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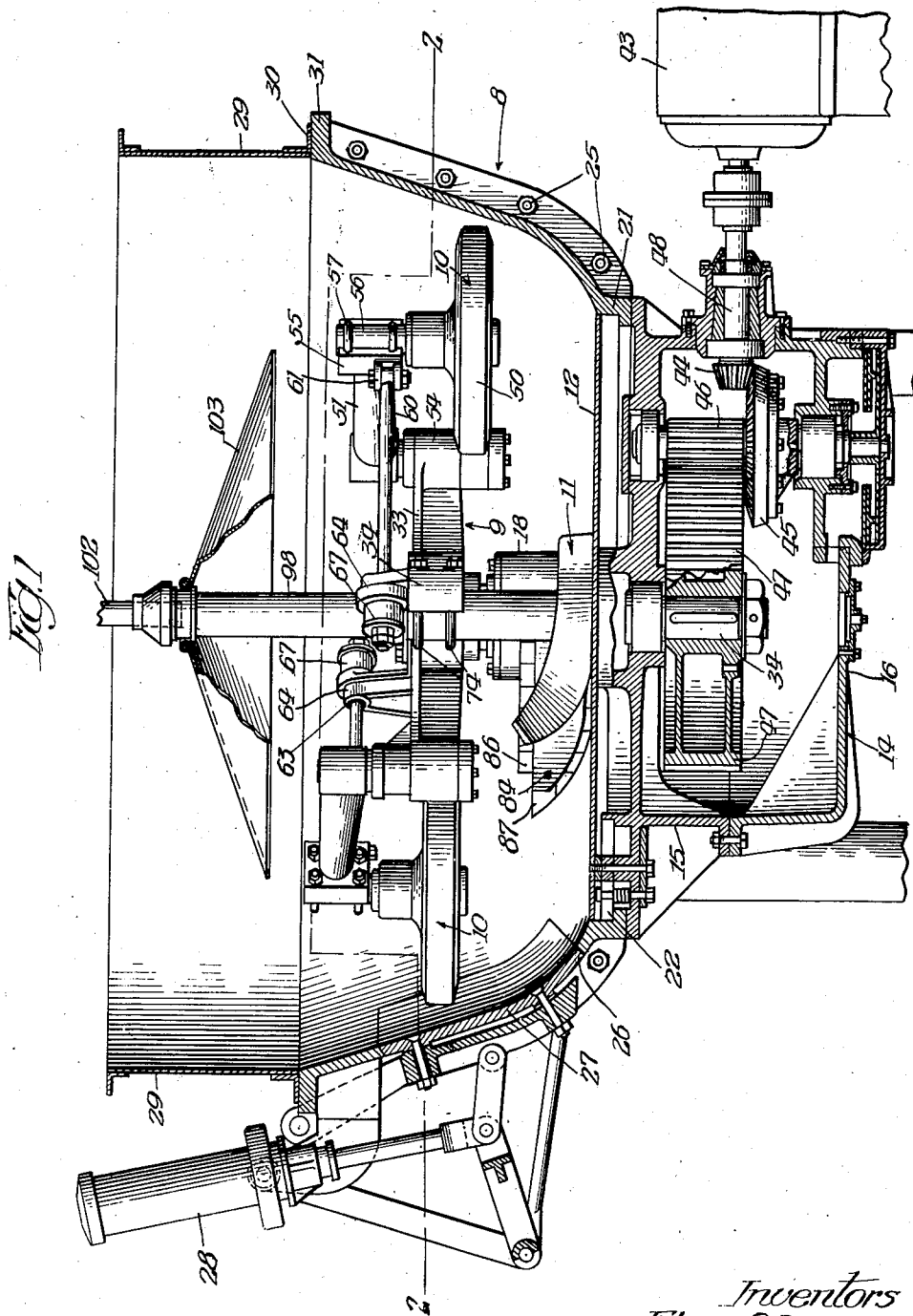
E. O. BEARDSLEY ET AL

2,303,319

MULLING APPARATUS

Filed Nov. 1, 1939

5 Sheets-Sheet 1



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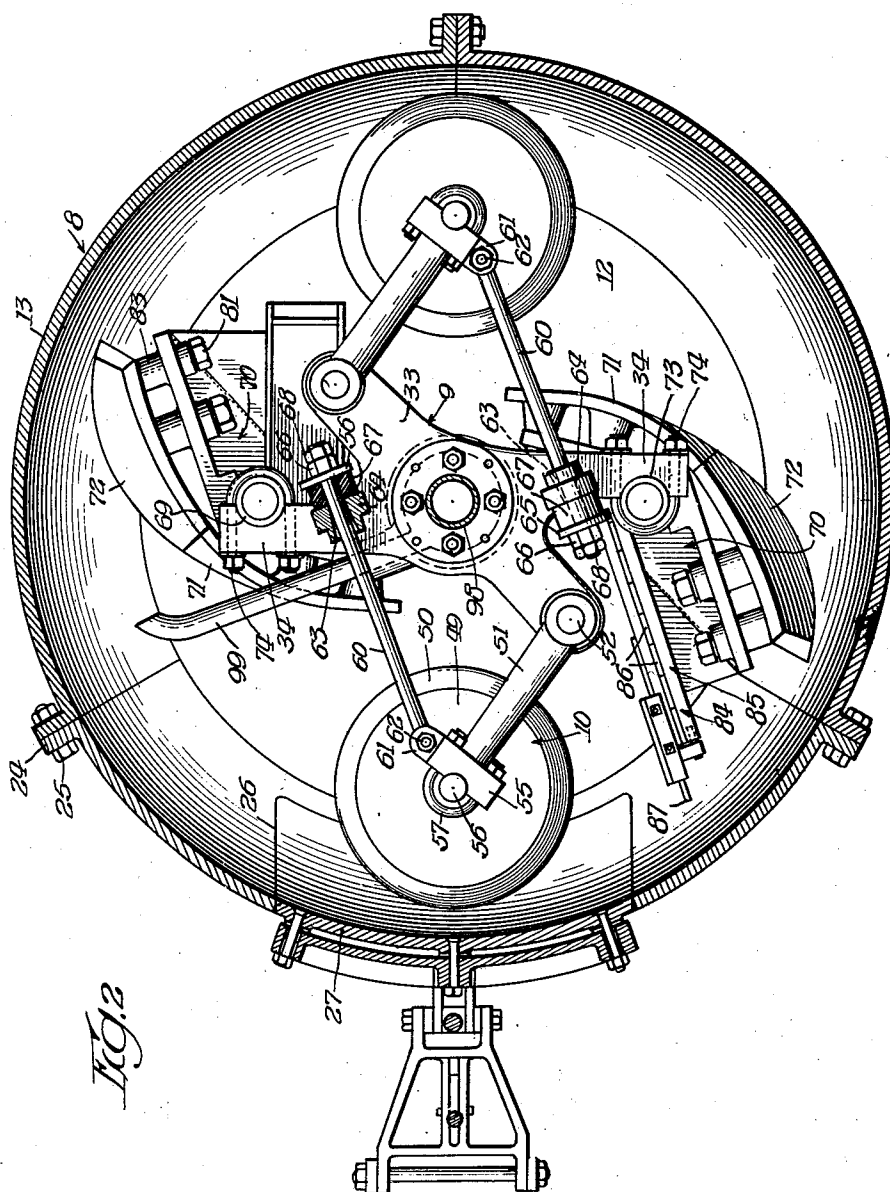
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MULLING APPARATUS.

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5 Sheets-Sheet 2



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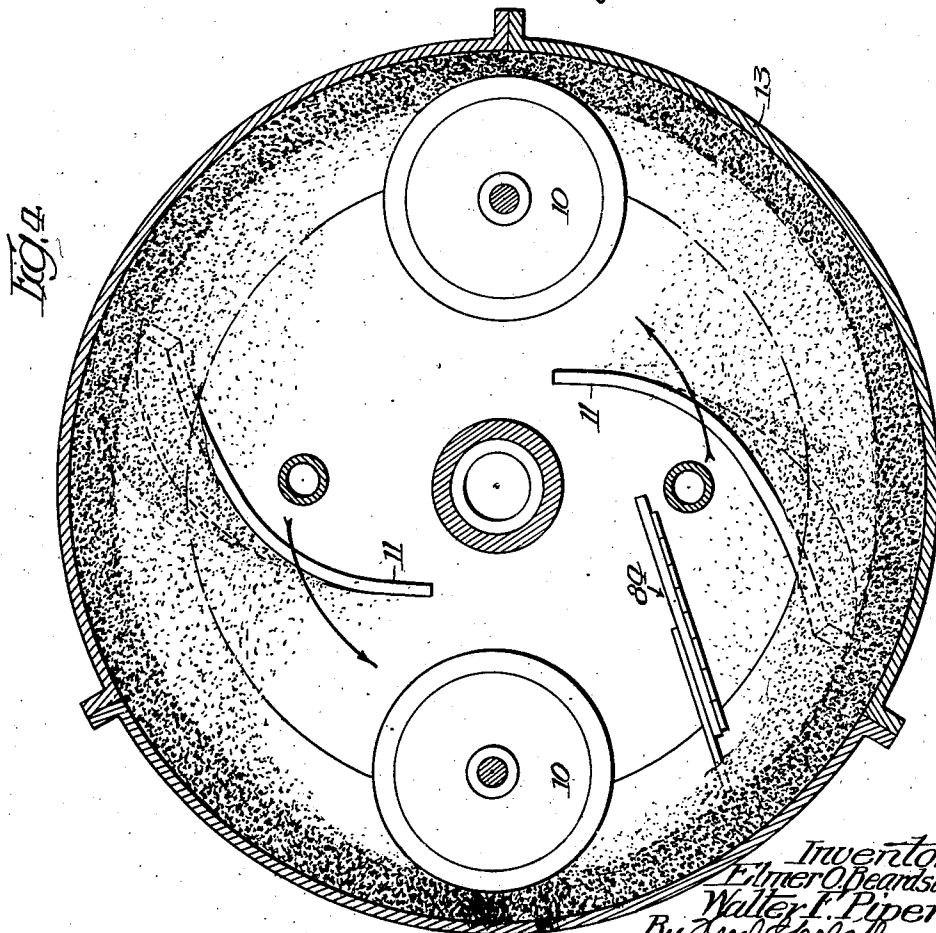
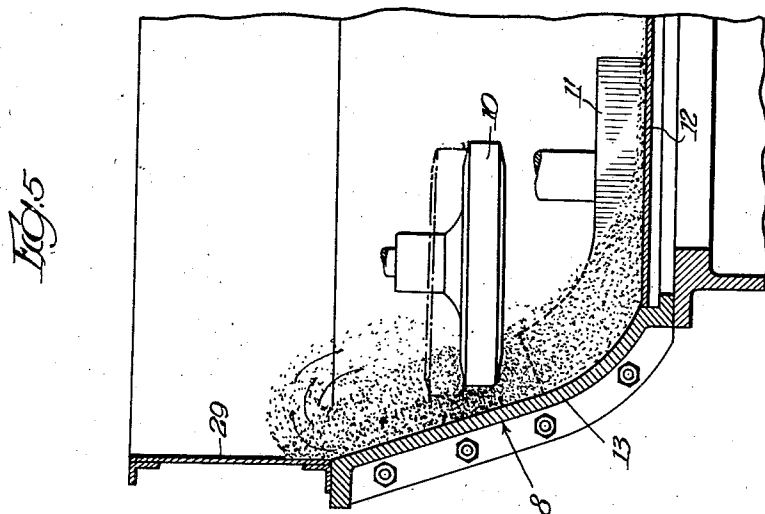
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MULLING APPARATUS

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5 Sheets-Sheet 4



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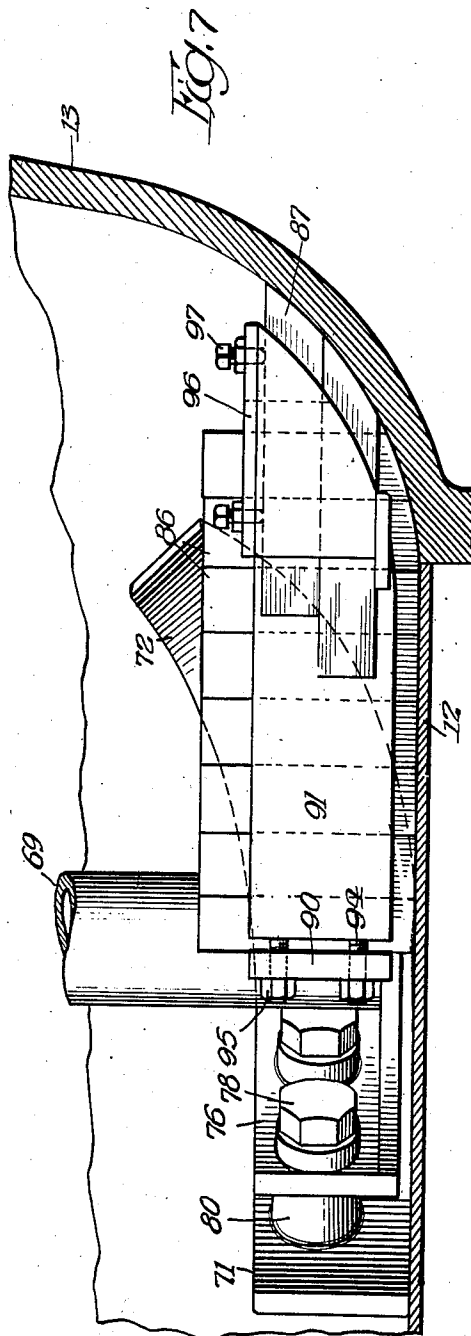
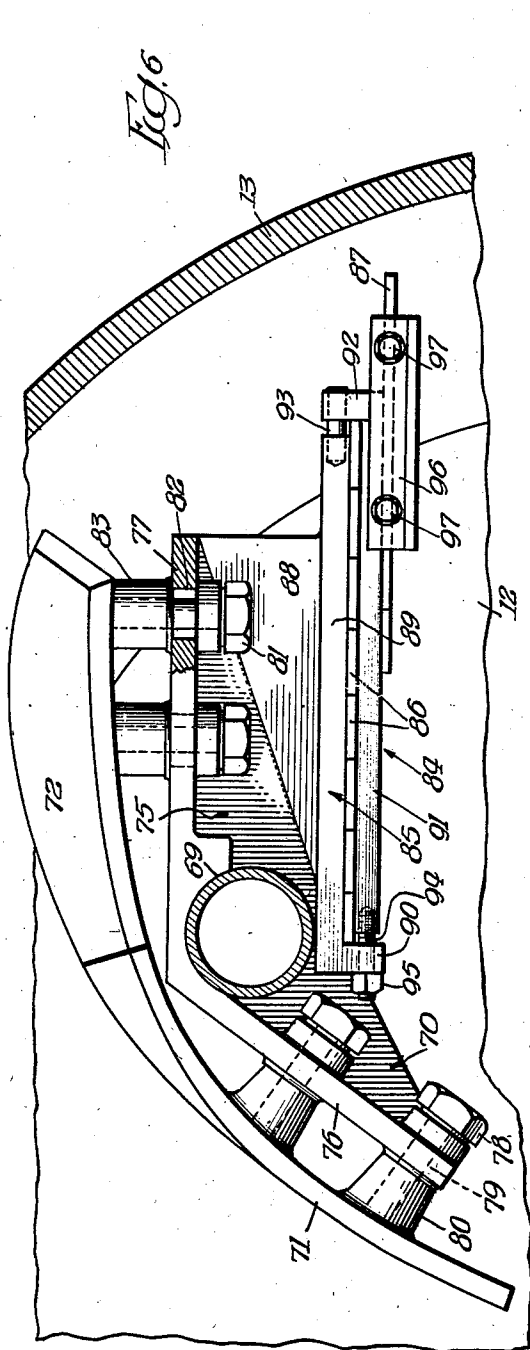
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MULLING APPARATUS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,303,319

MULLING APPARATUS

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Application November 1, 1939, Serial No. 302,312

13 Claims. (Cl. 83—45)

The present invention relates generally to apparatus for mulling or conditioning granular material. More particularly the invention relates to that type of mulling apparatus which is primarily adapted for use in a foundry in connection with the mulling, mixing or conditioning of molding sand and as its main or principal parts comprises (1) an open top bowl-like sand retaining receptacle which is suitably supported above the floor of the foundry in which the apparatus is used and embodies a flat circular bottom and an annular side wall around and extending upwardly from the margin of the bottom; (2) a rotary horizontally extending crosshead which is disposed in the central portion of the receptacle and is driven at a comparatively high speed by an electric motor and speed reducing gearing beneath the receptacle; (3) a plurality of rotary mulling elements which are carried by the crosshead and are adapted during drive of the latter to travel in a circular course around the inner face of the receptacle side wall and at the same time to spin or roll and effect mulling of the sand by squeezing it against the annular side wall; and (4) a set of plow type deflectors which are carried by the crosshead between the mulling elements and operate during a mulling operation to deflect the sand in the receptacle upwardly and outwardly against the receptacle side wall and into the path of the rotary mulling elements.

One object of the invention is to provide a mulling apparatus of this type which is more practical and efficient than, and has certain advantages over, previously designed apparatus of the same general character.

Another object of the invention is to provide a mulling apparatus of the type under consideration in which the side wall of the receptacle is upwardly flared and the mulling elements are in the form of horizontally extending wheels and have tires with cylindrical outer peripheries which during operation of the apparatus so squeeze the sand against the side wall that it is caused to move or work upwards toward the top of the side wall and then fall down towards the receptacle bottom into the path of the deflectors for further action by the latter and the mulling wheels.

Another object of the invention is to provide a mulling apparatus of the last mentioned character in which the mulling wheels are connected to the power driven crosshead by way of horizontally extending arms which are pivotally connected to the crosshead so that they, together

with the wheels, are permitted to swing outwards toward the receptacle side wall in response to centrifugal force during drive of the crosshead.

Another object of the invention is to provide a mulling apparatus of the type and character under consideration in which outward swing of the arms and mulling wheels is limited or restricted by means of tie rods which extend between the distal ends of the wheel supporting arms and brackets on the crosshead.

A further object of the invention is to provide a mulling apparatus of the aforementioned type which includes a novel and readily adjustable scraper behind one of the plow type deflectors for scraping from the receptacle bottom and the lower portion of the receptacle side wall any sand which tends to cake thereagainst.

Other objects of the invention and the various advantages and characteristics of the present mulling apparatus will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a vertical section of a mulling apparatus embodying the invention;

Figure 2 is a horizontal section taken on the line 2—2 of Figure 1 and illustrating in detail the arrangement and design of the mulling wheels and plow type deflectors;

Figure 3 is an enlarged vertical section showing the design and mounting of the rotary power driven crosshead and the manner in which the wheel supporting arms are pivotally connected to the crosshead and also showing the construction and design of the mulling wheels and the manner in which they are rotatably mounted with respect to the distal ends of the wheel carrying arms;

Figure 4 is a diagrammatic type horizontal section illustrating the manner in which the sand is squeezed against the side wall of the receptacle by the mulling wheels and also the manner in which the sand is controlled and flung outwardly and upwardly against the receptacle side wall by the plow type deflectors;

Figure 5 is a diagrammatic type fragmentary vertical section showing the manner in which the sand, due to the upward flare of the receptacle side wall, is caused, after squeezing or

mulling against the receptacle side wall by the mulling wheels, to move upwards toward the top of the side wall;

Figure 6 is a view partly in plan and partly in horizontal section showing the construction and design of the plow type deflectors and also showing the arrangement, design and construction of the adjustable scraper for eliminating caking of sand on the bottom of the receptacle and the side wall; and

Figure 7 is a side elevation of the scraper.

The apparatus which is shown in the drawings constitutes the preferred embodiment of the invention and is adapted primarily for use in a foundry or like establishment in connection with the treatment of molding sand. It serves or operates as hereinafter described, to mull, mix or recondition the sand and comprises an open top bowl-like sand retaining receptacle 8, a rotary crosshead 9, a pair of mulling wheels 10 and a pair of plow type deflectors 11.

The receptacle 8 is suitably supported over the floor of the foundry or other establishment in which the apparatus is used. It is adapted to be charged or filled with a batch of sand to be mulled or otherwise conditioned for molding purposes and comprises a flat circular bottom 12 and an annular upstanding side wall 13. The bottom 12 is preferably in the form of a steel plate and overlies a cast metal housing 14. The latter, as shown in Figure 1, consists of an upper section 15 and a complementary lower section 16. The lower section is suitably bolted to the upper section and is adapted upon release of the bolts, to be dropped or moved to provide access to the interior of the housing. The upper section has an outwardly extending marginal flange 17 at the top thereof and embodies an integral upstanding tubular member 18. The receptacle bottom 12 has a central hole 19 therein through which projects the tubular member 18. The inner margin of the bottom rests on an annular shoulder 20 on the central portion of the member 18. The side wall 13 of the receptacle 8 is preferably formed of cast metal and extends upwardly from the outer margin of the bottom 12. It is of sectional design as shown in Figures 2 and 4 and has at the bottom thereof a downwardly extending flange 21 of L-shaped cross section. This flange rests on the flange 17 of the upper section 15 of the housing 14 and its upper portion surrounds and engages the outer edge of the bottom 12. Radially extending clamping plates 22 are applied to the bottom portion of the flange 21 and serve to hold the side wall of the receptacle in fixed or connected relation with the housing. Bolts 23 extend through the flange 17 and the receptacle bottom 12 and operate to hold the bottom against rotation relatively to the side wall. The lower portion of the side wall of the receptacle is curved downwardly and inwardly. The upper portion of the side wall is conical and extends upwardly and outwardly at an angle of 10° to 15° with respect to the vertical. The sections of the side wall are complementary and are secured together by means of pairs of abutting side flanges 24 and bolts 25. One of the side wall sections is provided with a discharge opening 26 for the mulled sand and this opening is normally closed by means of a door 27 which is hinged at the upper end thereof so that it may be swung downwardly and outwardly into an open position when it is desired to discharge the sand from the receptacle at the completion or end of a mulling

operation. A fluid pressure cylinder piston type device 28 is secured by suitable brackets on the side wall of the receptacle adjacent the discharge opening 26 and serves as a medium for opening and closing the door 27. In addition to the bottom 12 and the side wall 13 the receptacle 8 comprises a cylindrical horizontally extending ring 29. This ring is located directly above the receptacle side wall and has at the bottom thereof an annular angle bracket 30 which rests upon and is bolted or otherwise fixedly secured to an outwardly extending flange 31 at the top of the receptacle side wall. The internal diameter of the ring is the same as the internal top diameter of the top of the side wall and as a result the ring forms a top continuation of the receptacle side wall. When the apparatus is in use a batch of sand to be mulled or conditioned is dumped or otherwise delivered into the ring 29 and is then, after mulling by the mulling wheels 10, discharged via the opening 26.

The crosshead 9 carries the mulling wheels 10 and the plow type deflectors 11 and is preferably in the form of a one-piece casting. It is positioned centrally with respect to the side wall and midway between the bottom 12 and the top of the receptacle side wall and consists of a hub 32, a pair of outwardly extending legs 33 and a pair of outwardly extending legs 34. The hub 32 of the crosshead is cup shaped as shown in Figure 3, and embodies a cylindrical side wall 35 and a cross wall 36. The cross wall is spaced slightly above the bottom margin of the cylindrical side wall 35 and defines with the latter a bottom chamber 37 and a top chamber 38. The legs 33 are joined to and extend radially from the side wall of the hub and are positioned one diametrically opposite the other. They extend horizontally and are positioned behind the legs 34. The latter are also joined to and project radially from the side wall of the hub and are disposed diametrically opposite one another. The crosshead is mounted on the upper end of, and driven by, a vertical shaft 39 which extends through the tubular member 18 of the upper section 15 of the housing 14. The upper end of the shaft 39 is provided with an enlarged head 40 on which rests the hub 32 of the crosshead 9. Bolts 41 extend through the hub and the head 40 and serve fixedly to secure the crosshead to the upper end of the shaft 39. The lower end of the shaft 39 projects beneath the tubular member 18 and into the interior of the housing 14. The central portion of the shaft is journaled in roller bearings 42 so that it is free or adapted to rotate about its axis. An electric motor 43 together with speed reducing gearing serves to drive the shaft 39 and the crosshead 9. As shown in Figure 1, the motor is located at one side of and a small distance beneath the receptacle 8 and embodies an armature shaft, one end of which projects in the direction of the housing 14. The speed reducing gearing is disposed in the housing and comprises a bevel pinion 44, a bevel gear 45, a pinion 46 and a gear 47. The bevel pinion 44 is connected to the armature shaft of the electric motor by way of a horizontally extending shaft 48 which is journaled in a suitable bearing between the upper and lower section of the housing 14. The bevel gear 45 meshes with and is driven by the bevel pinion 44 and is keyed or otherwise fixedly secured to the central portion of a vertically extending shaft. The pinion 46 is fixed to the last men-

tioned shaft above the bevel gear and meshes with and serves to drive the gear 47. The latter, as shown in Figures 1 and 2, is keyed to the lower end of the main drive shaft 39. When the electric motor 43 is in operation it serves, through the medium of the speed reducing gearing in the housing 14, to drive the shaft 39 and the crosshead 9. Preferably the crosshead is driven between 60 to 90 revolutions per minute.

The mulling wheels 10 are positioned in close proximity to the central portion of the side wall 13 of the receptacle 8. They consist of cast metal bodies 49 and solid rubber tires 50 and are carried by a pair of horizontally extending arms 51 so that they are permitted to swing outwards toward the receptacle side wall. The arms 51 are disposed above the crosshead 9 and project outwardly from the ends of the crosshead legs 33. The inner ends of the arms 51 are fixedly secured to the upper ends of a pair of vertically extending shafts 52. The lower ends of the shafts 52, as shown in Figure 3, extend through and are suitably journaled in a pair of vertically extending sleeves 53 at the ends of the legs 33 of the crosshead. The sleeves fit within a pair of sockets 54 at the outer extremity of the legs 33 and are suitably secured against vertical displacement with respect to the crosshead. The shafts 52 together with the sleeves 53 form pivotal connections between the arms 51 and the mulling wheels 10 are permitted to swing outwards in response to centrifugal force during drive of the crosshead. The distal ends of the arms 51 are provided with enlarged brackets 55. These brackets, as shown in Figure 3, are provided with seats for the upper ends of a pair of vertically extending shafts 56. U bolts 57 extend around the upper ends of the shafts 56 and through the brackets 55 and serve fixedly to connect the shafts to the arms 51. The bodies 49 of the mulling wheels are hollow and have enlarged hubs 58 around the lower ends of the shafts 56. Roller bearings 59 extend between the lower ends of the shafts 56 and the hubs and constitute mountings whereby the mulling wheels are permitted to rotate or freely spin with respect to the shafts 56. The solid rubber tires 50 surround and are suitably fixed to the rim portions of the wheel bodies and have cylindrical outer peripheries. They are adapted during operation of the apparatus yieldingly to engage the sand between them and the adjacent portion of the receptacle side wall and to squeeze such sand in such manner that the grains roll relatively to one another and effect a substantially uniform distribution of any bonding material which is introduced into the sand either before or after the sand is delivered into the receptacle. As a result of the fact that the mulling wheels are free to swing outwards in response to the action of centrifugal force the sand between the tires 50 and the adjacent portion of the receptacle side wall is subjected to a pronounced squeezing action and any lumps therein are effectively broken up. Because the outer peripheries of the rubber tires 50 are cylindrical and the upper portion of the receptacle side wall is upwardly flared the sand, in connection with mulling or squeezing thereof, is wedged upwards in such manner that it works or moves to the top of the receptacle side wall and then, as shown in Figure 5, drops or falls back toward the receptacle bottom 12. The two mulling

wheels are vertically offset and as a result the sand which is mulled and squeezed upwards by the lower wheel moves into the path of the upper wheel and is again mulled and wedged or squeezed upwards. Preferably the top face of the lower mulling wheel is coplanar with the bottom face of the upper wheel. As a result of the arrangement of the two mulling wheels the sand which is subjected to the mulling action of the lower wheel is also subjected to the mulling action of the upper wheel during each revolution of the crosshead and the two wheels coact with the upwardly flared upper portion of the side wall to wedge or move upwards the mulled sand toward the top of the receptacle side wall. During drive of the crosshead the mulling wheels not only move outwards during travel around the receptacle side wall but also spin or roll.

In order to prevent the mulling wheels 10 from swinging outwards into contact with the side wall 13 of the receptacle two horizontally extending tie rods 60 are provided. These rods overlie the crosshead 9 and extend inwardly from the enlarged brackets 55 at the distal ends of the arms 51. The outer ends of the tie rods fit between pairs of vertically spaced lugs 61 on said brackets 55 and are pivotally connected to such lugs by way of vertically extending bolts 62. The inner ends of the tie rods extend through holes 63 in the upper ends of a pair of upstanding brackets 64 on the crosshead legs 34 and have externally threaded extremities with washers 65 and nuts 66 thereon. Solid rubber collars 67 are mounted on the inner ends of the tie rods 60 between the washers 65 and the brackets 64 and serve, together with the washers and nuts 66, to limit outward movement of the tie rods and the mulling wheels. The brackets 64 are preferably formed integrally with the crosshead legs 34. The holes 63 through which the inner ends of the tie rods 60 extend are flared in the direction of the mulling wheels in order to permit the tie rods to swing laterally relatively to the brackets in connection with outward or inward swinging movement of the wheels. The collars 67 serve as cushions or shock absorbers and operate to eliminate shock at the end of outward swing of the mulling wheels in connection with starting of the electric motor 43. By limiting the outward swing of the mulling wheels the solid rubber tires 50 are not permitted to contact with the side edges of the discharge opening 26 during a sand discharging operation. By adjusting the nuts 66 on the inner externally threaded extremities of the tie rods 60 the extent of outward swing of the mulling wheels may be varied. If it is desired to permit the wheels to operate nearer the inner periphery of the receptacle side wall the nuts 66 are loosened and if it is desired to have the wheels operate at a greater distance from the side wall of the receptacle the nuts are tightened. Lock nuts 68 are mounted on the inner ends of the tie rods 60 outwardly of the nuts 66 and serve when in abutment with the last mentioned nuts to prevent loosening or turning of the latter. The brackets 64 are preferably located at the inner ends of the crosshead legs 34. The tie rods 60, brackets 64 and solid rubber collars 67 together with the washers 65 and the nuts 66 constitute simple and novel stop means for limiting outward swing of the mulling wheels.

The plow type deflectors 11 are carried by the crosshead for conjoint circular travel with the

mulling wheels around the inner periphery of the side wall of the receptacle. They are carried by a pair of vertically extending pipes 69 and a pair of brackets 70 and consist of inside deflector member 71 and outside deflector members 72. The upper ends of the pipes 69 fit within arcuate or curved seats 73 in the outer ends of the legs 34 of the crosshead 9 and are fixedly secured in place by means of U bolts 74. The brackets 70 are located at the lower ends of the pipes 69 and consist of flat triangular shaped bottom pieces 75, inner upstanding pieces 76 and outer upstanding pieces 77. The bottom pieces underlie the lower ends of the pipes 69 and abut thereagainst. The inner upstanding pieces 76 are joined to the outer pieces 77, as shown in Figure 6, and extend at substantially an angle of 125° with respect to the latter. The lower ends of the pipes 69 fit against the junctures of the inner and outer pieces 76 and 77 and are welded in place in order fixedly or rigidly to secure the brackets 70 to the pipes. The inner pieces 76 of the brackets extend substantially radially with respect to the main drive shaft 39 and are connected to and support the inside deflecting members 71 by way of bolts 78. The latter extend through vertically elongated slots 79 in the inner bracket pieces 76 and into bosses 80 on the rear or back faces of the inside deflector members 71. The last mentioned members are curved and are disposed directly over the receptacle bottom 12. They operate to scrape the sand off the bottom and are so curved that during operation of the apparatus the sand which comes in contact with them is flung outwards in the direction of the outside deflector members 72 and the receptacle side wall. The outer ends of the members 71 are rearwardly canted so as to direct the sand upwards as well as outwards. Because of the vertically elongated slots 79 in the inner pieces 76 of the brackets 70 the inside deflector members 71 may be vertically adjusted in order to bring the bottom edges thereof into close fitting relation with the top face of the receptacle bottom 12. The outer bracket pieces 77 are connected to and support the outside deflector members 72 of the plow type deflectors 11 by way of horizontally extending bolts 81. The latter extend through slots 82 in the outer bracket pieces 77 and into bosses 83 on the rear or back faces of the outside deflector members 72. Said members 72 are arcuate and upwardly and rearwardly canted and operate during operation of the apparatus to fling the sand upwardly and outwardly toward the central portion of the receptacle side wall 13 and into the path of the mulling wheels 10. The outer ends of the outside deflector members 72 overlie and are shaped conformably to the lower curved portion of the receptacle side wall and are so canted that they serve in connection with outward and upward deflection of the sand into the path of the mulling wheels so to scatter the sand that the latter is aerated to a pronounced extent. The inner ends of the outside deflector members abut against the outer ends of the inside members 71 as shown in Figure 6. When the apparatus is in operation the deflectors 11, due to the speed of travel, maintain in suspension the entire batch of sand other than that which is squeezed or wedged upwards by the mulling wheels 10. The slots 82 in the outer upstanding pieces 77 of the bracket 70 extend at an acute angle with respect to the vertical and permit the outside deflector mem-

bers 72 to be angularly adjusted for positioning purposes.

In addition to the receptacle, the mulling wheels and the plow type deflectors 11, the apparatus comprises a scraper 84 for scraping any sand which tends to accumulate and cake on the receptacle bottom 12 and the lower curved portion of the angular side wall 13. This scraper consists of a bracket 85, a horizontal series of vertically extending scraper plates 86 and a vertical series of horizontally extending scraper plates 87. The bracket 85 comprises a triangular base piece 88 and an upstanding side piece 89. The base piece fits against and is welded to the rear edge of the bottom piece 75 of one of the deflector supporting brackets 70 and extends horizontally. The side piece 89 extends substantially radially with respect to the main drive shaft and has a rearwardly extending right angle flange 90 at its inner end. The vertically extending scraper plates 86 fit against the rear face of the side piece 89 of the bracket 85 and are clamped in place by means of an elongated clamping plate 91. The latter extends parallelly to the side piece 89 and has a forwardly extending right angular flange 92 at its outer end. The latter engages the outer side face of the outermost scraper plate 86 and is connected to the outer end of the side piece 89 by pin and socket connections 93 so that the clamping plate 91 is longitudinally slidable with respect to the side piece 89. Said clamping plate 91 fits against the back faces of the vertically extending scraper plates 89 and is provided at its inner end with studs 94 which extend through aligned holes in the flange 90 and have nuts 95 at their outer ends. When the nuts 95 are tightened the clamping plate 91 is slid inwards with respect to the side piece 89 of the bracket 85 and operates firmly to clamp in place the scraper plates 86. The latter while in their clamped position are adapted to be hammered downwards into contact with the top face of the receptacle bottom 12 in order to maintain such contact with the bottom that they serve during operation of the apparatus to prevent caking of sand on the receptacle bottom. The clamping plate 91 forms a part of the scraper bracket 85. In addition to the bottom piece 88, the side piece 89 and the clamping plate 91 the bracket 85 comprises a C-shaped piece 96. The latter is carried by the clamping plate 91 and supports the horizontally extending scraper plates 87 so that they are longitudinally slidable into contact with the lower curved portion of the receptacle side wall 13. The bottom part of the C-shaped piece 96 is welded or otherwise secured to the outer end of the clamping plate 91 and underlies the lowermost scraper plate 87. The top part of the C-shaped piece 96 overlies the uppermost plate 87 and is provided with a pair of set screws 97. The latter when tightened operate to clamp the horizontally extending scraper plates 87 in place. Said plates 87 are curved at the edges as shown in Figure 7 and are adapted to be hammered outwards into abutment with the adjacent curved portion of the receptacle side wall. When the apparatus is in operation the vertically extending scraper plates 86 of the scraper 84 scrape the receptacle bottom and prevent any sand from caking thereon and the horizontal scraper plates 87 scrape the lower curved portion of the receptacle side wall and likewise prevent sand from caking or accumulating thereon. The scraper 84 is located directly behind the plow type deflector with which it is associated and is so angularly

positioned that any sand which is scraped by the scraper plates thereof is deflected outwards toward the receptacle side wall.

In order to introduce water or other liquid into the receptacle for sand moistening purposes a vertically extending pipe 98 and a horizontally extending pipe 99 are provided. The pipe 98 overlies and is axially aligned with the hub 32 of the crosshead 9. The lower end of the pipe 98 communicates with the top chamber 38 in the crosshead hub and embodies a radially extending flange 100 which fits against and is bolted to the hub side wall 35. The pipe 99 extends radially and is positioned in front of one of the plow type deflectors 11.

The inner end of the pipe 99 fits into and is suitably secured within the outer end of a horizontally extending passage 101 in the crosshead. This passage communicates with the top chamber 38 in the crosshead hub 32, as shown in Figure 3, and permits any liquid in said chamber to flow outwards through the pipe 99 and into the receptacle. A supply pipe 102 serves to introduce water or other liquid into the upper end of the pipe 98. When liquid is permitted to flow through the pipe 102 it flows downwards through the pipe 98 into the top chamber 38 and thence through the passage 101 and the pipe 99 into the receptacle. By reason of the fact that the pipe 99 is connected to the crosshead 9 it rotates or swings around the receptacle during operation of the apparatus and hence distributes the water or other liquid over the entire mass or batch of sand in the receptacle.

For the purpose of preventing any sand from accumulating on the crosshead 9 or the arms 51 a conical shield 103 is provided. This shield overlies the crosshead and wheel supporting arms and is fixedly connected to the upper end of the pipe 98. When the apparatus is in operation and a batch of sand is dumped into the receptacle the shield 103 operates, because of rotation thereof, uniformly to distribute the sand throughout the interior of the receptacle.

When it is desired to use the apparatus for mulling purposes the electric motor 43 is started. This results in comparatively high speed drive of the crosshead 9 and causes the mulling wheels 10, the plow type deflectors 11 and the scraper 84 to swing or revolve in a circular course around the receptacle side wall and over the bottom 12 of the receptacle. After the apparatus is set in motion a batch of sand is dumped into the top of the receptacle. As the sand drops downwards through the ring 29 it strikes against the conical shield 103 and is deflected outwards into all portions of the receptacle. When the sand comes in contact with the plow type deflectors it is flung outwards and upwards towards the central portion of the upwardly flared side wall 13 of the receptacle and into the path of the mulling wheels 10. When the wheels contact with the sand on the adjacent portion of the receptacle side wall they squeeze the sand and wedge it upwards towards the top of the receptacle side wall, as hereinbefore pointed out. When the sand reaches the top of the receptacle side wall it drops back towards the receptacle bottom and is then again subjected to the action of the plows and mulling wheels. The constant cycle of outward and upward fling of the sand by the plows and squeezing and upward wedging of the sand by the mulling wheels 10 results in an effective mulling of the sand. Aeration of the sand takes place due to the scattering action of

the deflectors 11. Immediately after the introduction of a batch of sand into the receptacle water or other liquid is introduced into the vertically extending pipe 98 by the supply pipe 101 in order to moisten the sand. At the conclusion of the mulling operation the door 27 is swung into its open position by manipulation or control of the device 28. As soon as the door is opened the sand is discharged through the discharge opening 26 by the plow type deflectors 11.

The herein described mulling apparatus effects an efficient and quick mulling of the sand and is both rugged and durable. It may be manufactured at a comparatively low and reasonable cost and requires substantially no servicing or replacement of parts.

Whereas the apparatus has been described as being adapted primarily for use in mulling molding sand and as comprising two mulling wheels and two plow type deflectors it is to be understood that it may be used in connection with the conditioning of other granular material and may be built or made with a single mulling wheel and a single deflector or with more than two mulling wheels and a corresponding number of deflectors. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified or changed within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

1. An apparatus adapted to mull granular material and comprising a receptacle adapted to contain the material to be mull and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom and having a portion of the inner face thereof flared to an appreciable extent, a revolvable crosshead in the receptacle, power means for driving the crosshead, means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly against the upwardly flared inner face portion of the side wall, and a rotary horizontally extending mulling wheel carried by the crosshead adjacent said inner face portion of the side wall and so that during drive of the said crosshead it travels in a circular course around the aforesaid portion, and provided with a substantially cylindrical outer periphery adapted to squeeze the material against said inner face portion and coact with the latter to wedge the material upwards and effect pronounced rolling of the grains.

2. An apparatus adapted for use in mulling granular material and comprising a receptacle adapted to contain the material to be mull and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom and having the central and upper portions of the inner face thereof flared upwardly to an appreciable extent, a revolvable crosshead in the receptacle, power means for driving the crosshead, means connected to the crosshead for conjoint drive therewith for directing the material outwardly and upwardly toward the central portion of the inner face of the receptacle side wall, and a rotary truly horizontally extending mulling wheel carried by the crosshead adjacent the central inner face portion of the side wall and so that during drive of the crosshead it travels in a cir-

cular course around said central portion, and provided with a substantially cylindrical outer periphery adapted to squeeze the material against said central portion of the inner face of the side wall and coact with the latter to wedge the material upwards onto the upper portion of the inner face of the side wall and effect pronounced rolling of the grains.

3. An apparatus adapted to mull granular material and comprising a bowl-like receptacle adapted to contain the material to be mulled and embodying a substantially flat circular bottom and an annular upwardly extending side wall having the lower portion thereof joined to the margin of the bottom and its central and upper portions of the inner face thereof flared upwardly at an angle of between 10° to 15° with respect to the vertical, a revolvable crosshead in the central portion of the receptacle, power means for driving the crosshead, means connected to the crosshead for conjoint drive therewith for directing the material outwardly and upwardly toward the central portion of the inner face of the receptacle side wall, and a rotary truly horizontal mulling wheel carried by the crosshead adjacent the central inner face portion of the side wall and so that during drive of the crosshead it travels in a circular course around said central inner face portion and is free to move outwards in response to centrifugal force, and provided with a substantially cylindrical outer periphery adapted to squeeze the material against said central portion of the inner face of the receptacle side wall and coact with the latter to wedge the material upwards onto the upper portion of the inner face of the side wall and effect pronounced rolling of the grains.

4. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom and having the central and upper portions thereof flared upwards, a revolvable crosshead in the central portion of the receptacle, power means for driving the crosshead, means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly toward the central portion of the receptacle side wall, an elongated horizontally extending arm above the crosshead pivotally connected at one end thereof to said crosshead so that it is free to swing outwards in a horizontal plane toward the side wall and provided at its distal end with a vertical shaft, and a horizontally extending mulling wheel rotatably mounted on said shaft and adapted during drive of the crosshead to travel in a circular course around the central portion of the receptacle side wall and in addition to swing outwards and spin or roll, and having a cylindrical outer periphery adapted to squeeze the material against said central portion of the side wall and at the same time to wedge it upwards onto the upper portion of the receptacle side wall.

5. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the receptacle, power means for driving the crosshead, a plurality of rotary horizontally extending wheel type mulling elements carried by the crosshead adjacent said side wall and in vertically offset relation and adapted during drive

of the crosshead to travel in a circular course around the receptacle side wall and in addition to spin or roll and squeeze the material between them and said side wall, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly against said side wall and into the path of the mulling elements.

6. A mulling apparatus comprising in combination a bowl-like receptacle adapted to contain the material to be mulled and embodying a bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the central portion of the receptacle, power means for driving the crosshead, a pair of horizontally extending mulling wheels carried by the crosshead adjacent the receptacle side wall and in such vertically offset relation that the top face of the lower wheel is substantially coplanar with the bottom face of the upper wheel, and adapted during drive of the crosshead to travel in a circular course around the receptacle side wall and in addition to spin or roll and squeeze the material between them and said side wall, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly against said side wall and into the path of the wheels.

7. An apparatus adapted for use in mulling granular material and comprising a receptacle adapted to contain the material to be mulled and embodying a bottom and an annular side wall extending upwardly from the margin of the bottom and having the central and upper portions of the inner face thereof flared upwardly to an appreciable extent, a revolvable crosshead in the receptacle, power means for driving the crosshead, a pair of horizontally extending rotary mulling wheels with substantially cylindrical peripheries, carried by the crosshead adjacent to the central inner face portion of the side wall and in vertically offset relation and adapted during drive of the crosshead to travel in a circular course around said central inner face portion of the side wall and in addition to rotate or roll and squeeze the material between them and said central inner face portion and at the same time wedge the material upwards toward the upper portion of inner face of the said side wall and effect pronounced rolling of the grains, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly against said central inner face portion of the side wall and into the path of the mulling wheels.

8. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the receptacle, power means for driving the crosshead, an elongated horizontally extending arm pivotally connected at one end thereof to the crosshead so that it is free to swing outwards in a horizontal plane toward the side wall, a rotary horizontally extending mulling element mounted on the distal end of said arm and adapted during drive of the crosshead to travel in a circular course around the receptacle side wall and in addition to spin or roll and squeeze the material between it and the receptacle side wall, means extending between said distal end of the arm and the crosshead for limiting outward swing of said arm and

element to such an extent that said element cannot contact the side wall of the receptacle, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwardly and upwardly against said side wall and into the path of the mulling element.

9. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the receptacle, power means for driving the crosshead, an elongated arm pivotally connected at one end thereof to the crosshead so that it is free to swing outwards toward the side wall, a rotary mulling element mounted on the distal end of said arm and adapted during drive of the crosshead to travel in a circular course around the receptacle side wall and in addition to spin or roll and squeeze the material between it and the receptacle side wall, means for limiting outward swing of said arm and preventing the element from contacting the receptacle side wall consisting of an apertured bracket on the crosshead and a tie rod having one end thereof pivotally connected to said distal end of the arm and its other end extending through the aperture in the bracket and provided with a stop in engagement with said bracket, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwards against said side wall and into the path of the mulling element.

10. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a substantially flat circular bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the receptacle, power means for driving the crosshead, an elongated horizontally extending arm pivotally connected at one end thereof to the crosshead so that it is free to swing outwards in a horizontal plane toward the side wall, a rotary horizontally extending wheel type mulling element mounted on the distal end of said arm and adapted during drive of the crosshead to travel in a circular course around the receptacle side wall and in addition to spin or roll and squeeze the material between it and the receptacle side wall, means for limiting outward swing of said arm and preventing the element from contacting the side wall of the receptacle consisting of an apertured bracket on the crosshead and a horizontally extending tie rod having one end thereof pivotally connected to said distal end of the arm and having its other end extending through the aperture in the bracket and provided with an externally threaded extremity with a nut thereon and a resilient collar between the nut and the bracket, and means connected to the crosshead for conjoint drive therewith for deflecting the material outwards and upwards against said side wall and into the path of the mulling element.

11. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a circular bottom and an annular side wall extending upward-

ly from the margin of the bottom, a mulling element in the receptacle arranged to travel in a circular course around the side wall and adapted during such travel to squeeze the material between it and said side wall and thus effect mulling of the material, means for propelling the element in said circular course, and a scraper for scraping the material from the bottom and deflecting it outwards toward the side wall, connected for conjoint travel with the element and comprising a horizontal series of side by side vertically extending scraper plates and a clamp type bracket extending around the plates and having releasable means adapted normally to hold or lock the plates in fixed or rigid relation and upon release thereof to permit the plates to be adjusted vertically.

12. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a circular bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the receptacle, power means for driving the crosshead, a mulling element carried by the crosshead and adapted during drive of the crosshead to travel in a circular course around the side wall and squeeze the material against said side wall, and a scraper for scraping the material from the lower portion of said side wall, connected for conjoint travel with the crosshead and comprising a vertical series of horizontally extending scraper plates, and a clamp type bracket extending around the plates and having releasable means adapted normally to hold the plates in rigid or fixed relation and upon release thereof to permit the plates to be adjusted horizontally.

13. A mulling apparatus comprising in combination a receptacle adapted to contain the material to be mulled and embodying a circular bottom and an annular side wall extending upwardly from the margin of the bottom, a revolvable crosshead in the central portion of the receptacle, power means for driving the crosshead, a rotary mulling element carried by the crosshead adjacent the central portion of the receptacle side wall and adapted during drive of the crosshead to travel in a circular course around the central portion of the side wall and in addition to spin or roll and squeeze the material against said portion, a plow type deflector in front of the mulling element and connected to the crosshead for conjoint drive therewith and arranged and shaped to deflect the material outwards and upwards toward said central portion of the receptacle side wall and into the path of the mulling element, and a scraper behind the deflector for preventing caking of the material on the receptacle bottom and the lower portion of the receptacle side wall, connected to the crosshead for conjoint drive therewith and comprising a horizontal series of side by side vertically extending and adjustable scrapers over the receptacle bottom and a vertical series of side by side horizontally extending and adjustable scraper plates adjacent said lower portion of the receptacle side wall.

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