

June 9, 1964

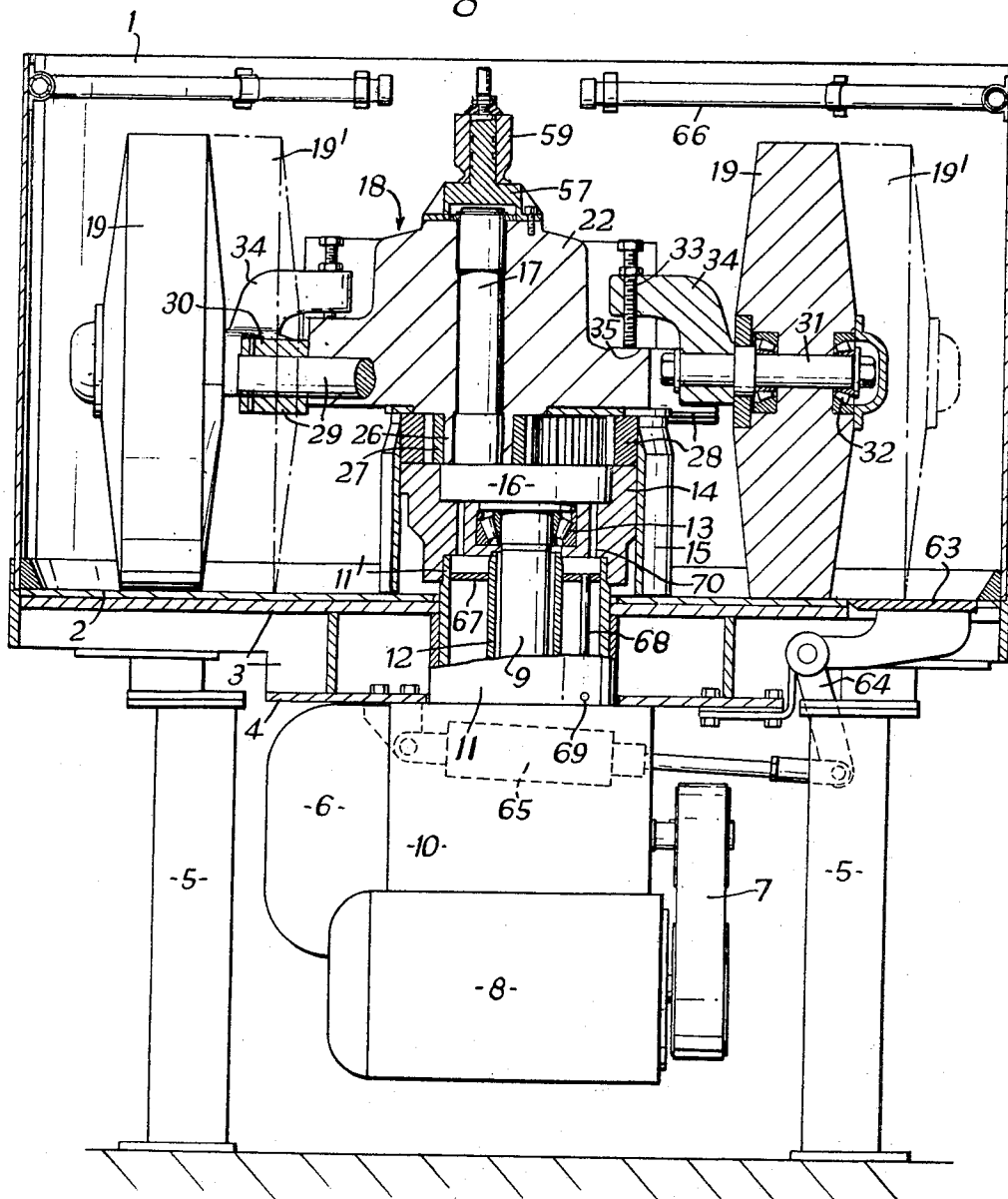
K. H. G. DOUGHTY
MULLING MACHINES

3,136,490

Filed Jan. 15, 1962

4 Sheets-Sheet 1

Fig. 1.



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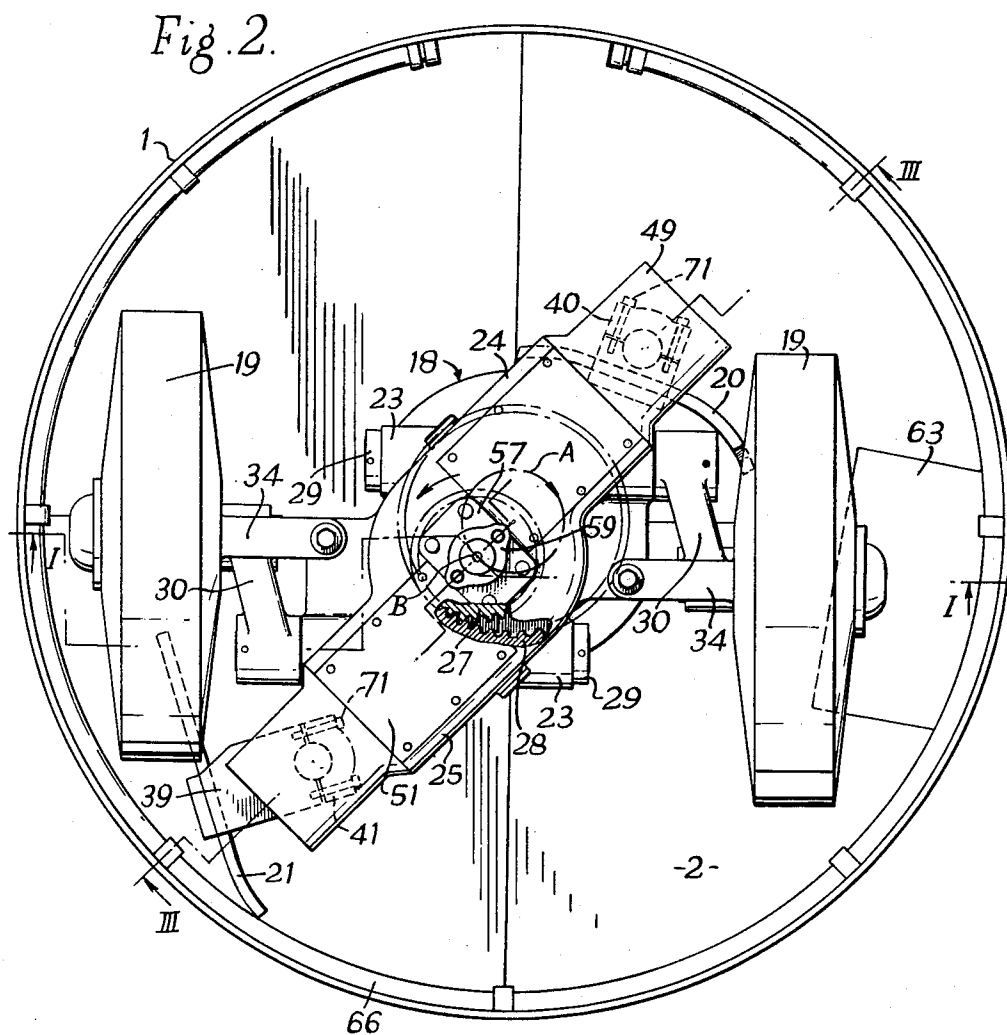
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Fig. 3.

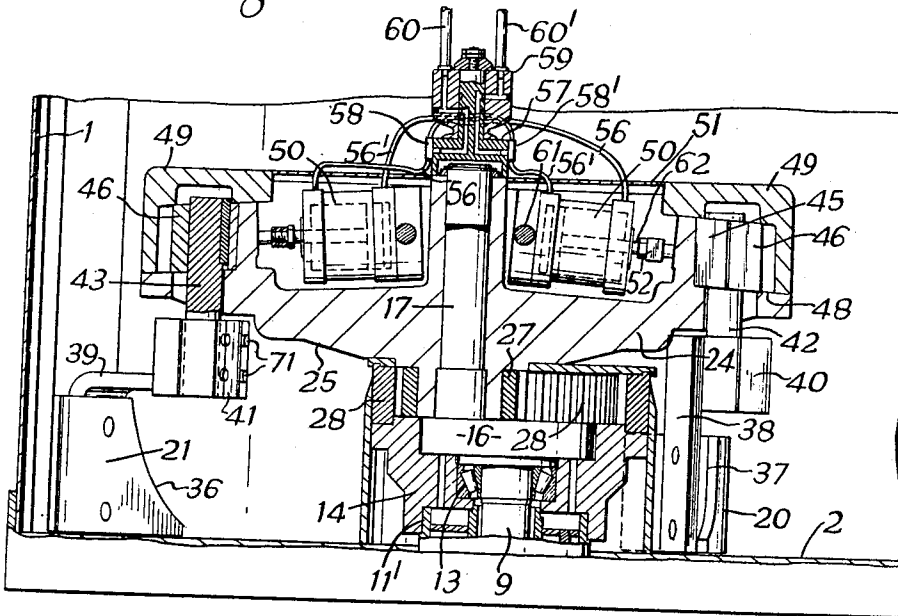
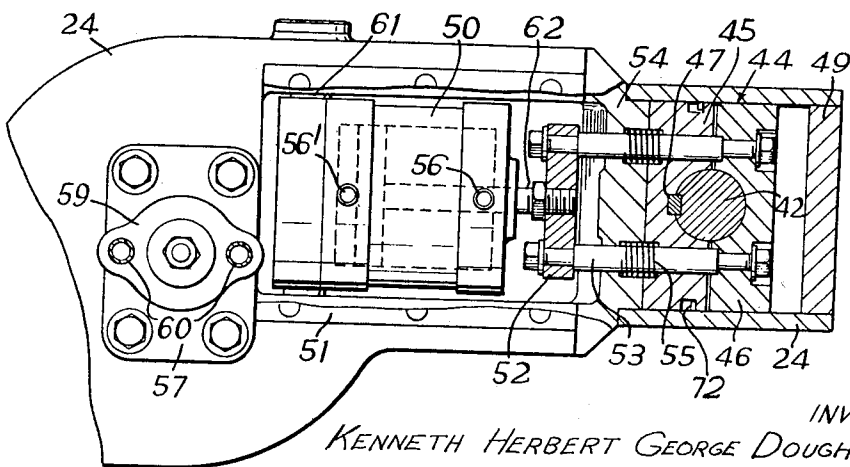


Fig. 4.



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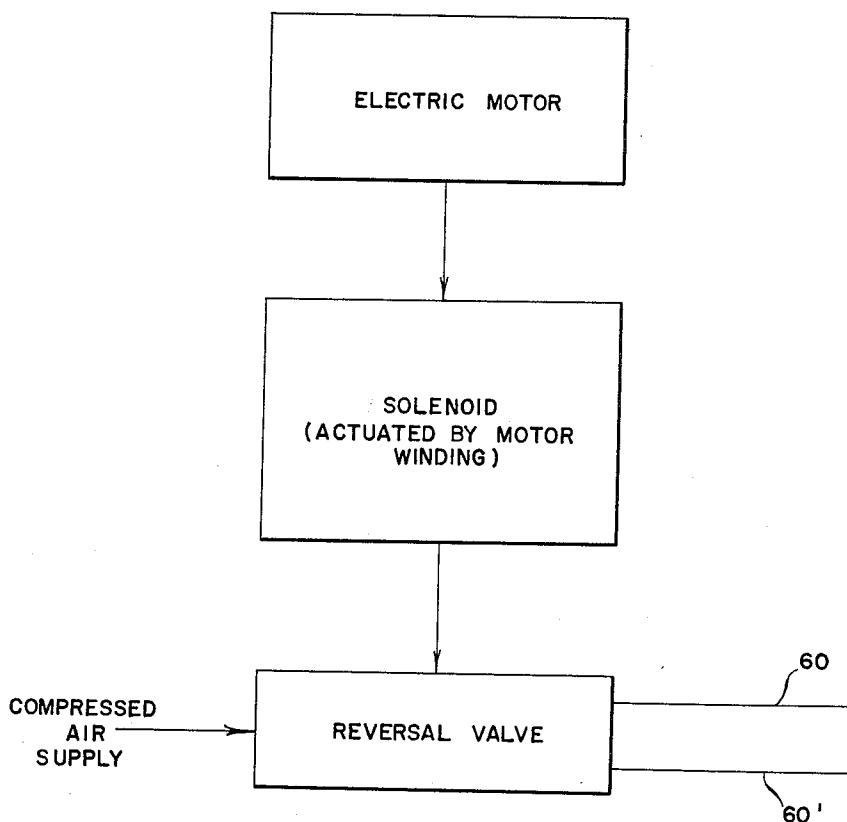


FIG. 5

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3,136,490

MULLING MACHINES

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Filed Jan. 15, 1962, Ser. No. 166,189

Claims priority, application Great Britain June 14, 1961

5 Claims. (Cl. 241-109)

This invention relates to mulling machines, that is to say machines for crushing and mixing (i.e., mulling) such finely divided materials as foundry sand to which reference will hereinafter be confined for convenience.

In particular the invention is concerned with machines of this kind in which one or more rollers (so-called mulling wheels) roll around the bottom (so-called bedplate) of a cylindrical pan (a so-called crib) in company with plough blades which turn over the sand into the track of the or each roller respectively from the outside and from the inside of this track. The plough blades depend from supporting arms (which may be combined into one cross arm) carried by a driven mounting structure (usually a head which actually traverses the muller wheels(s) around the crib), and each plough blade and its supporting arm will hereinafter be termed a "plough unit."

To ensure a homogeneous mixing and kneading of the sand it is desirable that the blades shall pick up and turn over as much of the sand as possible, so that they should clear the surface of the bedplate by a minimum amount. In practice, of course, perfect conditions do not prevail, so that the bottom edge of a plough blade will be continually rubbing over and leaving a fine layer of sand in patches or over the whole area of the bedplate.

This sand (foundry sand) is of a highly abrasive character and consequently wear develops on the plough blade. Under normal conditions the resultant further clearance, produced by this wear, between the edge of the blade and the surface of the bedplate causes further sand to build up. As the thickness of the sand layer increases it tends to be packed down by the passing blade and, as the sand becomes denser, the rate of wear of the blade increases. There is thus an accelerating rate of wear, along with an encrustation of the pan bottom which is troublesome to remove, and this can only be ameliorated by re-setting the blade edge relatively to the surface of the bedplate.

Now in mulling machines of the kind set forth it is normally possible to adjust the setting of the plough blade relatively to the bedplate, and this has to be accomplished manually, takes time, and is awkward to accomplish as it often means that an attendant has to climb into the crib to do it. Experience teaches, in fact, that the adjustment is not carried out as frequently as is desirable to restrain the accelerated wear referred to above.

To combat this difficulty and secure attendant advantages, i.e., a smaller expenditure for the installation of new plough blades and shorter shut-down periods enforced by the time required to adjust or re-mount the blades, in accordance with the present invention each plough unit is equipped with means which are adapted, in response to the starting and/or stoppage of travel by the unit, or of the means driving the same, to bring about release of the plough blades and automatic re-setting thereof, to a predetermined clearance (which may be a comparatively close fit) from the underlying surface of the bedplate.

In most forms of mulling machine of the kind set forth, each plough blade is carried by an upstanding stem which in turn is suspended from the supporting arm which, as indicated above, may form part of a structure

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which is driven from the centre of the crib and includes the mounting for the mulling wheel or wheels.

In one method of carrying the present invention into effect with an arrangement of this latter character, we secure this plough stem to its supporting arm by a clamping device which is releasable, and adapted for re-engagement, by means responsive to the travel of the blade or the operation of its driving means. The principle is that, when the plough blade is arrested, with the crib empty of sand, the stem will automatically be released by the clamping device and drop the small amount required to bring its edge into abutting contact with the bedplate at the crib bottom. Immediately thereupon, after a pre-set time interval, or in response to re-initiation of the travel of the plough unit, the blade will be raised a selected very small amount from the bedplate as the clamping device is re-fastened.

Thus, for example, we can arrange that the clamping device shall be released and re-engaged by mechanical means (e.g., a holding screw or cam piece) which is capable of applying an increment of upward movement to the blade and is operated by an air cylinder, an electro-magnetic unit, or other suitable device which answers to the discontinuance and/or restarting of plough travel or of movement of the means driving the latter.

In one arrangement within the invention, the stem of the plough blade is received in a clamping device comprising a pair of jaws, one of which is movable relatively to the other by an air cylinder which is governed by a solenoid itself triggered when an electric motor driving the plough unit is stopped, e.g., during a normal shut-down period of the machine, so that the clamp will automatically open to allow the blade to drop down for the purpose indicated above.

The clamping jaws referred to may be slidable, both together and relatively to one another, on a cam or wedge surface so that, when the machine is restarted, the plough blade will be re-clamped and the clamping devices moved a small distance on the cam or wedge surface so as automatically to lift the blade the required fractional amount.

The following is a description of the mulling machine illustrated in the accompanying drawings, being an example of a machine embodying the principles of the present invention. In these drawings:

FIGURE 1 is an elevational view of the machine, partly in section on the line I—I of FIGURE 2.

FIGURE 2 is a plan view of the machine in question.

FIGURE 3 is a cross section taken on the line III—III of FIGURE 2.

FIGURE 4 is an enlarged view, with parts in cross section and parts broken away, of one of the plough arms of the machine, and

FIGURE 5 is a diagrammatic representation of a solenoid-actuated reversal valve.

The machine illustrated has an open-topped crib 1 of cylindrical cross section closed at its lower end by a bedplate 3 covered by a removable wear plate 2. The bedplate is a fabricated webbed structure with a bottom plate 4, and it is supported, along with the crib and the rest of the machine, clear of the ground by pillars 5.

Bolted to, and depending from, said bottom plate 4 is an electric motor 6 for driving the working parts of the machine. For this purpose the drive shaft of the motor is coupled through a belt and pulley transmission 7 to a reducing gear arranged in a gear box 8 and having its output shaft connected, through a worm and worm wheel gearing (not shown), to a main driving shaft 9. This latter is supported at its lower end within a casing 10 attached to the plate 5 and extends vertically through a central cylinder 11 forming part of bedplate 2 concentric with the crib 1.

The cylinder 11 includes a lining sleeve 11' which, at

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its upper end, supports a bearing block 14 carrying a set of taper bearings 13 by which the upper end of shaft 9 is rotatably mounted. A similar set of bearings (not shown) is arranged around the shaft at the lower end part of cylinder 11. This cylinder 11 internally supports, through upper and lower discs of which one is seen at 67, a smaller diameter sleeve 12 which surrounds the shaft 9 with a small grease-packed clearance. The discs 67 also support a lubricating pipe 68, to which grease can be applied through an external nipple 69.

At its upper end the shaft 9 carries a disc 16 with an upstanding post 17 which is disposed eccentrically in relation to the axis of the main drive shaft 9. The disc 16 is rotatable in a recess in the bearing block 14 and the contact faces are lubricated through ducts 70. Disposed loosely on this post 17 is the cross head, generally denoted 18, which carries the operative moving parts of the machine performing the mulling action in the crib 1, viz. the mulling wheels 19 and inner and outer ploughs 20 and 21 respectively (these ploughs have been omitted from the showing of FIGURE 1 to avoid complication). The cross head 18 is thus destined to share the eccentric rotation of post 17 when drive shaft 19 turns.

It primarily consists of a solid casting which is shaped to provide, in effect, a central boss portion 22 with a pair of bored shoulders 23 each to receive a suspension for the mulling wheels 19. The casting 18 also includes a pair of arms 24 and 25 respectively carrying the inner and the outer ploughs. At its lower end the cross head casting 22 has a spigot 26 on which is force fitted a pinion 27. This pinion 27 runs on an internally toothed ring 28 which is carried by the bearing block 14 and is concentric with drive shaft 9. This central assembly of the machine is surrounded by a casing 15 which serves as a shield.

As will now be observed, rotation of the shaft 9 causes the axis of post 17 to travel in a circular path A (see FIGURE 2) around the axis of the crib as centre, whilst simultaneously the pinion 27 rolls on the toothed ring 28 so that the cross head simultaneously rotates about the axis B of post 17. Consequently, any point on the cross head will, as seen in plan, follow the epicyclic motion of the pinion 27 and, as a result, the locus of the point of contact of each of the mulling wheels with the bedplate 2 will consist of a continuous series of quasi-elliptical loops, and it is arranged that each loop will gain on its predecessor. Consequently, the wheel continually runs in different tracks to roll over the whole of the area of the bedplate, with the exception of the relatively small central area and a narrow marginal strip.

As suggested in the foregoing, not only does this give much greater coverage for a smaller expenditure of power, but the sand is rolled and re-rolled from continually changing angles. Examples of contrasted positions which the mulling wheels 19 will take are to be seen in FIGURE 1, where the wheels are shown dotted at 19' in one of the series of positions through which these wheels will pass in the course of their circuits around the crib. It will be appreciated that this epicyclic motion is also shared by the ploughs 20 and 21, and FIGURES 1 and 3 clearly show an eccentric disposition which this can entail for these ploughs.

Referring now to the mounting of the mulling wheels, each shoulder 23 accommodates a half shaft 29 which has attached to one end a link arm 30 which, at its opposite end, receives the spindle 31 of the mulling wheel 19 concerned. It will be seen from FIGURE 1 that these wheels are of solid steel, are tapered widthways, and are mounted on their wheel spindles 31 through taper bearings 32.

As will also be appreciated, the arms 30 being free to pivot on the cross head, the mulling wheels 19 will drop under their own weight as far as allowed, usually so that they just rest clear of the surface of the wear plate 2.

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This is implemented in conventional fashion through the agency of an adjustable stop screw 33 which is mounted on an upstanding horn 34 integral with each link arm 30, and is arranged to abut against a stop shoulder 35 integral with the cross head boss 22.

The inner and outer ploughs, 20 and 21 respectively, each consists of a vertically-disposed blade which, at one end at least (see FIGURE 2), is of shallow curvature in plan. As regarded in side elevation, each blade has a curved leading edge, 36 and 37 respectively, these shapings being destined to turn the sand outwards and inwards respectively, as the blade concerned travels through it. In each case, the blade is carried by a flat shank, 38 and 39 respectively, which is shaped at its other end so as to engage around a vertical supporting stem, 42 and 43 respectively. It is clamped to the relevant stem by a cooperating cap, 40 and 41 respectively. This clamped coupling allows the angular setting of the blades to be adjusted.

In the case illustrated, means are provided to afford automatic setting of these blades with a minimal clearance above the bedplate at the start of each mulling run from an empty crib.

Thus, each of the supporting stems 42 is received in the outer end part of the appropriate arm 24 or 25 and is there engaged by a releasable clamping device, generally designated 44, of which more details are to be seen in FIGURE 4. These devices are operable in unison and the means operating them are entirely similar. Moreover the devices themselves are identical in form and each comprises a pair of jaws 45 and 46 which are recessed to embrace the stem 42 from opposite sides. It will be observed that the stem 42 is held against rotation in jaw 45 by a key 47.

Each set of clamping jaws, 45, 46 is slidably mounted on the upper face 48 of the stepped end of the arm 24 or 25 concerned, and it will be observed that the bottom faces of these jaws, and the faces 48, are inclined to the horizontal. This inclination is shown exaggerated in the drawings and in practice it will be relatively slight. At the upper side the clamping jaws 45 and 46 are enclosed in a housing having a detachable cover 49.

Each outer jaw 46 is movable towards and away from the corresponding inner jaw 45, in performance of the actions of clamping and unclamping the corresponding plough stem 42 or 43, under the action of an air cylinder 50 which is mounted by a pin 61 in a cavity, in the plough arm concerned, closed by a cover plate 51. The piston rod 62 of each air cylinder 50 is coupled to a bar 52 carrying a pair of plungers 53 which project through the adjacent wall 54 of the corresponding arm 24 or 25, and are secured at their outer, reduced ends to the jaw 46 concerned. A spring 55 is disposed around each plunger 53 and is housed in opposed recesses in the wall 54 and inner jaw 45.

Air is supplied to the outer end of each cylinder 50 through a line 56, and to the inner end of each cylinder through a line 56'. The lines 56 are connected to a T 58, and lines 56' to a T 58', on a union piece 57 mounted centrally on the cross head block 22. This union piece 57 shares the compound epicyclic motion of the cross head 22, but it will be noted that it has an upstanding spigot on which is fitted, with the intermediary of packing glands, a sleeve 59 which participates with the cross head 22 in the circular travel of the latter around the axis of shaft 9, but not in the secondary rotation of the cross head, and thus of union piece 57, about axis B. The function of the sleeve 59 is to allow for coupling of an appropriate air supply of the air cylinders 50 irrespective of the orientation of the cross-head, and it is provided with air admission lines 60 and 60' for connection to a reversing valve shown diagrammatically in FIG. 5 controlling the supply from a compressed air source. This reversing valve may be of conventional shuttle type and shifted from one operative position to the other in conjunction with

the operation of switches governing the electrical supply to the motor 6. The reversal valve, shown diagrammatically in FIG. 5, is located between the air supply and ducts 60 and 60' and is controlled by a solenoid actuated by a motor winding. These ducts 60 and 60' connect to ducts which open into the bore of sleeve 59 and there communicate with corresponding annular grooves in the union piece 57 themselves connected by ducting in this piece to the lines 56 and 56' of the two air cylinders.

To implement the automatic adjustment of the vertical position of each of the ploughs 20 and 21 the arrangement is that, when the motor 10 is stopped to bring the mulling gear to a standstill, the aforesaid reversing valve will be operated by a solenoid in the motor circuit and air will be applied through 60' and T 58' to the inner ends of the air cylinders 50 and the jaws 46 moved outwards. This will allow the inner jaws 45 also to shift outwards under the action of springs 55, until each is stopped by the abutment of a pin 72, on the parent arm 24 or 25, with the end of a slot in the jaw 45. In this condition there will have been a parting movement between jaws 45 and 46 and between jaw 45 and wall 54.

The ploughs 20 and 21 will thereby be allowed to descend a small amount under gravity until they rest on the wear plate 2, which will have been cleared of sand by the previous operation of the ploughs.

When the machine is re-started, the aforesaid reversing valve will automatically be changed over and compressed air now supplied through line 60 to the outer ends of cylinders 50, resulting in a retraction of their piston rods 62 and consequently of the plungers 53. During this retraction each outer clamping jaw 46 will first be clamped around the stem 42, and the complete clamping jaw assembly 45-46, together with the stem 42, will be shifted inwards compressing the springs 55 until the jaw 45 reabuts against wall 54. By virtue of the wedge formation afforded by the inclined surface 48 and the corresponding formation of the lower faces of the jaws 45, 46, the result is to slightly raise the stem 42, and with it the associated plough, so that the blade of the latter is finally clamped with a very slight clearance from the surface of the wearplate 2. The angle of inclination of the surface 8 is, in practice, made very slight, in order to achieve a very small plough blade clearance.

A delay relay is conveniently used in the motor supply circuit to allow a slight pause for the adjustment to be performed as described and is so set, and the operating circuits so interlocked, that the cross head will commence to rotate as soon as, but not before, the vertical setting of the plough blades is complete.

The machine illustrated in the drawings is shown as being provided with a door 63 in the bedplate for removal of mulled sand. This door is operable through a linkage 64 connecting it to an air piston/cylinder unit 65 which is pivoted from and below the base structure 3.

The crib is also shown as provided with an upper annular pipe 66 which is perforated for the sprinkling of water into sand present in the crib, prior to or during a mulling operation.

I claim:

1. A mulling machine comprising a crib with a bottom bedplate, at least one mulling wheel rotatable over said bedplate, a structure supporting said mulling wheel, driving means for rotating said structure to traverse the mulling wheel around said crib, at least one plough blade carried by said structure, means for adjusting the position of said plough blade relatively to the bottom bedplate of the crib, and means interlocking the operation of said driving means and said plough blade adjusting means.

2. A mulling machine comprising a crib with a bottom bedplate, at least one mulling wheel rotatable over said bedplate, a structure supporting said mulling wheel, driving means for rotating said structure to traverse the mulling wheel around said crib, at least one plough blade having a stem carried by said structure, a clamping device in said structure releasably engaging said stem, said clamping device including means to shift the stem and its plough blade axially in response to closure of said clamping device and means for unfastening and re-fastening said clamping device.

3. A mulling machine as claimed in claim 2, in which the said driving means comprises an electric motor, and the means for unfastening, and re-fastening the clamping device include electromagnetic means in the electrical supply system of said motor.

4. A mulling machine comprising a crib with a bottom bedplate, at least one mulling wheel rotatable over said bedplate, a structure supporting said mulling wheel, driving means for rotating said structure to traverse the mulling wheel around said crib, at least one plough blade having a stem carried by said structure, a pair of relatively-movable clamping jaws slidably mounted on an inclined surface of said structure, and means for moving said clamping jaws relatively to one another, thereby to clamp said stem and to move the latter relatively to said structure.

5. A mulling machine comprising a crib with a bottom bedplate, at least one mulling wheel rotatable over said bedplate, a structure supporting said mulling wheel, driving means for rotating said structure to traverse the mulling wheel around said crib, said driving means including an electrical operating system, a pair of relatively-movable clamping jaws slidably mounted on an inclined surface of said structure, a plough blade with a stem received between said clamping jaws, an air cylinder mounted on said structure and having a ram coupled to one of said jaws, a reversing valve controlling the supply of compressed air to the ends of said cylinder and electromagnetic means connected in said electrical operating system and operatively connected to said reversing valve.

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