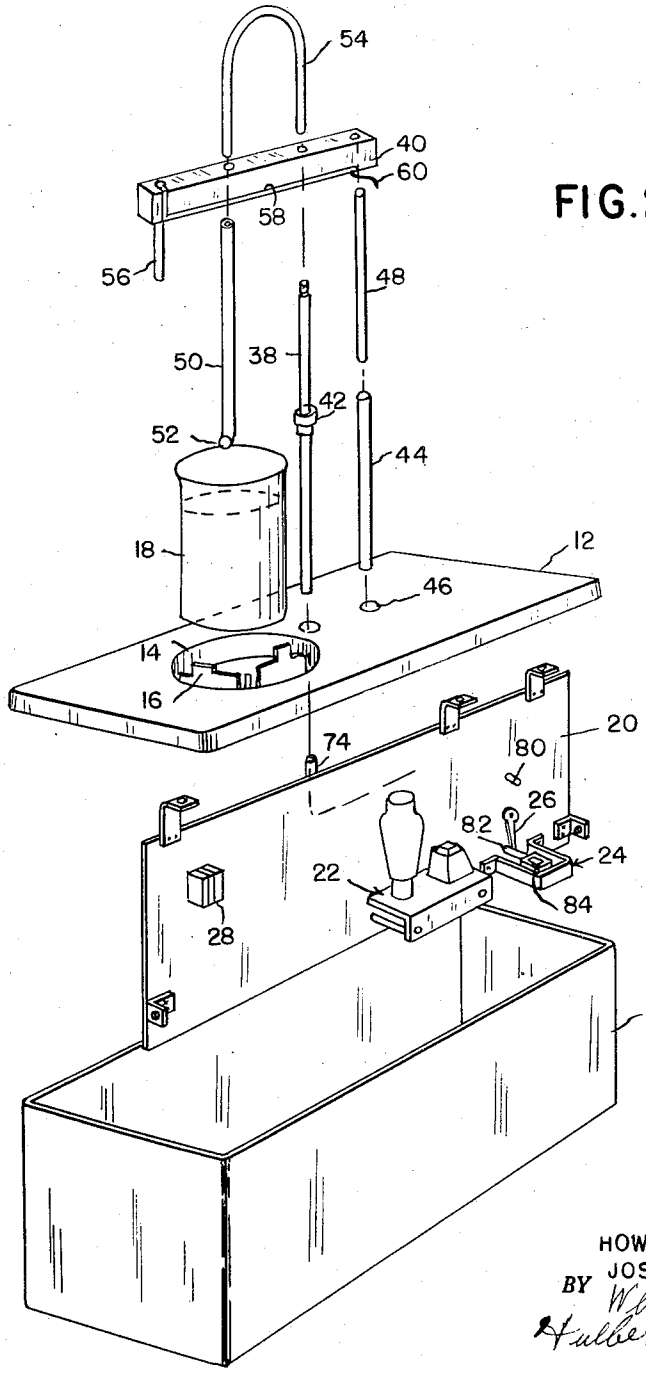

FIG. 2.

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Filed Oct. 30, 1956 3 Sheets-Sheet 3

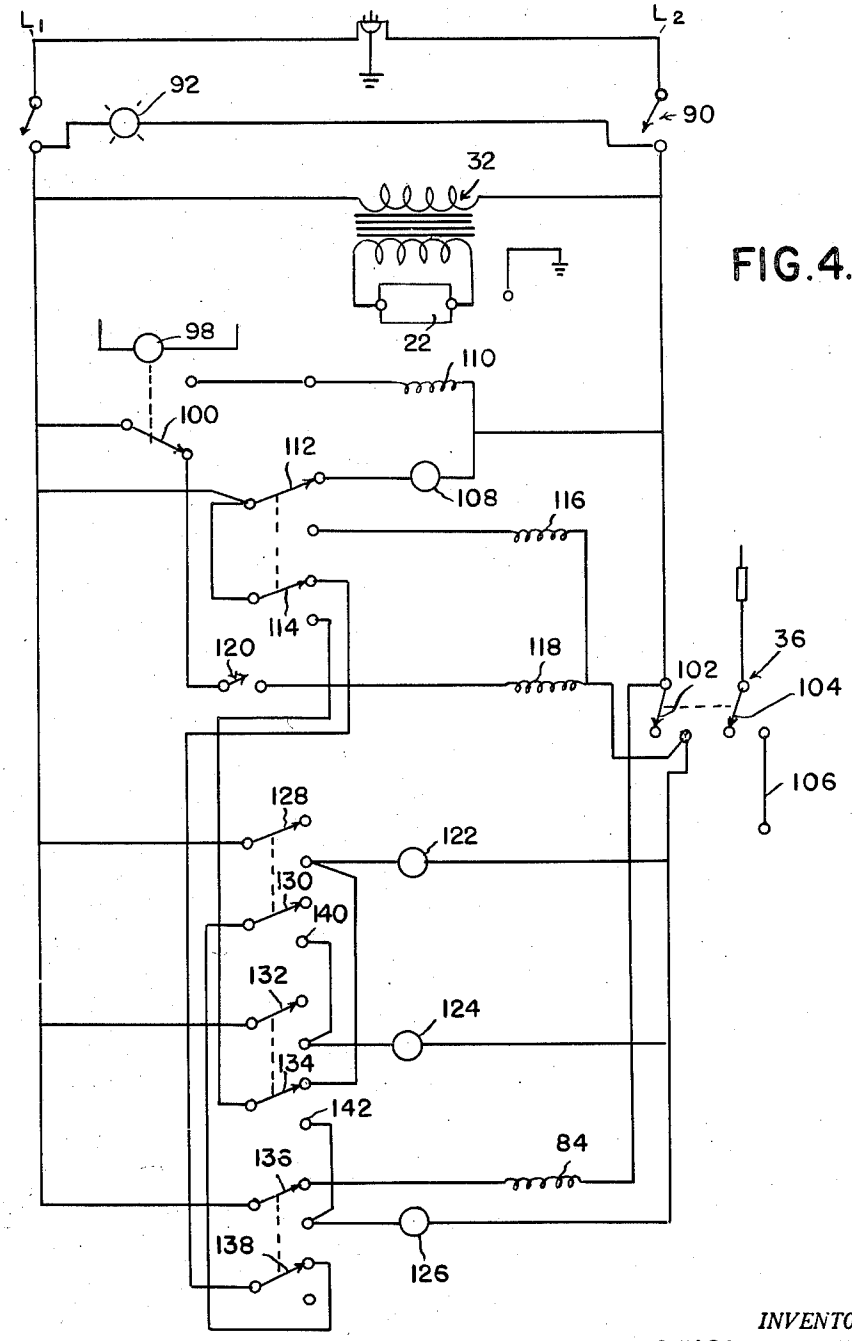

FIG. 4.

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United States Patent Office 2,855,098
Patented Oct. 7, 1958

2,855,098

APPARATUS FOR REMOVING CLAY FROM A FOUNDRY SAND SPECIMEN

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Application October 30, 1956, Serial No. 619,207

18 Claims. (Cl. 209—209)

The present invention relates to an apparatus for removing clay from a foundry sand specimen.

It is an object of the present invention to provide improved apparatus for automatically removing the clay content of molding sand from a measured specimen thereof.

More specifically, it is an object of the present invention to provide fully automatic means for repeatedly adding water to a predetermined level to sand in a receptacle, agitating the mixture of sand and water to provide for suspension of particles therein, providing a measured settling interval, and thereafter removing water from above a predetermined lower level from the receptacle.

Still more specifically, it is an object of the present invention to provide fully automatic means to control the addition and removal of water from sand in a receptacle by providing a probe sensitive to contact with the surface of the water for determining its upper level, and a siphon having an inlet at a predetermined position below said probe to determine the lower level of water.

It is a further object of the present invention, in apparatus of the character described, to provide a self-priming siphon having a discharge leg connected to inlet and outlet legs each containing a control valve.

It is a further object of the present invention to provide compact and efficient sand washing apparatus including a support for a receptacle, a bar mounted for vertical movement on said support, a top surface probe carried by said bar, and a siphon inlet tube carried by said bar having an inlet opening at a predetermined level below said surface probe.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

Figure 1 is a perspective view of the sand washing apparatus.

Figure 2 is a view of the sand washing apparatus exploded to expose the component parts thereof.

Figure 3 is a perspective view showing the rear of the support panel, the front of which appears in Figure 1.

Figure 4 is a simplified wiring diagram of the apparatus.

The apparatus is designed for the purpose of removing clay from a measured specimen of foundry sand. The operation is a part of a determination of the percentage of clay. In general, the operation consists of mixing water with the sand, agitating the mixture to provide a suspension, letting the mixture settle so that heavier particles can settle out, and thereafter withdrawing the upper portion of the water and clay suspension down to a predetermined level.

The operation is a standard operation as controlled by specifications of the American Foundrymen's Society. The procedure calls for the removal of all particles which settle in water at a rate of less than one inch per minute. In practice, a 50-gram sample of sand is mixed with 475 cc. of water and 25 cc. of a standard sodium hydroxide

solution. The mixture is agitated and then allowed to settle. The settling periods and the quantity of water are standardized. The first and second settling periods are of ten minutes each and following each settling period the top five inches of water are siphoned or otherwise drawn off. Thereafter, the operation may be continued as long as required except that the settling periods are reduced to five minutes.

As best seen in Figure 1, the apparatus comprises a support **10** in the form of an open topped cabinet **11** having a removable closure **12** provided with an opening **14** therein having legs **16** for the reception of the specimen receptacle **18**. The component parts of the apparatus are best seen in the exploded view of Figure 2 and the rear view of the panel as seen in Figure 3. Within the cabinet **11** is a support panel **20**. Mounted on the front of the panel **20** is an electronic water level control unit **22**, a timer control solenoid unit **24**, and the movable hand **26** of a timer. Also, carried at the front of the panel **20** are a plurality of relays indicated generally at **28**.

At the rear of the panel, as best seen in Figure 3, there is provided the electrical timer **30** the movable hand **26** of which is seen in Figure 2, a transformer **32**, and water control connections indicated generally at **34** which will subsequently be described. Also, mounted on the back of the panel **20** is a micro switch **36** used to initiate automatic cycling of the apparatus as will presently appear.

Fixedly mounted to extend upwardly from the removable closure **12** is a rigid conduit **38** which serves as a guide and support for a carrier bar **40**. For this purpose the conduit **38** is provided with an adjustable stop **42** thereon engageable by the carrier bar **40** to limit its downward movement and so to predetermine its position relative to the receptacle **18**. Also extending upwardly from the removable closure **12** is a guide tube **44** which is secured in an opening **46** in the closure **12**. Associated with the guide tube **44** is a guide rod **48** fixedly secured to extend downwardly from the carrier bar **40**. The rod **48** is vertically movable in guiding relation in the tube **44** and is of such length that when the bar **40** engages the stop **42**, the lower end of the rod moves through the opening **46** and trips the micro switch **36** to initiate cycling of the apparatus.

Extending downwardly from the carrier bar **40** is a rigid siphon inlet tube **50** having its lower end portion turned as indicated at **52** so that when water is ejected therefrom, it acts as a nozzle and agitates the mixture of sand and water in the receptacle **18**. The upper end of the tube **50** is fixed in an opening in the bar **40** and is connected to the upper end of the conduit **38** by a flexible tube **54**.

Also rigidly connected to the carrier bar **40** to extend downwardly therefrom is a top surface probe element **56** which is electrically connected by suitable means such as the metal foil indicated at **58** to a conductor **60** leading to the electronic level control device **22**.

From the foregoing it will be observed that when the parts are assembled together as illustrated in Figure 1, the bottom of the probe **56** is a predetermined distance above the opening into the lower end of the siphon tube **50** and that the vertical spacing between these elements is independent of the vertical position of the support or carrier bar **40**. This is an important feature of the present invention and provides automatic means for complying with the requirements of the American Foundrymen's Society for testing clay content of sand.

Referring now more particularly to Figure 3 there is provided a water inlet line **62** having a solenoid controlled inlet valve **64** therein. The inlet line **62** connects to a T **65** to which is connected the outlet line **66**, also

controlled by a solenoid actuated outlet or drain valve 68. The third branch of the T connects to a line 70 leading to a T 72, a line 73, and a flexible conduit 74 which is connected to the lower end of the conduit 38 previously described. Connected to the third branch of the T 72 is a lower level control probe 76 which comprises a contact element adapted to be electrically connected to the electronic level control apparatus 22.

It may be noted at this time that the electronic level control apparatus comprises means responsive to an electrical condition, such for example as electrical capacity effective on a probe surface and includes suitable electronic elements whose details form no part of the present invention. Thus, in the present instance the probes 56 and 76 may be connected in parallel so that the effective electrical capacities surrounding the probes are additive. Under these conditions when the water reaches the top level probe, the high effective capacity of the top level probe is additive to the high effective capacity of the low level probe. When the water level is intermediate the top level probe and the inlet to the siphon, the resultant effective capacity from the two probes is the relatively high value effective at the lower probe 76. When the siphon has sucked air so that an air bubble surrounds the exposed area of the probe 76, then the additive capacity of the two probes is at an extremely low value. From the foregoing it will be observed that conditions exist for effecting control of a relay as follows: The relay closes when the top level of water reaches the top level probe, and remains energized as the level of water falls until it uncovers the bottom probe, at which time the relay is de-energized and remains de-energized until the top level of water again reaches the top level probe.

It is sufficient to note that the electronic level control device finally controls a relay in such a way that the relay is energized when the level of water in the receptacle reaches the lower end of the probe 56 and remains energized until a bubble of air in the T 72 reaches the surface of the probe 76 within the T, thus signaling that the siphon tube 50 has lowered the level of water in the receptacle to its inlet port. At this time the relay is de-energized and remains de-energized until the level of water in the receptacle again reaches the probe 56.

The cycle of operation which repeats over and over until shut off by the operator, will now be described. Assuming the measured quantity of sand in the receptacle, the outlet or drain valve 68 is closed and the inlet valve is opened, permitting water to flow in through the tube 50 where it mixes with the sand and produces agitation thereof causing suspension of sand and fine particles in the water. The addition of water continues until the upper level of water reaches the top level probe 56. At this time by means which will subsequently be described, the inlet valve 64 is closed and a timer is started to provide a measured interval during which the particles in suspension may settle. After the timer has timed out, which for the first cycle is after a ten minutes' settling period, the outlet or drain valve 63 is opened. At this time since the lines 66, 70, 73, 74, 38, 54 and 50 are all filled with water, there is provided a siphon which is self-priming and as soon as the valve 68 opens, siphoning starts and the top five inches of water together with all fine particles still suspended therein is siphoned off. As soon as the level of water reaches the inlet port at the bottom of the siphon tube 50, air is drawn into the system and a bubble of air reaches the T 72 where it excludes water from the exposed area of the bottom level probe 76. This has the effect of energizing the electronic level control relay, which closes the valve 68, opens the valve 64, and starts the second cycle. This cycle is automatically repeated over and over with the exception of one change which takes place following the second cycle.

The timing means is of the type including a motor and clutch, the motor driving the indicating hand 26 when it is clutched thereto and also controlling switch contacts as will subsequently be described in the wiring diagram. The timer includes a fixed post 80 and a resilient return spring is connected to the hand 26 so that when the clutch is de-energized the hand 26 returns to starting position against the post 80. After two cycles have been completed a movable stop pin 82 is advanced by spring means (not shown) into position to be engaged by the hand 26 as it is returned by its spring when its clutch is disengaged. During the first two cycles of the machine the pin is retained in retracted position by a solenoid 84. After the completion of the second cycle the solenoid is de-energized and the spring projects the pin into the path of the hand 26. Thereafter, the hand is not permitted to return to its initial starting position but instead returns to an intermediate starting position so that it will time out after a reduced cycle. In practice, the first two settling periods are of ten minutes' duration and succeeding settling periods are of five minutes' duration.

Referring now to the wiring diagram there is provided a main control switch 90 closure of which energizes a pilot light 92, and a transformer 32 which powers the electronic level control device 22. The details of the automatic level control are not included herein but it is effective to energize and de-energize a relay 98 adapted to control a switch 100. The micro switch 36 which is closed by movement of the support bar 40 to operative position, includes a main circuit control arm 102 adapted to energize the control circuit generally, and an electronic level control arm 104 making contact with a line 106 which in practice is connected to the electronic control device 22.

The electric timer includes a timer motor 108 and a relay 110 controlling the clutch connecting the motor to the indicating hand 26 and the switch mechanism. The electric timer switch includes switch arms 112 and 114. The solenoid of the drain or outlet valve 68 is indicated at 116, and the solenoid of the inlet valve 64 is indicated at 118. The manually controlled "no-fill" switch is indicated at 120 and also appears in Figure 1.

Relays 122, 124 and 126 are provided and the relay 84 of the timer control solenoid is indicated in the figure. Relay 122 controls switch arms 128 and 130. Relay 124 controls switch arms 132 and 134. Relay 126 controls switch arms 136 and 138.

With the foregoing general description of the circuit the operation will be briefly described. The succeeding operation will have been brought to a close by opening the no-fill switch 120 which will terminate cycling of the machine after completion of a wash cycle, and presumably thereafter the power switch 90 will have been opened. The micro switch 36 will be open so long as the support bar 40 is in upper position. The receptacle 13 will not be filled with water, and accordingly the electronic level control relay 98 will be de-energized and its switch arm 100 in its lowermost position as illustrated in the figure. At this time the operator may close the no-fill switch 120 and the power switch 90. With a receptacle with the measured quantity of sand therein placed on the support 16, the support bar 40 is moved downwardly into engagement with the stop 42, thereby positioning the probe 56 within the receptacle and also closing the micro switch 36. Closure of the micro switch 36 closes a circuit through the switch arm to the electronic level control and also completes a circuit through the switch arm 102 which in general provides for completion of the various control circuits as will now be described.

In the first place a circuit is completed through the switch arm 112 to the timer motor 108. However, the relay 110 controlling the timer clutch is de-energized so that the timing interval is not started.

Closure of the switch arm 102 completes a circuit through the no-fill switch 120 and the solenoid 118 of the inlet valve 64 and accordingly, water flows into the receptacle. This continues until the upper level of water reaches the probe 56 at which time the relay 98 is ener-

gized and shifts the control arm **100** upwardly to complete a circuit to the timer clutch **110**. This initiates a timing cycle which in this instance will be ten minutes. In addition, upward movement of the arm **100** breaks the circuit to the solenoid **118** of the inlet valve and accordingly inflow of water is terminated.

At the conclusion of the predetermined interval as timed by the timer **30** the timer switch operates to shift the switch arms **112** and **114** downwardly. Downward movement of the switch arm **112** completes a circuit to the drain valve solenoid **116** and accordingly, siphoning off of the water in the receptacle immediately commences. At the same time, downward movement of switch arm **114** completes a circuit through the switch arm **134** through the relay **122** thereby shifting switch arms **128** and **130** downwardly. Downward movement of the switch arm **128** completes a holding circuit through the relay **122** and downward movement of the switch arm **130** prepares a circuit for subsequent operation.

After the top five inches of water have been siphoned off from the receptacle, the siphon sucks air and the air bubble surrounds the exposed area of the probe **76** in the **T 72** which de-energizes the electronic level control relay **98** causing its switch arm **100** to move downwardly to complete a circuit through the solenoid **118** of the inlet valve **64**, thus initiating a second cycle. At the same time, downward movement of the switch arm **100** de-energizes the clutch relay **110** permitting the spring means to move the switch arms **112** and **114** upwardly to the position shown in Figure 4. This has the effect of completing a circuit through the switch arm **114**, the switch arm **138**, and the switch arm **130** which at this time engages the contact **140** by reason of the holding circuit through the relay **122**. This shifts the switch arms **132** and **134** downwardly establishing a holding circuit through the relay **124** and maintaining the switch arm **134** in engagement with the contact **142**.

As soon as the level of water in the receptacle reaches the top level probe, relay **98** is again energized shifting the switch arm **100** upwardly to start a second timing cycle, upon the completion of which timer switch arms **112** and **114** move downwardly. Downward movement of the timer switch arm **112** again opens the drain valve by energizing drain valve solenoid **116**. At this time downward movement of the switch arm **114** completes a circuit through switch arm **134** and contacts **142** through the relay **126**. Energization of the relay **126** moves the switch arms **136** and **138** downwardly. Downward movement of the switch arm **136** deenergizes solenoid **84** and releases the stop pin **82** for movement into the path of the timer hand **26**. Thereafter the cycle is repeated over and over without variation except that the timing interval is now of decreased duration by reason of the pin **82** preventing full return movement of the timer hand **26**.

When the operator determines that the fine suspended material has been removed from the specimen, the no-fill switch is opened. This has no immediate effect and permits the cycling to continue up to the point where water is siphoned off from the receptacle and the refilling of the receptacle would normally be initiated. At this time the receptacle with the sand and water remaining therein is removed, the water removed from the sand, and the sand weighed to determine by loss of weight the quantity of clay which was originally included therein.

The drawings and the foregoing specification constitute a description of the improved automatic sand washer in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. An automatic apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for containing sand and water, water addition means for adding water to said receptacle, agitating means for agitating the mixture in said receptacle to cause suspension of fine particles in the water, water withdrawal means for withdrawing water and particles suspended therein from the mixture above a predetermined level therein, automatic control means for actuating said water addition means and said agitating means to fill said receptacle to a predetermined level and for agitating said mixture, and timing means for providing a measured interval for settling of particles and thereafter initiating operation of said water withdrawal means to lower the water to a predetermined level.

2. An automatic apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for containing sand and water, water addition means for adding water to said receptacle, said addition means including agitating means for agitating the mixture in said receptacle to cause suspension of fine particles in the water, water withdrawal means for withdrawing water and particles suspended therein from the mixture above a predetermined level therein, automatic control means for actuating said water addition means and said agitating means to fill said receptacle to a predetermined level and for agitating said mixture, and timing means for providing a measured interval for settling of particles and thereafter initiating operation of said water withdrawal means to lower the water to a predetermined level, said automatic control means being responsive to the water level reaching a predetermined minimum for terminating operation of said water withdrawal means and initiating operation of said water addition means and agitating means.

3. An automatic apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for containing sand and water, water addition means for adding water to said receptacle, said addition means including agitating means for agitating the mixture in said receptacle to cause suspension of fine particles in the water, water withdrawal means for withdrawing water and particles suspended therein from the mixture above a predetermined level therein, automatic control means for actuating said water addition means and said agitating means to fill said receptacle to a predetermined level and for agitating said mixture, and timing means for providing a measured interval for settling of particles and thereafter initiating operation of said water withdrawal means to lower the water to a predetermined level, said automatic control means being responsive to the water level reaching a predetermined minimum for terminating operation of said water withdrawal means and initiating operation of said water addition means and agitating means, said automatic control means being responsive to the level of water reaching a predetermined maximum for terminating operation of said water addition and agitating means and starting said timing means.

4. Apparatus as defined in claim 3 in which said water addition and agitating means comprises a nozzle arranged to discharge water forcibly into said receptacle.

5. Apparatus as defined in claim 3 in which said water withdrawal means comprises a siphon with its intake disposed at a predetermined distance below the maximum water level in said receptacle.

6. Apparatus as defined in claim 3 in which the water addition and withdrawal means together comprise a first tube having an open end adapted to be disposed within said receptacle at a fixed level therein, a second tube extending vertically outside said receptacle and connected at its upper end to the upper end of said first tube, the lower end of said second tube being below the open lower end of said first tube, supply and drain lines connected to the lower end of said second tube, and valves in said lines operable to supply water when the valve in said supply line is open and the valve in said drain

line is closed, and to initiate siphoning when the valve in said drain line is open and the valve in said supply line is closed.

7. Apparatus as defined in claim 3 in which said automatic control means comprises top and bottom probes responsive to movement of water level thereto.

8. In apparatus of the character described comprising a receptacle, means for adding water to the receptacle to a predetermined level and for removing water to a second lower predetermined level, comprising a first tube having an open end adapted to be disposed within said receptacle at said second lower predetermined level therein, a second tube extending vertically outside said receptacle and connected at its upper end to the upper end of said first tube, the lower end of said second tube being below the open lower end of said first tube, supply and drain lines connected to the lower end of said second tube, and valves in said lines operable to supply water when the valve in said supply line is open and the valve in said drain line is closed, and to initiate siphoning when the valve in said drain line is open and the valve in said supply line is closed.

9. In apparatus of the character described comprising a receptacle, means for adding water to the receptacle to a predetermined level and for removing water to a second lower predetermined level, comprising a first tube having an open end adapted to be disposed within said receptacle at said second lower predetermined level therein, a second tube extending vertically outside said receptacle and connected at its upper end to the upper end of said first tube, the lower end of said second tube being below the open lower end of said first tube, supply and drain lines connected to the lower end of said second tube, and valves in said lines operable to supply water when the valve in said supply line is open and the valve in said drain line is closed, and to initiate siphoning when the valve in said drain line is open and the valve in said supply line is closed, said first tube having its lower end portion inclined to induce turbulence in water in the receptacle.

10. In apparatus for removing clay from a measured specimen of foundry sand or the like, a support, a receptacle for sand and water positioned on said support, a first vertical conduit fixedly mounted on said support to extend upwardly therefrom, a transverse bar movable vertically on said conduit, a second conduit fixedly mounted on said bar and extending downwardly therefrom and movable into the open end of said receptacle, stop means on said first conduit engageable by said bar to determine the spacing of the lower end of said second conduit from the bottom of said receptacle, a flexible tube connecting the upper ends of said conduits and means for supplying and drawing off water through said conduits and tube.

11. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a support, a receptacle for sand and water positioned on said support, a first vertical conduit on said support, a transverse bar movable vertically on said conduit, a second conduit extending downwardly from said bar and movable into the open end of said receptacle, stop means on said first conduit engageable by said bar to determine the spacing of the lower end of said second conduit from the bottom of said receptacle, and a flexible tube connecting the upper ends of said conduits, a probe depending from said bar and movable into the receptacle, said probe comprising part of a water level sensitive device and being positioned a predetermined distance above the open end of said second tube.

12. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a support, a receptacle for sand and water positioned on said support, a first vertical conduit on said support, a transverse bar movable vertically on said conduit, a second conduit extending downwardly from said bar and movable into the open end of said receptacle, stop means on said first conduit engageable by said bar to determine the spacing of the lower end of said second conduit from the bottom of said receptacle, and a flexible tube connecting the upper ends of said conduits, a probe depending from said bar and movable into the receptacle, said probe comprising part of a water level sensitive device and being positioned a predetermined distance above the open end of said second tube, said second tube being connected to operate as the inlet to a siphon system so as to drain water to a level in said receptacle determined by the location therein of its open end.

13. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a support, a receptacle for sand and water positoned on said support, a first vertical conduit on said support, a transverse bar movable vertically on said conduit, a second conduit extending downwardly from said bar and movable into the open end of said receptacle, stop means on said first conduit engageable by said bar to determine the spacing of the lower end of said second conduit from the bottom of said receptacle, and a flexible tube connecting the upper ends of said conduits, a probe depending from said bar and movable into the receptacle, said probe comprising part of a water level sensitive device and being positioned a predetermined distance above the open end of said second tube, said second tube being connected to operate as the inlet to a siphon system so as to drain water to a level in said receptacle determined by the location therein of its open end, the relative position of said second tube and probe being fixed so that a fixed difference in water level is effective thereon irrespective of the exact position of said receptacle.

14. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a support, a receptacle for sand and water positioned on said support, a first vertical conduit on said support, a transverse bar movable vertically on said conduit, a second conduit extending downwardly from said bar and movable into the open end of said receptacle, stop means on said first conduit engageable by said bar to determine the spacing of the lower end of said second conduit from the bottom of said receptacle, a flexible tube connecting the upper ends of said conduits, a guide tube extending upwardly from said support, a guide rod fixed to said bar and movable in said guide tube and adapted to extend below said support when said bar is in lowermost position, and an automatic control circuit for said apparatus including a switch below said support in position to be engaged by said rod.

15. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for sand and water, automatic means for adding water to a predetermined upper level therein, timing means for providing a settling period, means operated by said timing means to drain water from above a predetermined lower level in said receptacle, said automatic means being responsive to the water level reaching its lower value for refilling the receptacle.

16. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for sand and water, automatic means for adding water to a predetermined upper level therein, timing means for providing a settling period, means operated by said timing means to drain water from above a predetermined lower level in said receptacle, said automatic means being responsive to the water level reaching its lower value for refilling the receptacle, said timing means being automatically started by the water level reaching its upper level.

17. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for sand and water, automatic means for adding

water to a predetermined upper level therein, timing means for providing a settling period, means operated by said timing means to drain water from above a predetermined lower level in said receptacle, said automatic means being responsive to the water level reaching its lower value for refilling the receptacle, said timing means being automatically started by the water level reaching its upper level, said timing means and said automatic means being alternately operable to fill and drain said receptacle until turned off by an operator.

18. Apparatus for removing clay from a measured specimen of foundry sand or the like comprising a receptacle for sand and water, automatic means for adding water to a predetermined upper level therein, timing means for providing a settling period, means operated by said timing means to drain water from above a predetermined

lower level in said receptacle, said automatic means being responsive to the water level reaching its lower value for refilling the receptacle, said timing means being automatically started by the water level reaching its upper level, said timing means and said automatic means being alternately operable to fill and drain said receptacle until turned off by an operator, and means operable after a predetermined number of cycles to reduce the settling period provided by said timing means.

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