

[54] **DRUM MIXER FOR CONTINUOUS PROCESSING OF A GRANULAR BULK MATERIAL**

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[57] **ABSTRACT**

For preparing a granular bulk material for use, such as in reclaiming foundry sand, a drum mixer is arranged to rotate about a shaft located at an acute angle to the horizontal. The circumferential side of the drum is closed while one transverse end is closed and the other is open. The shaft rotates the drum at a speed so that a portion of the bulk material, as it moves with the drum, drops in a free fall through the drum. A mixing and kneading tool extends into the bulk material in the drum, preferably into the center of gravity of the bulk material, and the drum, and the tool is rotated so that it provides a flow within the bulk material countercurrent to the flow generated by the rotation of the drum. Further, a pair of the mixing and kneading tools can be used, each rotating opposite to the other.

[30] **Foreign Application Priority Data**

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[58] Field of Search ..... 259/3, 15, 16, 32, 33, 259/84, 85, 174, 175, 176, 177, 154, DIG. 40, 168

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**4 Claims, 4 Drawing Figures**

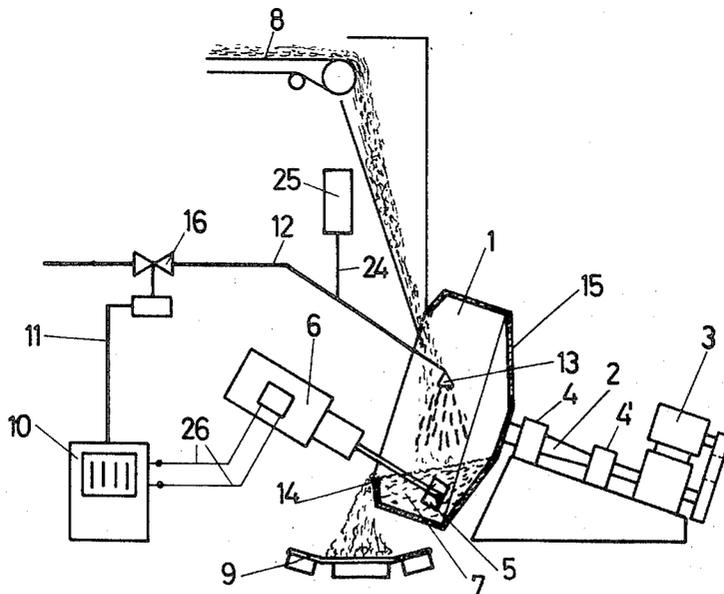


Fig. 1

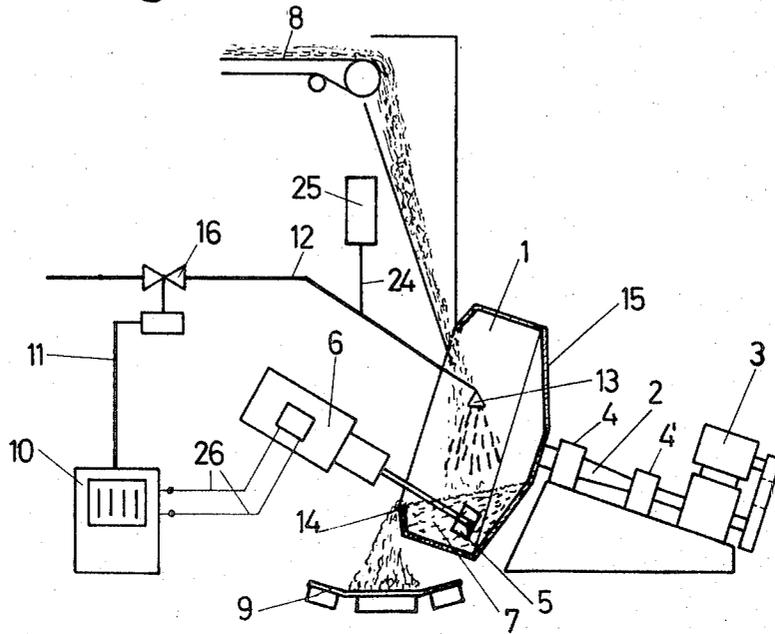
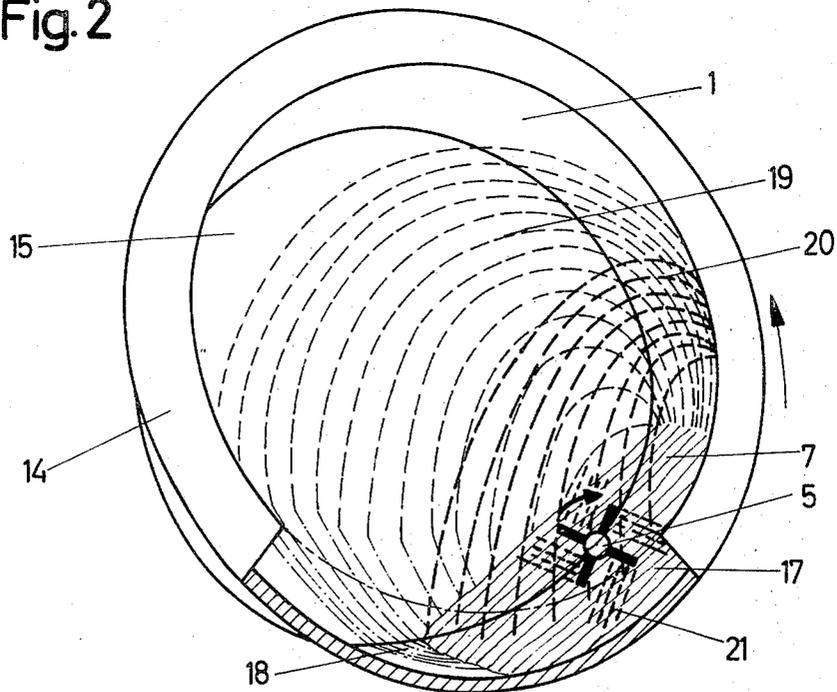
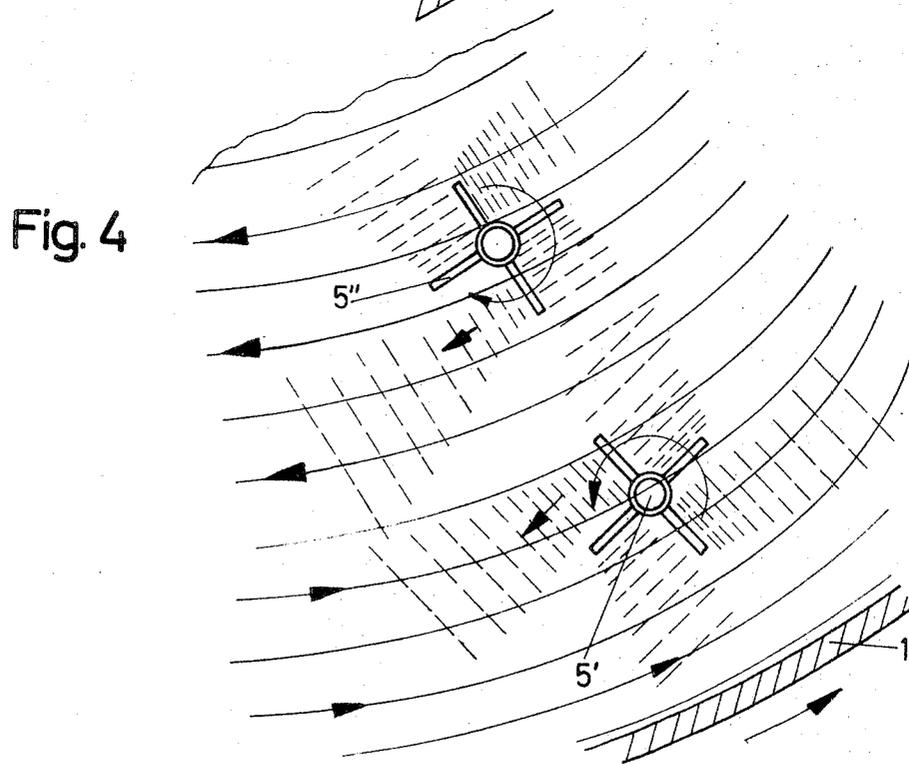
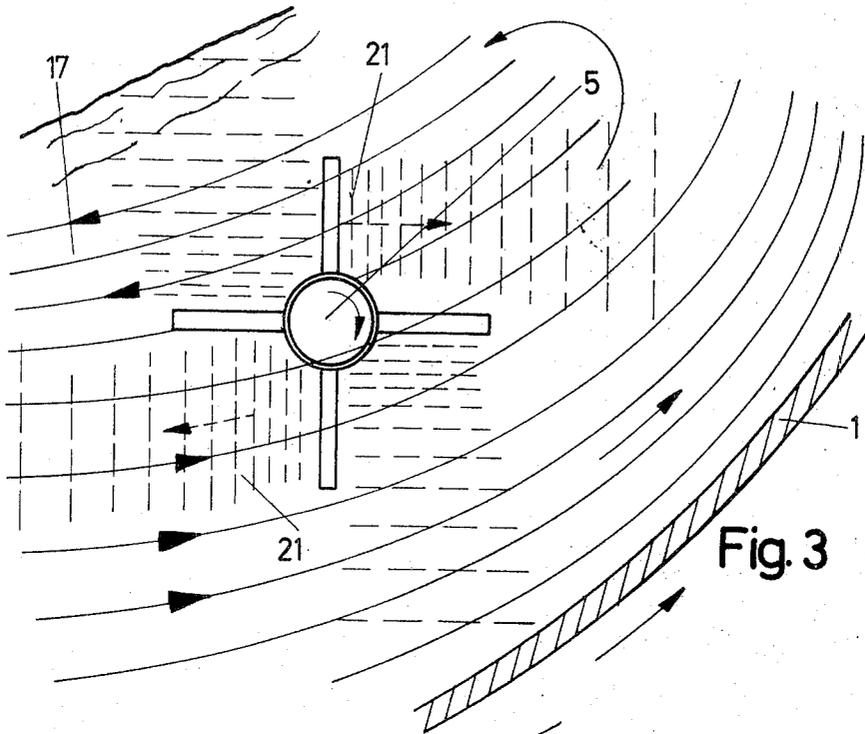


Fig. 2





## DRUM MIXER FOR CONTINUOUS PROCESSING OF A GRANULAR BULK MATERIAL

### SUMMARY OF THE INVENTION

The present invention is directed to a drum mixer for the continuous processing of granular bulk material, especially for reclaiming foundry sand, and, more particularly, it concerns the arrangement of the drum mixer which is adapted to rotate about an axis inclined to the horizontal with the drum rotating at such a speed that a portion of the material charged into the drum drops in a free fall as the material is moved by the rotation of the drum.

As is well known, when sand molds are cast the foundry sand directly adjacent the cast piece is heated to a considerable extent while the foundry sand more remote from the cast piece remains at a low temperature. Accordingly, when a mold is emptied, some of the foundry sand is very moist and at a relatively low temperature, while another portion is relatively hot and completely dry. The very moist or over-humidified sand tends to form lumps of various sizes when it is mixed with the dried-out sand. However, it is important, for the reprocessing and reuse of the foundry sand that it be in a relatively lump-free condition and of uniform moisture and temperature.

In reclaiming foundry sand an apparatus has been used which includes a drum arranged to rotate about an axis inclined to the horizontal, with the drum closed on the side and at one end and open on the other. The dimension between the opened and closed ends of the drum is less than its diameter. Further, driving means are provided for the drum so that it rotates at a speed which permits a portion of the foundry sand within the drum to drop in a free fall. It has been found that the elimination of the lumps in the foundry sand at times presents difficulties for this apparatus.

There is another known apparatus which uses a mixing tool extending into the foundry sand for mixing the sand and at the same time moistening it. However, in such an arrangement the aeration and cooling of the sand leaves much to be desired.

For use in forming molds, reclaimed foundry sand must have certain mechanical properties, for example, strength, permeability and the like, and, in addition, it must be lumpfree, aerated and homogeneously moistened, accordingly, it is the primary object of the present invention to provide an arrangement which meets the foregoing requirements for reclaimed foundry sand. Commencing with the known type of drum mixer indicated above, the present invention incorporates at least one rotating mixing and kneading tool of a mixing apparatus which is preferably positioned in the center of gravity of the compact bulk material located within the lower region of the drum. The characterizing feature of the use of the mixing and kneading tool is that it is rotated within the material so that it provides a flow within the material counter current to the flow developed by the drum as it rotates.

Therefore, in accordance with the present invention, it is possible to adequately reprocess the foundry sand so that it is mixed, kneaded and loosened at a considerable reduction in equipment costs and a better quality of reclaimed foundry sand can be obtained.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure.

For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a vertical sectional view through a mixing apparatus embodying the present invention;

FIG. 2 is a schematic representation of the manner in which the material is moved within the mixing apparatus;

FIG. 3 is a schematic representation of the flow of the material within the mixing apparatus due to the combined action of a drum and a mixing and kneading tool; and

FIG. 4 is a schematic representation, similar to that in FIG. 3, in which a pair of mixing and kneading tools are positioned within the material.

### DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 a mixing apparatus for reprocessing foundry sand is illustrated and includes a drum mixer 1 mounted on a centrally arranged drum shaft 2 for rotation about an axis arranged at an acute angle to the horizontal. The drum mixer 1 is formed by a conically shaped drum bottom or end 15 to which the shaft 2 is attached with a circumferentially extending wall extending axially from the end 15. Opposite the end 15 the drum is open and an edge member or flange 14 extends inwardly from the side of the drum and the inwardly extending dimension of the flange 14 determines the height of the compact foundry sand 7 within the lower portion of the drum 1, note FIG. 1. The drum shaft 2 is connected to a drive 3 and it is rotatably mounted in a pair of axially spaced bearings 4,4'. To provide a continuous supply of the foundry sand into the drum, a conveyor belt 8 is located above the open end of the drum. Another conveyor belt 9 is located below the drum for the continuous discharge of the reclaimed foundry sand which flows over the flange 14 on the drum.

Extending into the foundry sand through the open end of the drum is a mixing and kneading tool 5 driven by a known mixing apparatus 6. Preferably, the tool 5 extends into the center of gravity of the foundry sand 7 in the lower portion of the drum. The mixing apparatus 6 is movably mounted for maintaining the tool 5 at the center of gravity of the foundry sand 7 and it includes a follow-up device for the automatic guidance of the mixing and kneading tool.

A pipe line 12 having a nozzle 13 at its end extends into the drum 1 so that the nozzle is located above the body of the foundry sand 7 and serves to direct a supply of water into the sand. Within the pipe line 12 a valve 16 is arranged in communication with a control line 11 which extends to a control device 10. As can be noted in FIG. 1, measuring lines 26 extend between the control device 10 and the driving motor 6 of the mixing and kneading tool 5 so that the addition of water can be regulated in dependence on the input of the driving motor 6.

Clay-binders, coal dust and other substances can be added to the foundry sand either separately or with the water through the nozzle 13 by providing a proper de-

sign for the nozzle. In one embodiment, additional substances in the form of a slurry can be introduced into the pipe line 12 through a branch pipe 24 which is connected to a dosing device 25. As indicated above, it is also possible to supply these substances into the drum without using the pipe line 12 and the nozzle 13.

In FIG. 2 a schematic representation is provided of the manner in which the granular bulk material or foundry sand travels within the drum as the drum rotates. The speed of the drum 1 and of the variably insertable mixing and kneading tool 5, as well as the inclination of the shaft 2 for the drum, depend to a great extent on the type and composition of the foundry sand being reprocessed. With a properly selected ratio of speed and inclination of the shaft 2 and of the mixing and kneading tool 5, the foundry sand within the drum can be divided. As a rule, the speed of the drum 1 will be slower than that of the mixing and kneading tool 5.

As the drum rotates in the direction of the arrow shown in FIG. 2, a portion 17 of the foundry sand charged into the drum after exceeding the angle of repose of the sand slides back downwardly in an avalanche-like manner across the top of the body of foundry sand 7. This avalanche-like flow takes place without any detachment or separation of the foundry sand from the remaining compact body 7 of the sand. Another portion 19 of the foundry sand returns into the starting position passing along the closed end 15 of the drum and mixes with the compact body 7 at the point 18 on the drum within its lower region. In FIG. 2 a portion of the flange 14 is shown removed to indicate the various paths of flow of the foundry sand due to the action of the drum rotation.

Yet a third portion 20 of the sand is carried upwardly above the angle of repose and detaches itself from the drum 1 and returns in a free fall as a spray of sand through the portions 17 and 19. Further, the mixing and kneading tool 5 contributes to the circulation of the compact body 7 of the sand and the direction of rotation of the tool is opposite to the direction of rotation of the drum. The oppositely directed rotation of the tool provides a counter-current flow 21 in the sand relative to the flow provided by the drum. Due to the counter-current flow 21, the mixing and separation of the sand is intensified, because the individual grains of sand rub each other and are thus refined. Moreover, due to the whirling movement of the mixing and kneading tool 5, air is introduced into the foundry sand with the result that a particularly loose and moldable sand is obtained.

FIG. 3 is a schematic showing of the operation of the mixing and kneading tool 5 in a cross section of the body 7 of the foundry sand, showing the counter-current flow 21 to the flow of the sand developed by the drum.

In FIG. 4 a schematic representation is provided of the manner in which two spaced mixing and kneading tools 5', 5'', which rotate in opposite directions, provide an intensified mixing action within the compact body 7 of the foundry sand.

What is claimed is:

1. Drum mixer for the continuous processing of a granular bulk material, such as foundry sand, including a rotatable shaft disposed at an acute angle to the horizontal, first driving means operatively connected to said shaft, a drum mounted on said shaft for rotation therewith, said drum comprising a closed end secured to and extending transversely of said shaft, an annular shaped closed side secured at one end to said closed end and extending outwardly therefrom in the axial direction of said shaft with said closed side sloping upwardly from said closed end, and an annular flange extending radially inwardly from the end of said closed side spaced outwardly from said closed end and the radially inner edge of said flange defining the opening in the opened end of said drum, means for supplying granular bulk material into said drum so that a compact body of material is formed in the lower portion of said drum with the surface of the body of material sloping downwardly from said closed end to said radially inner edge of said flange in the lower portion of said drum and with the said radially inner edge forming an outlet edge over which the processed material flows from said drum, said first driving means arranged to rotate said drum at a speed so that the compact body of material remains in the lower portion of said drum, wherein the improvement comprises a mixing and kneading tool mounting such that it extends into said drum below the axis of rotation of said drum and said tool having a head end arranged to be positioned below the downwardly sloping surface of the compact body of material within the lower part of said drum such that it is located at the center of gravity of the body of material for mixing and kneading said material, second drive means operably connected to said tool for rotating said tool in a direction counter-current to the direction of rotation of said drum so that said tool provides a flow in the body of material counter-current to the direction of flow of the material developed by said drum, and said second driving means and said tool being movably mounted for maintaining the head end of said tool at the center of gravity of the material.

2. Drum mixer, as set forth in claim 1, wherein a pipe line having a nozzle at its end is arranged for spraying water into the body of material in the lower portion of said drum with said nozzle spaced above the body of material, a branch pipe connected to said pipe line for adding solid substances in powder, granular and slurry form into said pipe line for introduction into the material in said drum through said nozzle.

3. Drum mixer, as set forth in claim 2, wherein a valve is positioned in said pipe line, a control device connected to said second driving means, a control line extending between said control device and said valve, so that the addition of water into said drum through said pipe line can be regulated in dependence on the input of said second driving means.

4. Drum mixer, as set forth in claim 1, wherein at least two mixing and kneading tools are arranged within the compact body of the granular material within said drum.

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