

May 21, 1929.

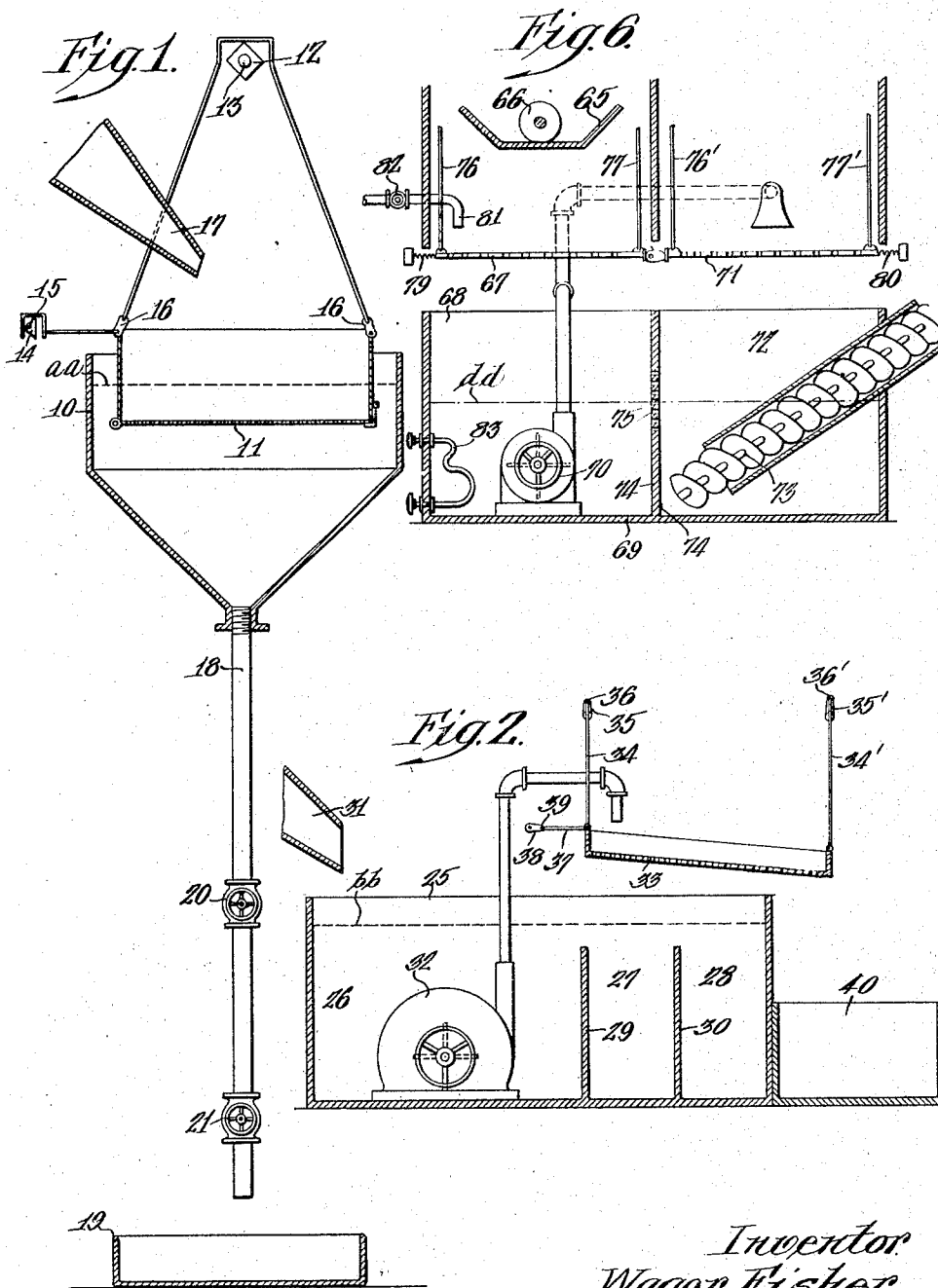
W. FISHER

1,713,869

APPARATUS FOR PREPARING MOLDING SAND

Filed Aug. 28, 1925

4 Sheets-Sheet 1



Witness:
Halter Chalmers

Inventor
Wager Fisher
by Wm. Steel Jackson
Attorney

May 21, 1929.

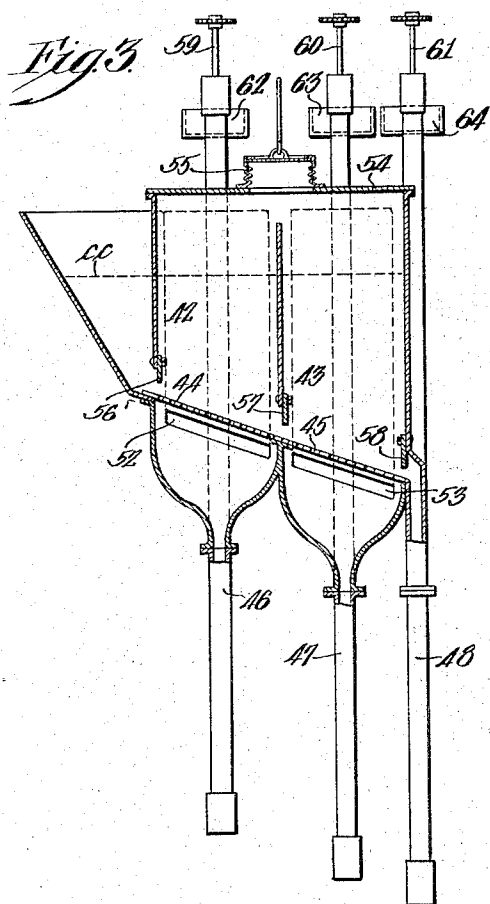
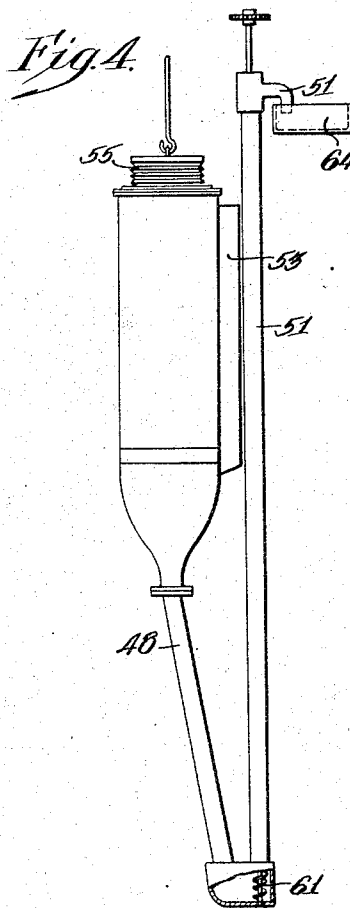
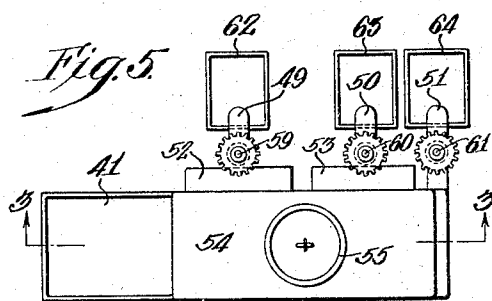
W. FISHER

1,713,869

APPARATUS FOR PREPARING MOLDING SAND

Filed Aug. 28, 1925

4 Sheets-Sheet 2



Inventor:
Wager Fisher

Witness:
Valter Chom

By *Ed Steel Jackson*
Attorney

May 21, 1929.

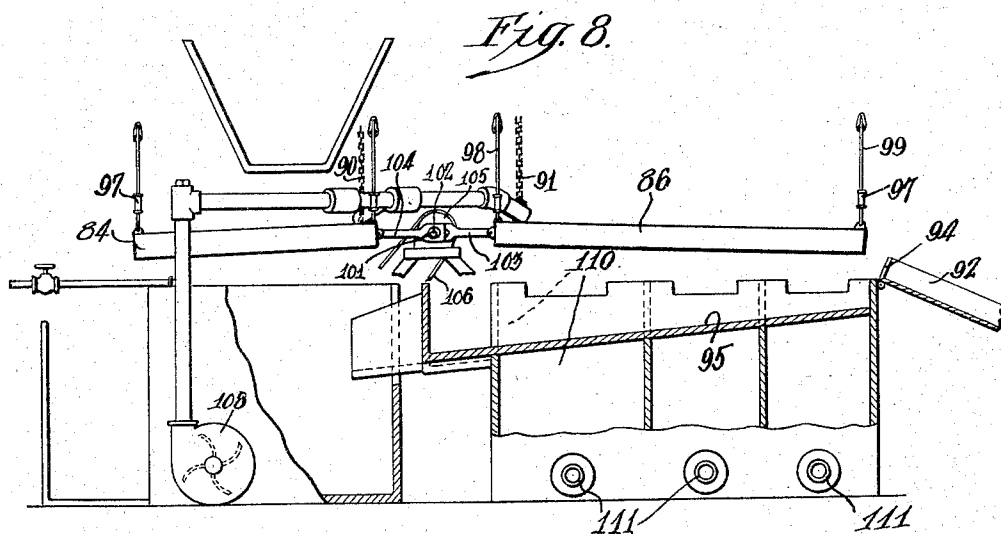
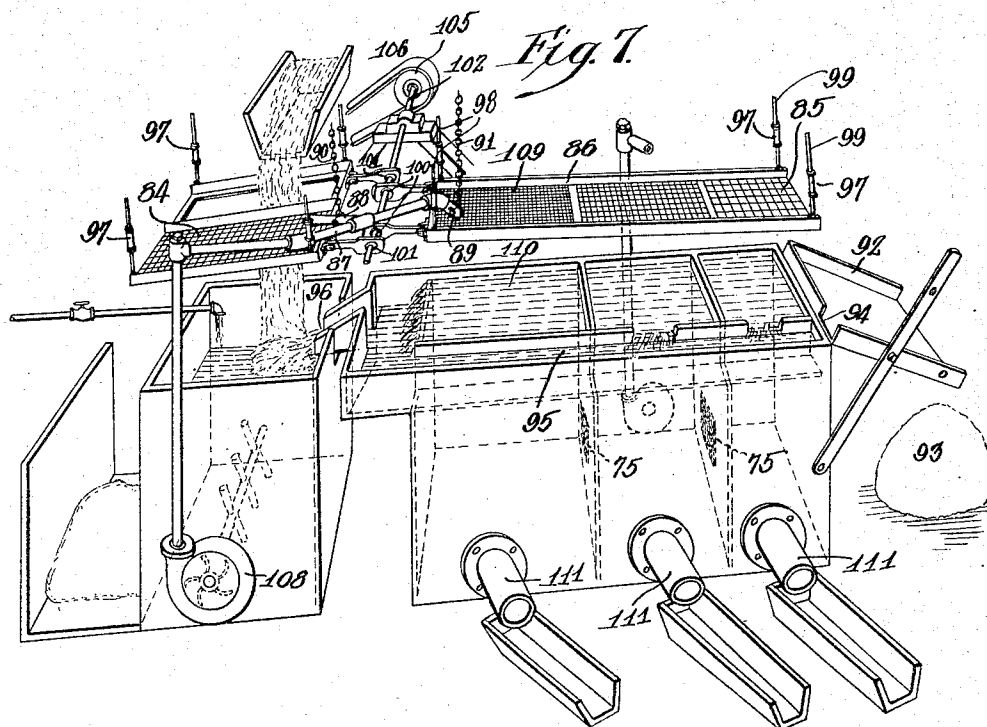
W. FISHER

1,713,869

APPARATUS FOR PREPARING MOLDING SAND

Filed Aug. 28, 1925

4 Sheets-Sheet 3



Witness:
Walter Chum

Inventor:
Wager Fisher
by *W. Stahl* Attorney

May 21, 1929.

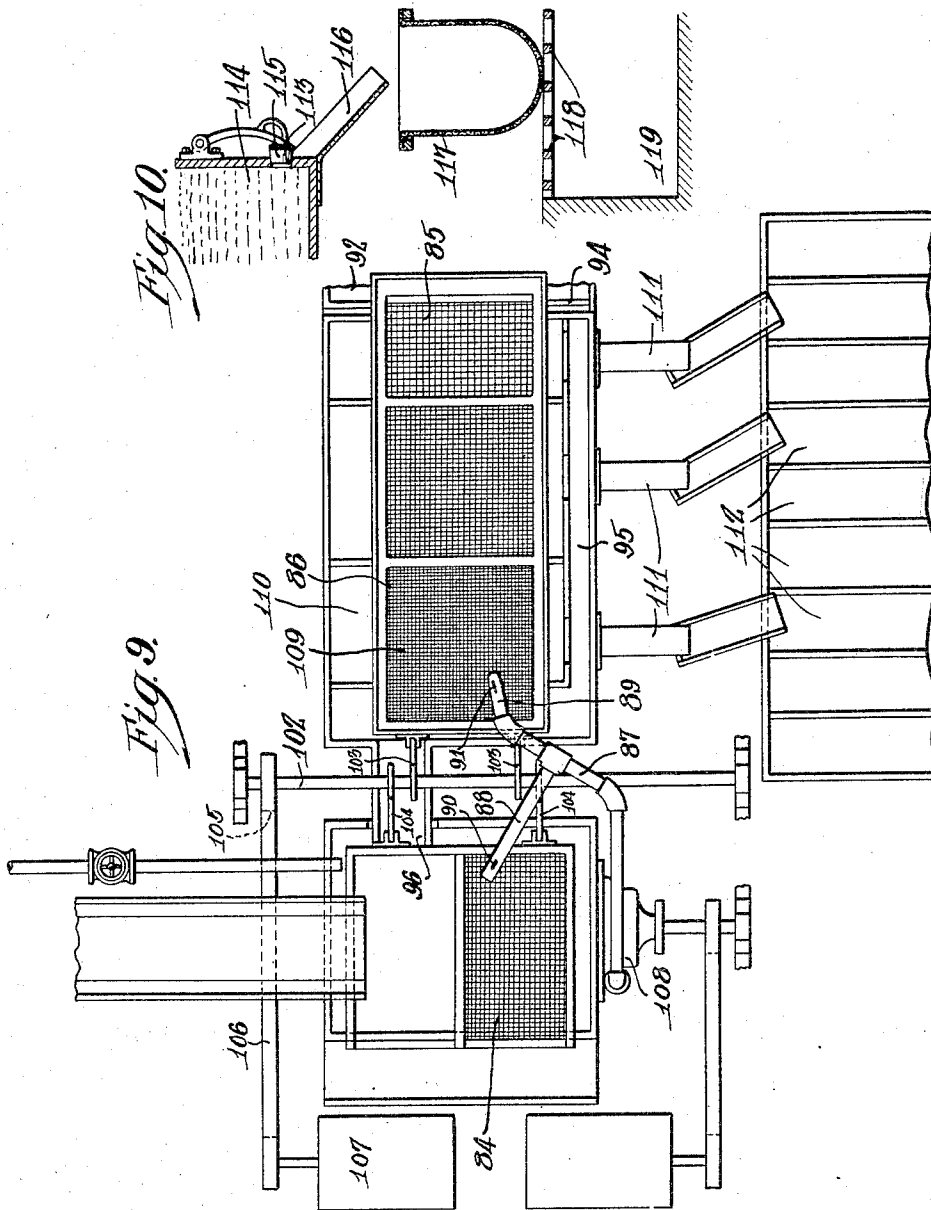
W. FISHER

1,713,869

APPARATUS FOR PREPARING MOLDING SAND

Filed Aug. 28, 1925

4 Sheets-Sheet 4



Inventor:
Wager Fisher

Witness:
Walter Chion

by Chas. Steel Jackson
Attorney

UNITED STATES PATENT OFFICE.

WAGER FISHER, OF BRYN MAWR, PENNSYLVANIA.

APPARATUS FOR PREPARING MOLDING SAND.

Continuation of application filed April 6, 1922, Serial No. 550,151. This application filed August 28, 1925.
Serial No. 52,983.

My invention relates to the manufacture of molding sand and is a continuation and commercial development of the subject matter of my Patent No. 1,551,738, process for preparing molding sand.

A purpose of my invention is to greatly increase the output of molding sand without a corresponding increase in the requisite size of apparatus used, by avoiding or lessening delay incident to sand settling.

A main purpose is to violently circulate a stream of water, which may contain various amounts of sand and binder, out of and back into a suitable compartment and while it is circulating, modify or adjust the binder or water until the binder solution (considered apart from the sand which it carries) attains a definite strength and then to deliver a controlled portion of this circulating stream to one or more jiggling screens progressively of larger mesh in order to size the sand, catching the sand and liquid that passes each screen in a separate tank and circulating the surplus back to the original stream.

The violent circulation secures homogeneity of binder solution and frees the sand grains from any adhering binder. I provide easily controlled means for diverting any desired portion of the stream through the sizing screens and settling tanks. This comprises a conduit, preferably a pipe, having branches with vertically adjustable outlets delivering respectively back to the compartment and to the sizing screens.

By changing the relative vertical adjustment of the outlets any desired portion of the whole stream is directed through either branch. An ordinary valve would here quickly choke with sand and be of little use.

Further purposes are to segregate the settling tanks from vibrating machinery in order to avoid the disadvantageous packing and disassociation of the binder and sand incident to rapid vibration; to recirculate tailings from the sizing screens whenever they become unduly loaded with binder solution; to aid screening above a settling tank by washing the screening mixture with liquid thrown from the settling tank.

Further purposes will appear in the specification and in the claims.

Figure 1 is a sectional elevation of simple apparatus for performing my original process.

Figure 2 shows in sectional elevation different apparatus for accomplishing the same result.

Figure 3 is a section upon line 3—3 of Figure 5 of still different apparatus for accomplishing the same result.

Figure 4 is a side elevation of Figure 3.

Figure 5 is a top plan view of Figure 3.

Figure 6 shows in sectional elevation other apparatus that may be used.

Figure 7 is a perspective view illustrating a desirable form found well adapted to manufacture molding sand commercially.

Figure 8 is a side elevation of the apparatus shown in Figure 7, and illustrating additional features not seen in Figure 7.

Figure 9 is a top plan of Figure 8.

Figure 10 is a fragmentary elevation illustrating a modification.

Like numerals refer to like parts in all figures.

Describing in illustration and not in limitation and referring to the drawings:—

Figures 1–6 are generally similar to Figures 1–6 in my Patent No. 1,551,738 of which this is a development and continuation.

In my former application referred to I disclosed and broadly claimed a process for preparing molding sand in which raw sand was agitated with water (usually in binder solution) to disintegrate lumps and to loosen the grains of sand from adhering binder, then sized by screening while wet and loosened from binder and then passed into and permitted to settle in a binder solution of definite predetermined strength to give a molding sand of definite binder content.

I did not then realize the advantage of avoiding violent vibration in the settling tanks because of the disadvantageous effect of such vibration upon settling, nor other advantageous features brought out in the specification and claims of the present application.

In Figure 1 I have shown a tank 10 filled with water to some line *a a*, above the bottom 11 of a screen which is typified by the simple form shown. This screen is of gen-

eral box form and is jiggged vertically by cam 12 upon rotatable shaft 13 and in a lateral direction by cam 14 upon rotatable shaft 15. These motions can synchronize or
5 alternate giving any separate or combination jiggging desired.

The jig box is shown as hung from links 16 to limit its ultimate movement.

The raw molding sand is intended to be
10 fed into it through a chute 17. The finished product settles into the well 18 whence portions may be periodically removed to a suitable container 19 by closing valve 20 and opening valve 21.

15 As thus shown in its simplest form, the iron oxide or other binder will be loosened from the sand grains by the agitation with water to go into colloidal solution, the sand screening like naked grains, all sand particles that pass the mesh of the screen settling with some rapidity to the bottom of the tank. On the way they become coated somewhat with binder and as they settle
20 at the bottom they trap more binder within their voids.

In Figure 2 a tank 25 has a compartment 26 for receiving and agitating the raw sand with water, and settling compartments 27 and 28. The tank 25 is filled with water or
30 with binder solution to some level *b-b* above the tops of the partition walls 29 and 30. Raw sand is charged into the agitating chamber 26 from the chute 31. 32 is a centrifugal pump and agitator driven in any
35 suitable way, discharging a stream of sand and water upon the screen 33 which is given continuous vertical and lateral jiggging by suitable vertically and horizontally operating links and cranks such as links 34
40 and 34' connected to cranks 35, 35' upon rotating shafts 36, 36' and links 37 connected to cranks 38 upon shafts 39.

The colloidal binder solution discharged upon the screen 33 drains through the
45 screen falling back into the compartments 27 and 28 of tank 25, flowing over the tops of the partition walls 30 and 29 back into the compartment 26 giving effective circulation of the solution. That part of the screen 33
50 which is directly above compartment 27 is of closer mesh than that directly above compartment 28, and grains that fall into compartment 27 are thus all sizes not too large to pass this closer mesh while grains that
55 fall into compartment 28 are too large to pass the smaller mesh but too small to be caught on the larger mesh. Everything too large to pass either mesh finally falls off the edge of the screen into a suitable container 40.

60 While the screen 33 is here raised above the surface of the colloidal binder solution, original binder on the sand is loosened from the sand grains by strong agitation in the
65 presence of water in compartment 26; the

sand grains thus loosened from binder are thrown with a strong stream of solution upon the screen and particles sufficiently small to pass the mesh of the screen are carried through with the stream of solution, the
70 screening being aided by jiggging. The stream of solution and sand from compartment 26 may be suitably directed to different parts of the screen 33 by hand or otherwise.

75 Molding sand is removed from the settling compartments 27 and 28 in any suitable way, as by shoveling it out periodically or removing it continuously by means of a suitable automatic screw or belt conveyor
80 (not shown).

In Figures 3 to 5 the apparatus shown includes a tank of special form, to be filled with water or with a colloidal solution of oxide of iron or clay or of other binder to
85 some level *c c*. It is divided into communicating compartments. I show also a hopper 41 for raw sand, a succession of screening chambers (only two in the apparatus shown) 42 and 43, sloping screens 44 and
90 45 (one screen in each chamber), settling wells 46 and 47 (one settling well beneath each screen) and a settling well 48 after the last screen. The sand is removed through conveyor pipes 49, 50 and 51 (one for each
95 settling well). The pulsator standpipe compartments 52 and 53 (one for each screening chamber) are open to the screening chambers beneath the screens at one end each and are open to the atmosphere at the top.
100 The screening chambers are provided with a common lid 54, sealing these chambers from the atmosphere and in it is supported a pressure pulsator diaphragm 55.

Raw sand charged into the hopper 41 is
105 continuously delivered through the adjustable gate 56 to the sloping screen 44 where it is screened by reason of the pulsation of water or solution through the mesh of screen 44; sand too coarse to pass the mesh of the
110 first screen is delivered through the adjustable gate 57 to a second sloping screen 45 having a mesh more coarse than in screen 44. The pulsation of solution through the mesh of screen 45 results in proper screening
115 and sizing, grains that will pass screen 45 doing so and grains too large to pass screen 45 being delivered through the adjustable gate 58 into the settling well 48.

The sand settling into the wells 46, 47 and
120 48 is removed by the screw conveyors 59, 60 and 61, being delivered into any suitable receptacles 62, 63 and 64.

The screening chambers are in air communication at the top and water communication at the adjustable gates. Air pressure
125 above the solution in the screening chambers pulsates by reason of the pulsation given the diaphragm 55. This action creates pulsation through the screens 44 and 45; also a
130

pulsation through the adjustable hopper gate 56 but has little effect in creating pulsation through the gate 57 or through the gate 58.

5 It is obvious that pulsation through the screens can be brought about otherwise than as shown, and that such variation in the way of creating pulsation at the screens does not in any way affect the broad principles involved.

10 In Figure 6 raw sand from a hopper 65 is delivered at any desired rate by means of a worm 66 to a rough jiggging screen 67 to remove pebbles, from which it passes down into the agitating chamber 68 of the tank 69 which is filled with water to some level *d d*.

The sand and water in the chamber 68 are maintained in violent agitation by means of the centrifugal pump and agitator 70 which simultaneously agitates the raw sand to loosen the binder and delivers a continuous stream of sand and water and loosened binder to the jiggging screen 71 which is of finer mesh than the screen 71. Sand particles that pass the screen 71 drop into the settling chamber 72 with water and loosened binder and the molding sand product may be continuously removed by means of a worm 73.

The agitation chamber 68 and the settling chamber 72 are separated from one another by a partition 73 approximately tight in its lower portion 74 and with an upper portion 75 that is merely a fine mesh screen. The water solution of binder in the two chambers 68 and 72 for this reason maintains nearly the same level, the water delivered by the pump 70 upon the screen 71 and drains down into the chamber 72, flowing back through the screen 75 into the chamber 70.

The screens 67 and 71 are hung by vertical links 76, 77 and 76', 77' respectively, and a revolving cam and shaft 78 in conjunction with springs 79 and 80 maintains these screens in continuous jiggging.

A water pipe 81 with valve 82 is shown above the screen 67 for constantly adding the requisite amount of water.

50 I have diagrammatically illustrated a temperature control device at 83 which may be of any well known type to secure and maintain the intended temperature of solution where such control is desired.

55 The figures thus far described are generally the same as in the first application.

The apparatus illustrated in Figures 7-10 has features of Figures 2 and 6, with additional features that I now find desirable.

60 In Figure 6 the raw sand is delivered into the disintegrating and digesting tank 68 through screen 67, which screens out pebbles and lumps, that would otherwise go in with the sand.

The raw material, whether wet or dry, is often to considerable extent made up of hard lumps comprising grains of sand and pebbles cemented together with binder.

These lumps separate into their individual grains of sand, pebbles and binder when agitated with water and for this reason it is frequently desirable to deliver the raw material directly into the agitation compartment before screening as indicated in Figure 2 and also in Figure 7.

75 In Figures 2 and 6 the centrifugal pump discharges the whole stream of mixed sand, water and binder upon the sizing screen. In practice I find it desirable to discharge the stream from the centrifugal pump back into the agitation compartment for more perfect disintegration of lumps and until proper adjustment has been made of the strength of the binder solution, and after the binder solution has been brought to proper strength it is still advantageous to return a portion of the stream from the pump to the agitation compartment to screen out pebbles that have come in with the raw material and to secure more perfect agitation of new material added to the agitation tank.

If the larger portion of the stream be thus circulated back into the agitation compartment before going to the sizing screens most of the pebbles will be removed by the screen 84 (Figure 7) above the agitation compartment instead of going to the sizing screens.

If the whole stream be delivered to the sizing screens and the raw material is high in pebbles these pebbles unless they have already been taken out by preliminary circulation of the stream through screen 84, disadvantageously affect the action of the sizing screens and result in inefficient screening and passage of imperfectly screened sand and pebbles over the tailing screen 85.

In some cases it may be preferable to charge the raw material upon the screen 84 in the path of the return stream from the circulating pump. While this has a tendency to overload the screen 84 and be somewhat wasteful of raw material through imperfect disintegration of lumps it has the advantage that neither the pump nor the sizing screens have to handle pebbles.

I show in Figures 7 to 9 a particularly advantageous form of branching conduit adapted to turn all or any desired portion of the stream from the pump to either the sizing screens 86 or the screen 84 above the agitation compartment.

This arrangement is illustrated as comprising a branched pipe 87 having one branch 88 to the screen 84 above the agitation compartment and another branch 89 to the first sizing screen.

These branches 88 and 89 are each loosely

connected so as to freely turn up or down to any desired extent, the ends being adjustably supported, as by chains 90 and 91.

If the branch 88 to the screen above the agitation compartment be turned up while the other branch 89 delivering to the sizing screens is down then the whole stream will flow to the sizing screen, and vice versa, if the branch 89 be turned up and the branch 88 down the whole stream flows back into the agitation tank through the screen 84.

By proper vertical adjustment of these two branch pipes, as at end supporting chains 90 and 91, I find it very easy to send any desired portion of the stream from the pump in either direction.

The capacity of the sizing screens is greatly affected by the presence or absence of pebbles and is much less for sand carried in a solution rich in binder than for sand in a solution that is lean in binder. When a very rich molding sand is desired the binder solution must be very rich. In this event the sizing screens have relatively low capacity and the proportion of the stream delivered upon the sizing screens should not exceed a value that will result in a delivery too big for the screens to handle.

In practice the sizing screens sometimes flood, binder solution and sand then passing over the tailing screen 85 with pebbles, and I provide means for returning the tailings to the circulating stream when this happens.

I show for this purpose a hinged apron 92 receiving the tailings. Normally this apron slopes downward to the rear and delivers the tailings to a heap 93 at the rear of the machine, but if the tailings flood with sand and binder solution (usually a temporary occurrence due to excessive pebbles or imperfect disintegration of lumps in the agitation compartment) the apron may be moved up so as to throw the tailings back through the opening 94 of the apron and trough 95 leading back to the agitation tank.

Figure 7 shows this apron adjustably supported to slope outward as in the figure or inward to return the tailings to the trough.

In Figure 2 I have shown the return from the settling compartments to the agitation compartment to be back over the top of partitions 30 and 29. I have found it more advantageous to provide a separate trough 95 as seen in Figures 7-9. Each settling compartment overflows into this trough and the trough discharges at 96 back into the agitation compartment.

The screens slope rearwardly and the slope is preferably adjustable, as indicated at 97 in Figures 7-9. In these figures opposite ends of the screens are supported by overhead links 98 and 99, screw turn-buckles at 97 providing slope adjustment.

The screens are vibrated or jiggled horizontally by eccentrics 100 and 101 upon a

rapidly revolving shaft 102. A rich binder solution requires more rapid vibration of the sizing screens in order that the liquid and sand may pass through. With a binder solution of 1.2 a vibration of 500 V. P. M. of eccentric has been found satisfactory.

The eccentrics 100 are connected by links 103 to the sizing screens and the eccentrics 101 by links 104 to the screen 84 above the agitation compartment, so that the one shaft 102 vibrates both screens, and the shaft 102 driven by pulley 105, belt 106 and motor 107. The slope is made such that there is secured a proper passage of sand progressively across the screens.

The stream discharged upon the first screen comprising pebbles, sand and binder solution gradually works rearwardly, the finer sand passing through the first screen, the sand less fine passing through the second screen and so on, the tailings (pebbles) falling from the outer edge of the last screen. Most of the binder solution passes through the first screen and for this reason it is sometimes desirable to assist the screening action upon the latter screens by means of a stream of binder solution which may be from the compartments respectively underneath these sections of the screen.

This is illustrated in Figure 1, a centrifugal pump 108 delivering a stream of binder solution to the screen 109 above the compartment 110.

The raw materials are sand, binder and water which may come mixed with one another and with pebbles or other foreign matter to a widely variant degree.

The sand may be already sized and free from binder or it may already contain more binder or less binder than is desired in the finished product and the content of binder in the finished product will commercially widely vary according to the particular use for which it is desired and also to a considerable extent according to the individual views of different purchasers.

If the sand be already sized and the binder used is free from impurities all of the screens shown in Figures 7 to 9 may be dispensed with.

Whatever the character of the raw materials the initial operation produces a binder solution having a definite relation between the quantity of binder and the quantity of sand present, this relation being that required to give a molding sand having the desired content of binder.

The specific gravity of the liquid in the agitation chamber will vary widely with variation in the quantity of sand in suspension so that the specific gravity of the liquid in the agitation chamber does not in itself give any indication of the strength of binder solution.

The rapidity with which sand will settle

from a binder solution depends primarily upon the size and density of the grains of sand and the viscosity and density of the solution.

5 For practical purposes (and neglecting temperature variation which usually is not under control) the quantity of binder taken up by sand which settles through it will depend largely upon the concentration of the
10 binder solution, that is, upon the ratio of binder to water in the solution. If the binder solution be relatively concentrated sand will settle through it very slowly while if the binder solution is dilute sand will
15 settle from it or in it very rapidly. The binder in the solution settles relatively very slowly. That time of settling may vary from a few minutes to many hours according to the nature of the binder and density
20 of solution.

It is understood that by solution is here meant not true solution but what might be called a colloidal suspension or perhaps merely suspension.

25 The particles of binder are most minute as compared to the grains of sand so that the rate with which the sand settles through it is very great as compared to the rate with which the minute particles of binder settle.

30 The strength of a weak binder solution containing sand may be determined easily and quickly by merely waiting a moment or so for the sand to settle and then using a hydrometer.

35 If the binder solution be strong, however, the sand will not settle quickly and a long time would be required before there would be sufficient settling of the sand for the use of a hydrometer to determine the specific gravity of the binder solution (considered
40 apart from the sand).

To quickly determine the strength of a strong binder solution containing sand, a definite volume is taken and diluted when
45 the sand settles quickly and is measured. The solution is then further diluted to a definite volume with due correction for the amount of sand found, and this tested with a hydrometer. The specific gravity of the
50 original binder solution is then easily determined from the hydrometer reading and extent of dilution.

The mixture of binder solution and sand is whipped about and circulated by the centrifugal pump until the strength of binder
55 solution reaches the desired value.

If there be no change in the water content and the sand added already contains some binder the concentration of the binder
60 solution in the agitation chamber will continue to increase, whatever the amount of binder in the sand, that is, a sand very lean in binder put into a strong binder solution, that is not fully loaded with sand will in-
65 crease the concentration of the binder solu-

tion,—increase the ratio of binder to water present.

The operation may be continuous or intermittent. If it is continuous the sand added will usually already contain binder 70 and there should be maintained a definite ratio between the quantity of binder added and the quantity of water added.

If all of the sand added already contains more binder than is desired in the product 75 the volume of the binder solution would gradually increase until the agitation tank overflows unless the excess binder solution be removed elsewhere.

In actual practice sufficient sand lean in 80 binder or perhaps containing no binder would be added to avoid this growing excess of binder solution or else excess water would be added to keep binder solution down to desired limits, a suitable overflow being 85 provided.

If the sand added be all lean in binder the amount of water to be added will be insufficient to maintain the original volume of binder solution so that additional binder 90 should be added with a proper amount of water to maintain the proper volume of binder solution in the agitation tank.

In Figures 7 to 9 I illustrate pipes 111 from the bottom of the respective settling cham- 95 bers. These pipes are provided with swiveled trough ends so as to discharge in any one of a number of pits 112.

I find in practice that a hole in the bottom (or side near the bottom) of a settling 100 tank, closed when not in use by an ordinary swinging closure, may serve very well for the removal of molding sand from the tank.

It is not necessary to provide specially sloping bottom to the settling compartment 105 as in practice the sand will form its own slope provided this part of the apparatus is separated from the vibration of the machinery.

In Figure 10 the opening 113 from near 110 the bottom of a settling compartment 114 is merely a hole normally closed by a swinging closure 115.

When the molding sand has settled within the compartment to sufficient depth the clo- 115 sure is opened and the hydraulic head above the opening forces the sand out into the inclined trough 116 to suitable porous receptacle 117. If bags be used the molding sand may be packed in same for shipment at 120 the end of this trough, but must first be laid aside for drying.

I show the receptacle supported over a grating 118 above the pit 119. Normally the receptacle will be filled to slight over- 125 flowing and the overflow comprising chiefly binder solution collects in the pit.

In operation the binder content of a molding sand low in binder can be increased or the percentage of binder can be reduced 130

in a sand initially higher in binder as desired. This can be done by strengthening or weakening the binder solution by addition of separate binder or by addition of water respectively to control the percentage of binder in the solution through and in which the sand is settled.

Not only can the initial strength of the binder be varied but separate binders and sands can be mixed in any proportion desired to prepare molding sands to given specifications, covering by either of these methods the entire range of possible binder content and by screening or the use of separate screened sands and separate binders of different kinds covering the entire range of character of binder and percentage of binder with respect to sand and size of grain of sand content.

As the process may be either continuous or discontinuous it is also possible to feed an excess of mixed sand and binder to the screens by reason of which fine sand will be carried over the coarser screens and settle with coarser sand in the next compartment or to restrict the flow of mixed sand and binder so that substantially all of the finer sands will be sifted out by each screen as it passes the screens, reducing or substantially eliminating the amount of finer sand settling with the coarser sand in any given compartment. This control can be effected readily by the quantity of sand and by the solution by-passed.

Moreover since the coarser sand settles more quickly than the finer sand it is possible to further control the mixture of finer and coarser sands present in a compartment which may settle therefrom through the binder solution by intermittent operation allowing time for coarser sand only to settle out and then removing the solution above the settled sand in the tank.

By settling these withdrawn solutions separately it is possible to get a molding sand of finer sand content than could be reliably separated out by screens.

In screening sand composed of grains of several sizes through a sizing screen each section of the screen will pass all the sizes between its size of mesh and the next smaller mesh and, due to the more rapid settling of the grains the smaller grains will come in the next layer, but in running the process continuously there will be no layers between grains of different size which have gone through the same screen because they will all be settling down together even though at different rates.

The pump and the stirring mechanism should be run continuously and at substantially the same rate during operation of the process in order that as complete a mechanical mixture may be obtained as possible of the sand and binder which are in suspen-

sion and for the further reason that it is desirable to handle as large a quantity of sand as can be maintained in suspension in order to reduce the handling to a minimum for a given quantity of product. At the beginning of the process it is desirable that none of the product shall be carried over into the settling tanks because the desired concentration of binder in the liquid will not have been obtained and the percentage of sand in suspension will be low enough so that an excess quantity of liquid will have to be handled for the same quantity of product passed on through the settling tanks.

For the above reason the best results are ordinarily attained in the starting of the process by pumping wholly through the by-pass until the binder content has reached the required degree of concentration. It may be desirable to continue even further to increase the percentage of sand in suspension rather than to pump over into the settling tanks an excessive quantity of solution for a relatively smaller percentage of sand, but this is of less importance than is the percentage of binder in the solution.

The by-pass performs two main functions. In starting it permits the solution to be passed wholly through it until the desired binder concentration at least and permissibly the desired sand concentration also has been attained. In operation relative lifting of the by-pass pipe and lowering of the discharge pipe or, vice versa, provides for very exact adjustment of the quantity of discharge upon the screens with by-pass of any excess pumped and without slowing the pump. At the same time the adjustment permits discharge of the entire quantity pumped upon the screens. An excess quantity in this case would be returned to the tank as tailings until readjustment of discharge can be made.

Separate binder or sand can be added initially or during the continued operation.

Vibration of the settling tank is avoided by separating the screen and shaking mechanism mechanically from the settling tank and the time of settling and the percentage of binder content in the product are largely dependent upon the specific gravity of the solution in the settling tank. The sand will separate out of a solution of 1.2 specific gravity, for example, very much more rapidly than out of a solution of 1.3 specific gravity but the product will be much leaner in binder. The difference in speed and product due to differences in specific gravity are quite remarkable.

The height of the solution in the different settling tanks is equalized where desired by screened openings between the tanks, the screen being of such mesh as to prevent passage of finer sand to the tank in which the

coarser sand is being settled as in Figure 7.

Of course the steps can be modified to omit functions not needed such as omitting the sizing screens where sizing of the sand is not desired or has been performed preliminarily.

The overflow from each of the tanks is returned to the mixing tank without passing across the intervening tanks in the form shown in Figures 7-9 avoiding settling of coarser sand into a tank intended for finer sand.

The permissible return of the tailings to the mixing tank provides for rehandling of any mixture which is carried over by reason of excessive feed.

Raw material is often lumpy and does not screen well until after it has been thrown into the mixing tank. The by-pass arrangement makes it possible to dump the raw material directly into the starting tank and to screen out the pebbles to advantage by a screen beneath the by-pass opening.

While the machine illustrated is adapted to prepare molding sands of widely variant required binder from widely variant raw materials, specific features advantageously vary considerably, both with the character of the raw materials and with the character of the product.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art and I therefore claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a machine for mixing sand and a binder solution, a mixing chamber, a pump for removing solution from the mixing chamber, a by-pass for the material pumped adapted to return it from the pump back to the mixing chamber and a tank in addition to the mixing chamber to which tank that discharge from the pump is delivered which is not by-passed.

2. In a machine for mixing sand and a binder solution, a mixing chamber, a pump for removing solution from the mixing chamber, a by-pass for the material pumped adapted to return it from the pump back to the mixing chamber and a tank in addition to the mixing chamber to which tank that discharge from the pump is delivered which is not by-passed, the quantity of material discharged and that by-passed being adjustable by control of the height of the by-pass outlet.

3. In a machine for mixing sand and binder, a mixing chamber, a pump for removing solution therefrom, a by-pass for

the material pumped adapted to carry the material from the pump back to the mixing chamber and a tank in addition to the mixing chamber, to which tank that discharge from the pump is delivered which is not by-passed, the discharge and by-pass being adapted to turn on an outside axis so as to control the amount of discharge by the relative heights of the discharge and by-pass.

4. In a machine for mixing sand and binder, the combination of a mixing chamber, an agitator therein, a pump adapted to withdraw solution from the chamber, a plurality of screens through which the pump is adapted to discharge, means for vibrating the screens, a discharge and a by-pass for controlling the quantity of discharge to the screens while the pumping rate is maintained.

5. In a machine for mixing sand and binder in solution, and settling them out to form a molding sand, a mixing tank, a plurality of settling tanks having overflow from each of the tanks, that from farther tanks passing the others, to the mixing tank, screens for separating the sand and pumping means for discharging the mixture upon the screens.

6. In a machine for mixing sand and binder in solution, a mixing tank, a plurality of screens, pumping means for discharging the mixture of sand and binder upon the screens, settling tanks beneath the screens and connections for overflowing each of the settling tanks to the mixing tank free from the other tanks.

7. In a machine for mixing sand and binder in solution, a mixing tank, a plurality of screens, a pump discharging the mixture upon the screens, settling tanks beneath the screens and means for flowing the tailings from the last screen controllably to a separate point or back to the mixing tank.

8. In apparatus for preparing molding sand, an agitation chamber, a coarse screen there above, settling compartments near the agitation chamber, a sizing screen above the settling compartments, a centrifugal pump having an inlet from the agitation compartment and a delivery conduit having branches discharging respectively to the screen above the agitation compartment and to the sizing screens and means for controlling the relative flow through the branches.

9. In apparatus for preparing molding sand, an agitation chamber, a coarse screen thereabove, settling compartments near the agitation chamber, sizing screens above the settling compartments, a centrifugal pump having an inlet into the agitation compartment and a delivery conduit having branches discharging respectively to the screen above the agitation compartment and

to the sizing screens and means to vertically adjust the outlets of the branches with respect to one another.

10. In apparatus for preparing molding sand, an agitation chamber, settling compartments adjacent thereto, sizing screens above the settling compartments, a conduit fluid return from the settling compartments

delivering into the agitation chamber, and a circulating pump having inlet connection into the agitation chamber and outlet connection branching to deliver one portion back into the agitation chamber and another portion to the sizing screens and thence to the settling compartments.

WAGER FISHER.