

Sept. 1, 1925.

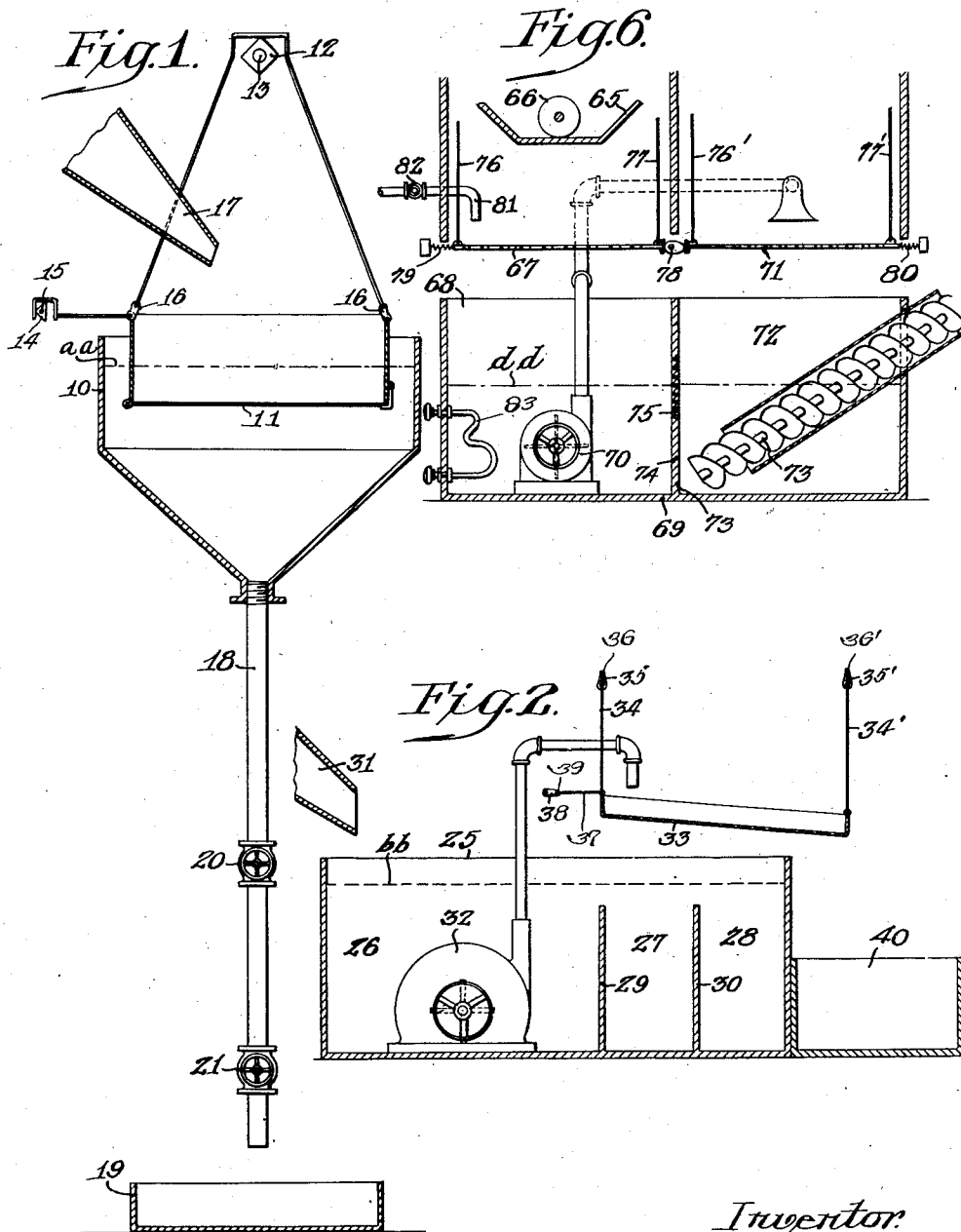
1,551,738

W. FISHER

PROCESS FOR PREPARING MOLDING SAND

Filed April 6, 1922

2 Sheets-Sheet 1



Inventor:
Wager Fisher.

by *W. Stuebel*
Attorney

Witness:
Walter Chism

Sept. 1, 1925.

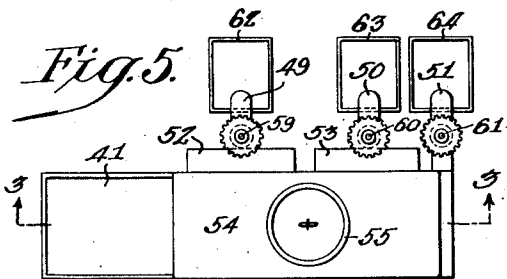
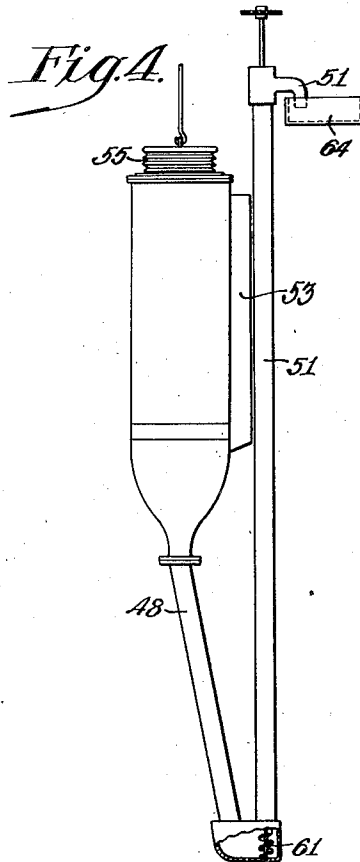
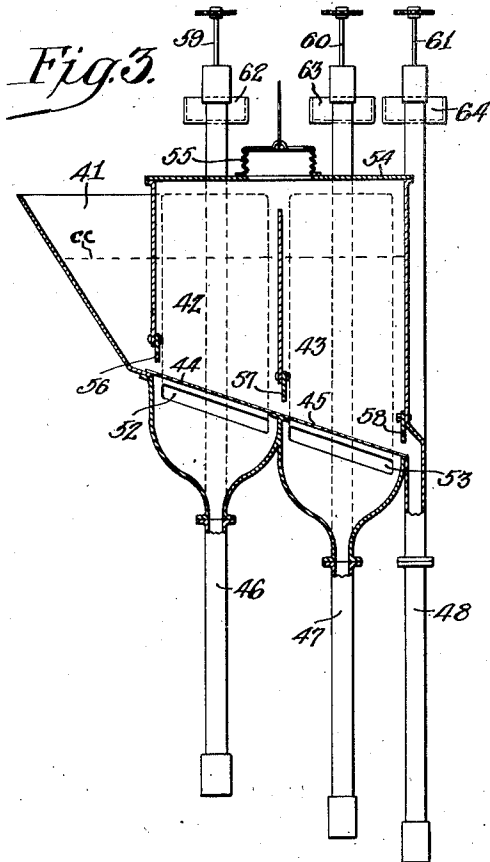
1,551,738

W. FISHER

PROCESS FOR PREPARING MOLDING SAND

Filed April 6, 1922

2 Sheets-Sheet 2



Witness:
Walter C. ...

Inventor:
Wager Fisher.
by A. Stuebel
Attorney.

Patented Sept. 1, 1925.

1,551,738

UNITED STATES PATENT OFFICE.

WAGER FISHER, OF BRYN MAWR, PENNSYLVANIA.

PROCESS FOR PREPARING MOLDING SAND.

Application filed April 6, 1922. Serial No. 550,151.

To all whom it may concern:

Be it known that I, WAGER FISHER, a citizen of the United States, residing at Bryn Mawr, in the county of Montgomery and State of Pennsylvania, have invented a certain new and useful Process for Preparing Molding Sand, of which the following is a specification.

My invention relates to molding sands and particularly to the control of the proportions of the several ingredients entering into molding sand.

The purpose of my invention is to secure uniformity in a molding sand as to a desired content of iron oxide or of other binding material.

A further purpose is to obtain uniformity in a molding sand as to a desired size of grain.

A further purpose is to obtain a single sand, uniform as to a desired content of iron oxide or of other binding material, from molding sands differing in binder content, as from sands respectively unduly rich and unduly lean in binder, doing this either in a single operation or in a plurality of operations as desired.

A further purpose is to coat relatively pure sand to a desired extent with binder by having it settle in a solution of binding material, the concentration of the solution determining the richness of the coat of binder.

A further purpose is to coat relatively pure sand to a desired extent with binder by having it settle in a solution of binding material, the temperature of the solution determining the richness of the coat of binder.

A further purpose is to obtain any desired uniform grade of molding sand by simultaneously controlling the size of grain and the binder content in the finished product, the size of the grain being controlled by screening with water or by screening with a colloidal solution of binder, and the binder content being controlled by controlling the concentration of a colloidal solution of binder in which the molding sand, in grains of desired size, settles.

A further purpose is to obtain any desired uniform grade of molding sand by simultaneously controlling the size of grain and the binder content in the finished product, the size of grain being controlled by screening with water or by screening with a colloidal solution of binder, and the binder

er content being controlled by controlling the temperature of a colloidal solution of binder from which the molding sand, in grains of desired size, settles.

The binder content in molding sand settling in a binder solution, will vary with the concentration of the binder solution, with the temperature of the binder solution, and with the size of the grains settling through it. With graded sands the percentage of voids is considered to be nearly the same for all sizes and the proportion of binder solution trapped within the voids and retained upon evaporation of the moisture will be nearly the same. The proportion of the void filled will depend upon the percentage of binder in the solution.

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

My invention relates primarily to the methods involved, and the apparatus illustrated in my drawings is selected primarily because of its simplicity and of its value in illustrating the principles of my invention.

Molding sand in its natural condition consists chiefly of ordinary silica sand with oxide of iron and a small amount of clay. Other binder than oxide of iron and clay may also be present.

The silica sand averages about 40% void. The voids will differ somewhat from this, being higher when the sand is sized and lower when widely different sizes of sand are mixed. The binder content should be not enough to fill entirely the voids and thus make it non-porous, since the intended use requires some porosity. My invention enables the extent of filling of the voids to be controlled reliably.

Though efforts have hitherto been made to size molding sand by screening, they have been thus far but indifferently successful because the screened particles have consisted of a mixture of grains of naked sand, of cakes of binder, of cakes of binder attached to individual grains of sand, and of two or more grains of sand stuck together by binder. This has been true with dry screening and also true, though to somewhat less extent, with moistened sand.

I have discovered that agitating molding sand in water loosens the binder from the grains of sand, the loosened binder going largely into colloidal solution, so that in screening under water the screened particles

consists only of grains of naked sand and that molding sand when under water, may be sized by screening or jiggling more perfectly than has hitherto been possible.

5 I have further discovered that when grains of naked sand settle in a solution of binder, as iron oxide, they become uniformly coated with binder to an extent dependent upon the concentration of the binder
10 solution, the temperature of the binder solution and the size of the sand grain.

I have further discovered that if molding sands of different and varying binder content are screened or jigged in a solution of
15 binder, as iron oxide, that the particles screen like naked grains of sand, which permits uniform sizing by screening or jiggling, and that these naked sand grains in settling from the binder solution, are again uniformly
20 coated with binder and that for a given size of grain the extent to which the grains are uniformly coated with binder may be controlled by controlling the concentration and temperature of the binder solution out
25 of which the grains settle.

In one operation sands irregular as to size and as to binder content may thus be made to yield a uniform product of desired
30 size and desired binder content and foreign matter and grains of sizes not suited for molding sands can be discarded.

My invention relates to processes rather than to specific apparatus and the apparatus shown, selected from many by which the
35 invention may be carried out and is intended to be diagrammatic though capable of practical use.

Figure 1 shows in sectional elevation simple apparatus for performing my process.

40 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.

45 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
50 apparatus that may be used to carry out my process.

In Figure 1 I have shown a tank 10 filled with water to some line *a*, above the bottom
55 11 of a screen which is typified by the simple form shown. This screen is of general box form and is jigged 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 alternate giving any separate or combination
60 jiggling desired.

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

65 The raw molding sand is shown as fed into it through a chute 17. The finished product settles into the well 18 whence por-

tions may be periodically removed to a suitable container 19 by closing valve 20 and opening valve 21.

As thus shown in its simplest form, the iron oxide or other binder will be loosened
70 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
75 of the tank. On the way they become coated somewhat with binder and as they settle at the bottom they trap more binder within their voids.

The speed with which sand particles settle in a solution is a function of the size
80 of the particles and of the viscosity of the colloidal binder solution.

This viscosity is dependent largely upon the concentration of the solution and upon
85 its temperature.

The viscosity-temperature curve of water is so steep as to indicate a very considerable advantage in uniformity of product from
90 keeping the temperature of the colloidal solution uniform, a thicker coating being obtained the lower the temperature.

The same degree of coating of the grains can be obtained in settling from a cold thinner
95 solution as in settling from a solution relatively warmer and thicker.

Where the product is either richer or leaner than is desired, a leaner product can be obtained either by diluting the colloidal
100 binder solution or by increasing its temperature; or a product more rich in binder can be obtained either by increasing the concentration or by lowering the temperature of the binder solution.

The words "colloidal" and "solution" are
105 used herein to refer to the mixture with the water of finely divided binder in suspension within which the sand is intended to settle, the concentration of the binder solution being varied by adding binder to increase the
110 concentration or adding water to reduce it and to replace the water of the solution used. Where natural molding sand is being treated the binder from the molding sand tends to maintain the concentration of the solution. There need be no waste of binder as
115 there need be no removal of binder solution except through that taken up by the sand. However, where the binder present in the molding sand treated is in excess of that
120 needed, either because of the removal of fine sand from that ordinarily in the molding sand or from excessively rich molding sand, the excess binder solution may be removed
125 for other purposes, as for use with other sand. It will be necessary to furnish additional water corresponding to the water removed along with the sand treated.

If raw sand is screened in the apparatus
130 of Figure 1 the grains that pass the screen

will vary in size from the smallest particle to the largest that will pass the mesh. These grains in settling from the binder solution become coated with binder to an extent that will, with individual grains, vary with the size of these grains; nevertheless the product is likely to have very fair uniformity in binder content for the reason that the variation in grain size is likely to be fairly uniform throughout the product.

The sand that does not pass the screen may be removed and screened in a similar apparatus but with a screen having somewhat larger mesh, the product from this second screening consisting of grains passing the second mesh but too large to pass the first.

In this manner screening through screens with successively larger mesh may be made to yield different desired grades of molding sand, each grade uniform as to desired size of grain and as to desired binder content.

It is possible to reclaim binder from sand with which it has been initially mixed but which may not be well suited for molding, and to reapply this reclaimed binder to other sand better suited for molding, this latter sand being initially perhaps lean in binder or perhaps without binder altogether.

For example, a sand poor for molding, may be almost wholly robbed of its binder by jigging in dilute solution or one at higher temperature so that the binder thus taken from the poor sand may be later used in coating better sand adding to one lean in binder or, with the addition of binder coating a free sand.

In beds of natural molding sand there is lack of uniformity as to binder content, the top of the bed usually being too rich in binder and the bottom of the bed too lean, a narrow intermediate portion being of the proper richness; thus in a nine foot bed of sand, the upper three feet of the bed may be molding sand, the lower six feet being sand free of binder, the upper surface of the nine foot bed being too rich in binder while sand three feet down is too lean and sand more than three feet down practically free of binder.

Sand that is too rich in binder does not vent properly and sand that is too lean fails to hold the shape of the mold after the pattern is removed. In my process the whole sand bed may be used to obtain desired uniform grades of molding sand.

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 with binder solution to some level *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

suitable way, discharging a stream of sand and water upon the screen 33 which is given continuous vertical and lateral jigging by suitable vertically and horizontally operating links and cranks such as links 34 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 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 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 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.

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 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 screening being aided by jigging. The stream of solution and sand from compartment 26 may be suitably directed to different parts of the screen 33 by hand or otherwise.

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 (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 of other binder to some level *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) and 43, sloping screens 44 and 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 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. 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 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 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 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 48 is removed by the screw conveyers 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 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 pulsation through the adjustable hopper gate 56 but has little effect in creating pulsation through the gate 57 or through the gate 58.

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.

In Figure 6 raw sand from a hopper 65 is delivered at any desired rate by means of a worm 66 to a rough jiggling 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*.

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 jiggling screen 71 which is of finer mesh than the screen 67. 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 draining 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 eccentric shaft 78 in conjunction with springs 79 and 80 maintains these screens in continuous jiggling.

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

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.

It is obvious in the scheme shown the process may be made continuous,—raw sand being delivered through the hopper 65 by the worm 66 to the screen 67 whence it falls into the agitation chamber 68. In the chamber 68 the centrifugal pump and agitator 70 loosens the binder from the sand and the pump delivers a stream of loosened binder, sand, and water to the jiggling screen 71, whence particles that will pass the mesh of this screen are delivered into the settling chamber 72, the water that flows through the screen 71 with the sand particles into the chamber 72 flowing back through the screen 75 into the chamber 68.

As the sand accumulates in the chamber 72 the worm 73 removes it to deliver it into any suitable receptacle, not shown.

In this apparatus the screen 71 may deliver upon a second screen not shown and the process of sizing the sand by successive screenings may be carried to such an extent as may be desirable.

The concentration of the solution may be controlled by controlling the relative quantity of water and sand, so that if the water from 81 is closed down the concentration of the solution in 68 will gradually increase and the binder content of the finished product will be increased.

It is obvious that the process thus carried out is generally the same as in the other apparatus. The raw sand is agitated with water to loosen it from the binder and is screened in presence of water whereby the sand screens as though the individual grains were free from the binder. The individual grains separate and settle through the binder solution in the tank 72 being at the same time coated to an extent with binder that is dependent upon the concentration of the binder solution in the tank 72, upon the temperature of this solution and upon the size of the grains.

In all of the illustrations of my process, it will be noted that the sand grains settle in the solution whether they enter the solution as naked grains to receive a complete binder therefrom or were robbed by it of all or part of a rich binder or receive addition to a weak binder with which they were previously associated. It does not make any difference whether any part of the binder in the particular solution from which the grains take their final coating had been part of this sand originally or not, as it may be wholly new to sand, or may have come from other sand.

In all cases the action of the sand within the binder is practically the same. It settles in the binder, obtaining a part of its ultimate binder content by contact with the solution as it settles (possibly retaining some part it had originally) and trapping a further part of the binder solution, which, filling the voids between the grains as they settle remains there. By reason of well known laws of physics, the binder once trapped in the proper proportion as determined by suitable control of the solution will not escape or drain away from the voids between the sands notwithstanding that the sand must be shoveled out or otherwise moved in a wet condition. Subsequent drying out of the sand, of course, evaporates surplus moisture between the voids.

I have obtained my best results using a strong solution, comparable with cream but not strong enough to prevent the rapid settling of the sand which I find very desirable. As the illustration herein is intended to be quite simple, largely diagrammatic and for the purpose of making clear the principles of the invention rather than for the purpose of meeting the requirements of efficiency and good engineering and because the character of the invention is such that a great variety of apparatus may be used to carry it out, many other and commercially better devices for carrying out the invention will occur to those familiar with the art, who will probably and also wish to vary the process according to the special needs which they may have in mind or to which the sands dealt with may be best suited. It is my purpose to cover herein all the processes pointed out, by whatever apparatus they may be put into effect and whatever the modifications thereof, which come within the reasonable spirit and scope of my claims.

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

1. In modifying molding sand to make of it a molding sand of uniform quality the process of agitating molding sand with water to loosen the binder from the sand grains and settling the sand grains in a binder solution.

2. In modifying molding sand to make of it a molding sand of uniform quality the process of agitating molding sand in the presence of water to loosen the binder from the sand grains, and while the binder is thus loosened from the sand grains, sizing the grains.

3. In modifying molding sand to make of it a molding sand of uniform quality the process of agitating the molding sand with water to loosen the binder from the sand grains, sizing the sand grains within the water and recoating the sand grains with binder from a binder solution.

4. In modifying molding sand to make of it a molding sand of uniform quality the process of agitating with water to loosen the binder from the sand grains, settling the sand grains while loosened from the binder in a binder solution to recoat the sand grains with binder and controlling the contents of binder by controlling the concentration of the binder solution in which the sand grains settle.

5. In modifying molding sand to make of it a molding sand of uniform quality the process of agitating the molding sand with water to loosen the binder from the sand grains, settling the sand grains in a binder solution and controlling the binder content of the molding sand by controlling the temperature of the binder solution from which the sand grains settle.

6. In making or modifying molding sand to make of it a molding sand of uniform quality, the process of settling sand grains in a binder solution to coat the binder.

7. In making or modifying molding sand to make of it a molding sand of uniform quality, the process of settling the sand grains in a binder solution to coat with binder and controlling the binder content by controlling the concentration of the binder solution.

8. In modifying molding sand to make of it a molding sand of uniform quality the process of settling sand grains from which binder has been loosened, in a binder solution to recoat with binder and controlling the amount of binder coating upon the grains by controlling the temperature of the binder solution.

9. In making or modifying molding sand to make of it a molding sand of uniform quality the process of settling sand grains in a binder solution to coat with binder and controlling the amount of binder taken by the sand grains in recoating by simultaneous control of the temperature and concentration of the binder solution.

10. In making or modifying molding sand to make of it a molding sand of uniform quality the process of settling sand grains in a binder solution to coat with binder and controlling the quantity of the binder taken

up by the sand grains by controlling the size of the sand grains that settle through the binder solution.

11. In making or modifying molding sand to make of it a molding sand of uniform quality the process of settling sand grains in a binder solution to coat with binder and controlling the amount of binder taken up by the sand grains by simultaneous control of the size of sand grains and temperature and concentration of the binder solution in which the sand grains settle.

12. In modifying molding sand to make of it a molding sand of uniform quality the process of mixing sand unduly rich in binder with sand unduly lean in binder by agitation in the presence of water and re-coating the grains uniformly with binder by settling them in a binder solution having a desired binder content.

13. In modifying molding sand to make of it a molding sand of uniform quality the process of changing the binder content of a molding sand by agitating it in a colloidal solution of binder, maintaining the colloidal solutions of requisite concentration by addition of binder or water and allowing the sand grains to settle in the colloidal solution.

14. In making or modifying molding sand to make of it a molding sand of uniform quality the process of agitating with water, sizing in the presence of a quantity of water and coating to a desired extent with binder by settling the grains in a binder solution.

15. In making or modifying molding sand to make of it a molding sand of uniform quality the process of agitating with water, sizing in the presence of a quantity of water, coating to a desired extent with binder by settling the grains in a binder solution and controlling the concentration of the solution.

16. In making or modifying molding sand to make of it a molding sand of uniform quality the process of agitating with water, sizing in the presence of water, coating to a desired extent with binder by settling the grains in a binder solution and controlling the temperature of the solution.

17. In making or modifying molding sand to make of it a molding sand of uniform quality the process of agitating with water, sizing in the presence of a quantity of water, coating to a desired extent with binder by settling the grains in a binder solution and simultaneously controlling the concentration and temperature of the solution.

18. In the process of treating molding sand the steps which comprise removing the excess of one of the ingredients of the molding sand by washing the molding sand to separate the sand from the binder content and reuniting the two elements after removing the excess of one element present.

19. The process of treating molding sand which consists in washing the sand free from the binder to separate the sand and binder, adding the binder to a concentrated solution of binder, passing the sand through the concentrated solution of binder to settle in the binder and trap the binder solution within the voids of the sand and removing the sand with its predetermined content of binder so trapped.

20. The process of regulating the binder content of a molding sand which consists in washing the molding sand to separate the sand and binder, in passing the molding sand through a concentrated solution of binder and determining the proportion of voids between the sand filled ultimately by the binder by the percentage of binder within the solution.

21. As a continuing process in the treatment of sand to produce a uniform molding sand, starting with a concentrated solution of a binder, the steps which consist in washing a molding sand to separate its binder from the sand, settling the sand in the binder solution to trap the binder content within its voids in proportion to the concentration of the binder solution and adding binder removed from the molding sand to additional binder as needed to maintain the concentration of the binder.

22. In the formation of molding sands having a predetermined proportion of sand and binding material, the process which consists in forming a concentrated solution of binder, in passing a sand substantially free from binder through the binder allowing it to settle in the solution and trap the binder in its voids and maintaining the concentration of the binder in the solution.

23. The method of grading the sand of molding sand which consists in screening the sand under water in order to separate the grains of sand from their binder during the screening, separating out the fine sand to leave a sand of nearly uniform size, combining the binder removed with a binder solution to render this solution additionally rich in binder, settling in the rich binder solution the coarser sand separated out so as to recoat this sand and applying the excess of binder remaining to other sand.

24. The method of grading molding sand to make the sand thereof uniform, which consists in separating the molding sand from its binder, in screening the sand while it is loosened from the binder and in recombining the selected grade of sand separately with the binder.

25. The method of combining sand with a binder to form a molding sand which consists in settling the sand in a concentrated solution of binder such that the quantity of binder solution taken up by the surface and

within the voids of the sand as it settles shall contain the required binder for the sand.

26. The method of averaging binder in
5 sands of different condition as regards
binder content, which consists in separating
the binder content from those sands having
a high binder content and uniting the
binder separated with a binder solution to
10 produce a solution very rich in binder, re-
coating the sand separated from the binder
with a moderate binder content by a set-
tling process within the binder solution and
settling through the same solution a sand

of lower binder content or without binder 15
content to give it a moderate binder content
from the excess of binder furnished by the
sand rich in binder content.

27. The method of equalizing the binder
content in sands having richer and poorer 20
or no binding content, which consists in dis-
solving the binder content from the sands
having excessive binder as well as from
those having less binder and settling all the
sands to be coated through the binder solu- 25
tion formed.

WAGER FISHER.