April 21, 1931. W. COOPER 1,802,197

CRUSHING MILL

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Fig. 1.

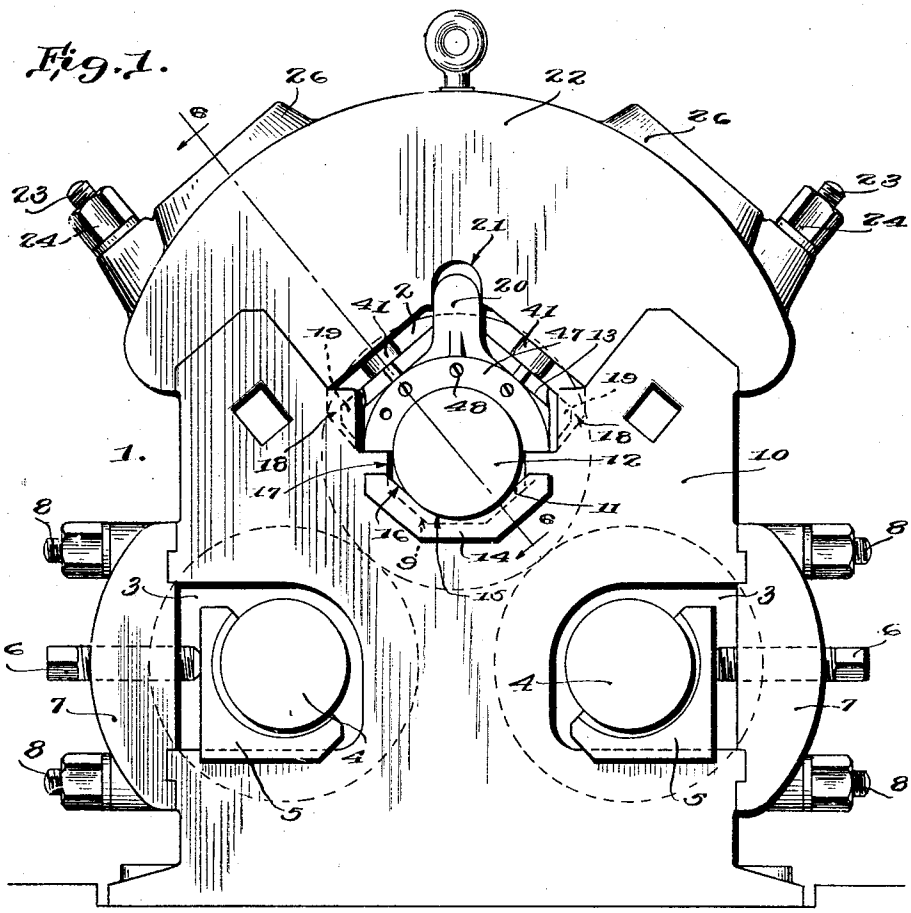
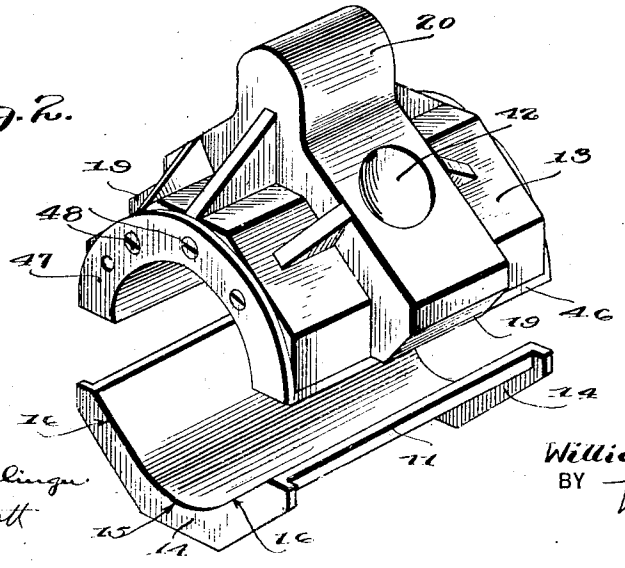



Fig. 2.




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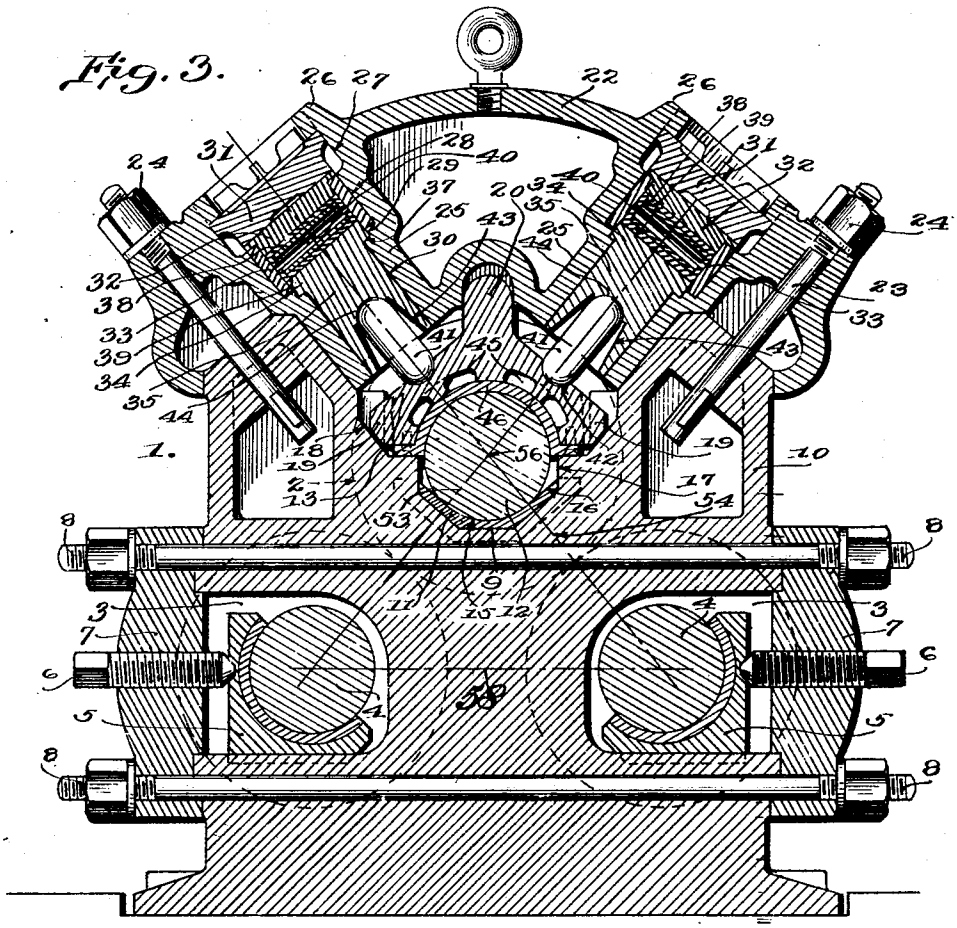
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Fig. 3.



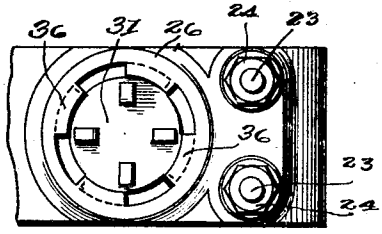


Fig. 4.

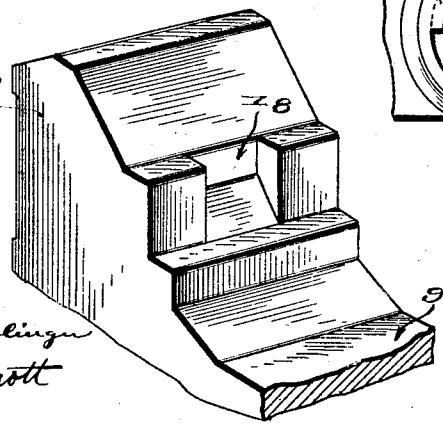


Fig. 5.

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CRUSHING MILL

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Fig. 6.

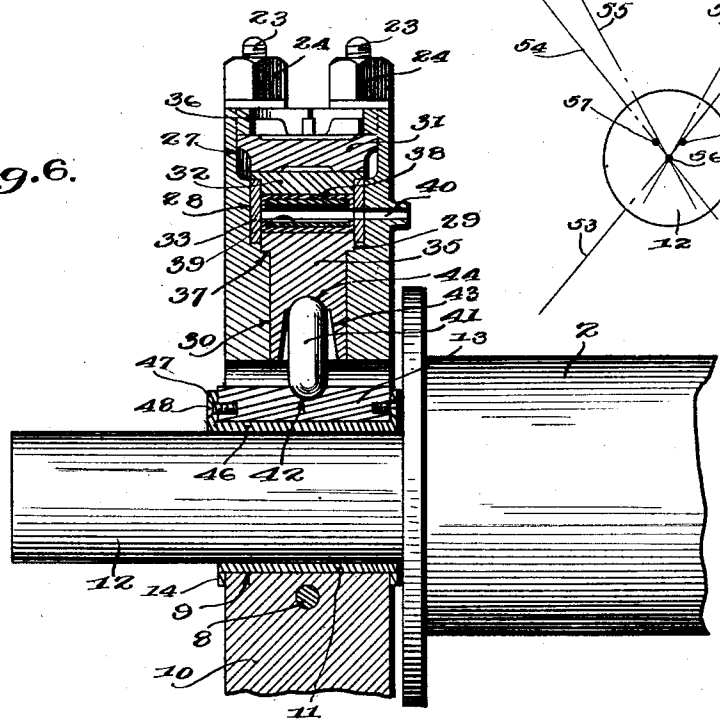



Fig. 11.




Fig. 7.

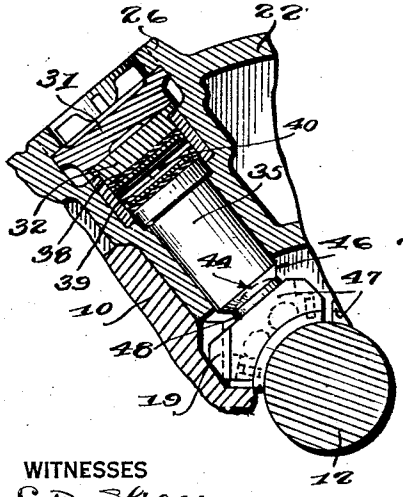



Fig. 8.

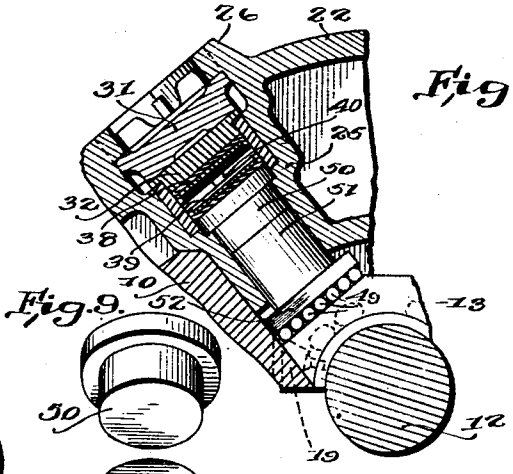
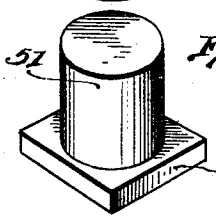



Fig. 9.

Fig. 10.




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# UNITED STATES PATENT OFFICE

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## CRUSHING MILL

Application filed November 27, 1928. Serial No. 322,215.

This invention relates to improvements in crushing mills, and it consists of the constructions, combinations and arrangements herein described and claimed.

An object of the invention is to provide, what is conveniently termed, a floating journal box for each trunnion of the top roll of a crushing mill, upon which journal boxes, the requisite pressure is imposed by the plungers of pressure cylinders so that the top roll will be made to yieldingly bear in the direction of the bottom rolls and crush the material passing between the various rolls.

Another object of the invention is to provide each journal box of the crushing roll of a crushing mill with a plurality of pressure means for imposing pressure upon said roll, the actuating pressure fluid of said pressure means being capable of individual or such other control that the pressure means may be made to press upon the journal boxes with any desired pressure, thus affording a certain floating action of the crushing roller within a prescribed area as fully developed below.

A further object of the invention is to adapt the so-called floating journal box and its plural pressure imposing means to sugar cane crushing mills.

Other objects and advantages will appear in the following specification, reference being had to the accompanying drawings in which:—

Figure 1 is an end elevation of a crushing mill illustrating features of the improvement,

Figure 2 is a detail perspective view of the improved journal box,

Figure 3 is a vertical section showing the internal construction immediately adjacent to the end of the crushing mill shown in Figure 1,

Figure 4 is a detail plan view of one end of the cap in Figure 3,

Figure 5 is a detail perspective view of a portion of the housing base, showing one of the slots which is engaged by one of the lugs in Figure 2 to prevent lateral movement of the journal box,

Figure 6 is a detail vertical section taken substantially on the line 6—6 of Figure 1,

Figure 7 is a detail sectional view of a modification in which the upper half of the journal box is made in two parts, each of which has a ball and socket connection with the pressure plunger,

Figure 8 is a detail sectional view in which the upper half is made in one part and the ball and socket connection is replaced by a series of rolls,

Figure 9 is a detail perspective view of one portion of the plunger in Figure 8,

Figure 10 is a detail perspective view of the other portion of said plunger,

Figure 11 is a diagram illustrating the area within which the top roll floats in the operation of the mill.

As has been generally indicated already, the invention concerns crushing mills. Although the principle will have utility in crushing mills of various types it has a particular advantage when embodied in a mill for crushing sugar cane.

An outstanding feature of the invention, and one that comprises the principle alluded to, is the use of a plurality (usually two) of pressure means in operative association with each journal box of the crushing roll of a crushing mill. A sugar cane crushing mill is the type of mill used herein as an example for the exemplification of the invention, and in this mill the pressure of hydraulic means is intended to be imposed upon the journals of the top roll.

Each of the pressure means will be connected with a source of pressure fluid and provided with such controls that any desired pressures can be imposed upon the journal boxes so that the pressures in one direction can be made greater or less than in the other direction, thus bringing about that result according to which the top roll will be enabled to float within a prescribed area in the operation of the crushing mill. The top roll is thus enabled to become adapted to varying qualities, consistencies, etc., of the sugar cane. in short, rendering the action of the top roll against the bottom rolls far more flexible than is possible with any known arrangement.

In a sugar cane crushing mill for which the journal box is particularly designed, the capability of varying the pressures will prove to

be an advantage as just indicated. It may be found necessary in the operation of the mill to either diminish or increase the pressures independently. The pressure means of each journal box are set at angles to each other, the axes of the said means coinciding with lines drawn through the centers of the top and bottom rolls.

This arrangement, as presently appears, will permit the top roll to adapt itself to the bottom rolls within a triangular area. This is the prescribed area referred to. The pressure of one set of pressure means along one of the lines can be adjusted either greater or less than the pressure of the other set of pressure means along the other line. Thus the initial pressure upon the cane may be greater or less than the secondary pressure. Or, if desired, the pressures of both sets of pressure means may be made the same. There is no limit to the amount of variation.

All of this will be readily understood from the drawings to which reference is now made. Figures 1 and 3 illustrate what is herein generally known as the housing 1. This housing is duplicated at each end of the crushing mill, and in view of such duplication, the following description is confined to one housing only, it being understood that there is a similar structure at the other end. The top roll 2 bears upon the bottom rolls 3, and its purpose is to press out the juice when sugar cane is passed between the rolls.

Conventional structure supports the bottom rolls. The trunnions 4 of the bottom rolls have a suitable support in bearings 5. These bearings are capable of limited adjustment by screw studs 6 which are mounted in heavy yokes 7 at the sides of the housing. The yokes are held in place by nuts on the threaded ends of the shafts 8 which extend crosswise of the housing.

A recess 9 in the housing base 10 receives the lower half or liner 11 of a box for the trunnion 12 of the upper roll 2. The upper half of the box consists of a cap 13. The liner 11 is merely laid in the recess 9, being retained therein by the end flanges 14 which contact with the sides of the housing base 10.

An allusion has been made to a floating journal box. This term must be understood. The cap 13 is actually the floating element because it follows the trunnion 12 in the floating movements of the top roll within the prescribed area. But the plural pressure means are also included in the term, and it is the use of the plural pressure means with the movable or floating cap 13 that constitutes the outstanding feature of the invention.

As the sugar cane passes through the mill the top roll 2 will naturally ride upwardly and away from the bottom rolls 3, but within the permissible triangular area. It will rest upon the sugar cane, but will be pressed downwardly by the pressure means which has a yielding quality. Any heaviness in the mass of sugar cane will be compensated for by a free yielding of the top roll, while any sparseness in the mass of sugar cane will be taken up by the pressure of the pressure means.

It is thus that the top roll 2 floats. It is suspended between the mass of sugar cane and the pressure means during the operation of the crushing mill. The liner 11 is intended to remain stationary in the recess 9. The bottom of the trough in the liner is curved at 15 to match the curvature of the trunnion 12, whence the sides 16 of the trough depart at tangents to the trunnion so that the area of contact of the trunnion is less than 180°.

The vertical side walls 17 of the recess 9 provide ample room between the cut-away portions of the liner 11 and the trunnion 12 for the free upward motions of the trunnion. Located adjacent to the recess 9 (particularly the walls 17) are slots 18 (Figures 1 and 5) to receive lugs 19 projecting from the cap 13. The lugs and slots guide the cap 13 in its upward floating motions, and prevent lateral motion of the journal box. They also prevent axial motion of the cap, that is to say, motion of the cap in the direction of the length of the trunnion 12. Although the cap is free to accomplish the floating motions mentioned, it will be held in its proper place within the housing base 10.

A vertical lug 20 on top of the cap 13 coacts with the foregoing lugs and slots in the guidance of the cap and to the end that it prevents the cap 13 from revolving in respect to the trunnion. For this purpose, the lug 20 loosely engages a guide slot 21 in the lower part of a cap 22 which completes the housing. This cap is firmly held down upon the housing base 10 by stud bolts 23 and nuts 24.

Further conventional structure resides in the pressure means. These pressure means comprise hydraulic cylinders. The pressure means is capable of operation by any desired pressure fluid. In practice suitable controls will be provided so that any degree of pressure may be imposed upon the cap 13 by the various pressure means. The cap 22 performs, in addition to the purposes already stated, the important purpose of a part of the pressure means for holding the cap 13 under pressure.

To the latter end, the housing cap 22 is made with two cylinders 25. Although these are incorporated in the cap they will be of any conventional nature. It must be understood that no restriction is intended on the type of pressure means, but it must also be understood that the pressure means must be in plural form, that is to say, it is intended to impose pressures on the cap 13 in a plurality of directions. Notwithstanding

the conventionality of the pressure means, the description of the details of one of the cylinders is as follows:—

A number of reductions 27, 28, 29 and 30 in the internal diameter of the cylinder 25 provide as many chambers which are respectively occupied by a cover 31, an abutment 32, a sleeve 33, head 34 and a plunger 35. The plunger is of a novel construction, and it is included as an element of the invention. Internal lugs 36 (Fig. 4) on the rim 26 are engageable by similar lugs on the cover 31 to hold the cover in the clamped position against the abutment 32 when given a partial turn in a manner readily understood. No part of the cylinder 25, excepting the rim 26 which bounds the upper opening of the cylinder, appears on the outside of the cap.

The lugs on the cover will slip through the passages between the lugs 36, and when the cover 31 is given a partial turn by means of the finger pieces on the cover, the various lugs will be brought into engagement and will hold the cover against the abutment. The latter has a flange that rests upon the upper edge of the sleeve 33 and that flange is situated in the chamber 27. The pressure of the cover extends to the sleeve and holds the latter firmly within the chamber 28. The differences in the diameters of the chambers 29 and 30 provide a shoulder 37 with which the head 34 of the plunger 35 is engageable to limit the outward movement of the plunger. The head is largely adapted to ride upon the sleeve 33, which in practice, may be made of brass.

Cupped leathers 38 and 39, respectively next to the abutment 32 and the head 34 of the plunger, directly receive the force of fluid under pressure introduced into the chamber inside of the sleeve 33 through a bore 40 (Fig. 6). This bore will be connected with a suitable source of fluid under pressure. The pressure fluid between the cupped leathers 38 and 39 provides a cushion which will vary in resilience accordingly as the pressure of the fluid varies. The function of the cushion is to permit a yielding of the plunger 35 when the journal cap 13 floats upwardly. The reservoir of the pressure fluid is not shown, nor are the connections thereof with the hydraulic cylinders and the means for controlling it. Any known arrangement will serve the purpose, the only requirement being the fluid under a given pressure, with an arrangement by which either full pressure may be imposed upon the plungers 35 or variations of the full pressures. It may be desirable to sometimes make the fluid cushion more rigid than at other times.

A spherical ended compression member 41 seats between the plunger 35 and the journal cap 13. The latter has a shallow recess 42 to receive the lower end of the member 41. A tapering or enlarged bore 43, in the outer end of the plunger 35, terminates in a spherical recess 44 to receive the other end of the member. The tapering or enlarged bore permits of angular adaptation of the member 41 when the journal box cap 13 follows the floating movements of the top roll 2. For example, the blanket of crushed cane will vary in thickness between top and front, and between the top and back bottom rolls in which case the bores 43 will compensate for the necessary adaptations of the members 41.

It is through the member 41 that the pressure is imposed upon the cap 13. The member 41 may be defined as a link. The plunger 35 acts as a cross head and guide for the link. In practice, the cap 13 may be cooled by circulating water which will be conducted to and from the openings 45 in any suitable manner. The cap may be brass lined at 46, the flanged ends 47 of the liner (Figs. 1 and 2) being secured to the cap as at 48. This, too, is conventional structure.

Figure 7 discloses a modification which concerns the compression member, that is to say, the link element between the plunger 35 and the journal box cap. Those parts in both this modification and the one presently to be described, which are the same as in the main form of the invention, bear corresponding reference numerals. The recess 44 in the plunger 35 is now formed directly in the outer end, the exposed rim of which end is beveled as at 46. The cap is made in two parts, the parts shown being designated 47. Each has a convexly formed protuberance 48 which engages the recess 44. The arrangement forms a ball and socket joint or connection. The lugs 19 and cooperating guides 18 serve to guide the cap against lateral movement.

In Figures 8, 9 and 10, the modification resides in the replacement of the foregoing joint by a series of rolls 49. These rest upon the bearing cap 13 which is now in one piece as before. The plunger is made in two portions 50 and 51, this being necessary to enable the assembly thereof in the cylinder 25. The portion 51 has a square or other non-circular head 52 which bears upon the rolls 49. One of the flat sides of the head 52 will bear against a corresponding portion of the housing base 10 and thus prevent the plunger portion 51 from revolving. The lug 19 and cooperating slot guides the cap vertically.

The operation is readily understood. Reference is made to Figures 3 and 11. The hydraulic or other pressure cylinders 25 are substantially in line with the centers of the top and bottom rolls 2 and 3. Lines 53 and 54 drawn through the centers of the rolls as illustrated will pass through the axes of the pressure means. A line 58 drawn through the centers of the bottom rolls 3 indicates a common plane in which these rolls are located.

The pressures of the pressure means, imparted through the plungers 35 and links 41

upon the cap 13, are substantially in the directions of the lines 53, 54. They produce independent actions of the top roll against either of the bottom rolls. The pressures are at angles to each other.

By a proper manipulation of the pressure controls (not shown) the pressure along the line 53 may be made greater than along the line 54. The top roll 2 would thus bear more heavily against the left bottom roll 3 than against the right bottom roll. Assuming the sugar cane to be introduced at the right, the initial pressure upon the sugar cane would be less than the secondary pressure. If the operation of the mill requires a reversal of these arrangements, or any other change in the ratios of pressure, the controls are readily manipulated to bring about the intended result.

In practice the location of the pressure means is not necessarily confined to the lines 53, 54. The pressure means may be offset so as to depart from these radial lines. They may be placed on other lines 55 (Fig. 11) which are radial to the top roll 2. A more acute triangle would thus be formed, and the pressures of the pressure means would be more directly downward, or to one side of the bottom rolls.

Now as to the floating movements of the top roll 2. The center of the top roll is indicated 56 in Figure 11. This is regarded as the counterpart of the center 56 in Figure 3. Assume a mass of sugar cane to be introduced between the various rolls. The top roll, by virtue of its cushioned mounting, will rise upwardly. The first act will be to shift its center to the point 57 (Fig. 11). As the sugar cane passes out of the mill the center of the top roll will tend to shift toward the point 58. But inasmuch as the passing through of cane is continuous, the top roll will so adapt itself that its center will shift about in the prescribed triangle defined by the points 56, 57 and 58. The exact location of the center within this triangle will be determined by the volume of the sugar cane. A heavy volume at the right of the mill will shift the center upwardly toward the left. A relatively heavy volume at the left of the mill will tend to shift the center upwardly toward the right. Substantially equal volumes will set the center elsewhere. In other words, the top roll will float freely upon the mass of cane, of course always being borne down by the pressure of the pressure means.

It is of utmost importance that each floating journal box shall include two pressure means. It is only by the action of a plurality of pressure means against the cap 13 of each journal box that the top roll 2 is enabled to float within the prescribed area. The pressures of the pressure means in diverse directions confine the top roll within said area when the top roll is supported by a blanket of material to be crushed. Otherwise, the resultant of the diverse pressures will be to set the top roll between the bottom rolls with which it coacts, and in instances wherein the pressure means are located upon lines other than those intersecting the centers of the top and bottom rolls the effort with which the top is borne down upon the bottom rolls will be increased.

As the mass of sugar cane passes between the rolls 2 and 3, the top roll 2 will rise upwardly by virtue of its cushioned mounting, being restrained from endwise motion by the guiding function of the slots 18 and lugs 19. These elements will prevent the journal cap 13 from revolving with the trunnion 12 of the top roll. The connections of the lugs 19 and 20 are loose. These lugs are necessary to guide the journal cap, but the connections must be and are loose enough to permit floating movements of the top roll within the prescribed area mentioned before.

While the construction and arrangement of the improved crushing mill is that of a generally preferred form, obviously modifications and changes may be made without departing from the spirit of the invention or the scope of the claims.

I claim:—

1. A journal box for the roll of a crushing mill comprising a journal cap, and a plurality of fluid pressure means located in radial positions in respect to the roll and including plungers adapted to impose pressures upon the cap along lines intersecting the axis of the roll.

2. A journal box for the roll of a crushing mill comprising a journal cap, a plurality of fluid pressure means including plungers for cushioning the thrust of the roll when a mass passes therebeneath, and means establishing a loose connection between each plunger and the cap, said last means being adaptable to the cap during floating movements of the roll.

3. A journal box for the roll of a crushing mill comprising a journal cap, a pair of fluid pressure means disposed radially of the roll and including plungers by which the fluid pressure is received, and means constituting links fitted between the plungers and the cap to transmit the pressures to the cap, said last means being adaptable to varying positions of the plungers and cap as the roll is shifted about in a prescribed area by virtue of a mass of material passing therebeneath.

4. A journal box for the roll of a crushing mill comprising a journal cap, a pair of fluid pressure means for an end of the roll being disposed in radial positions and including plungers which receive the pressure, link means fitted between the plungers and the cap transmitting the pressures to the cap and reacting against variations in a mass of material passing beneath the roll to permit the

roll to float within a prescribed area, and guide means for the cap keeping the cap in a desired position but permitting said floating movements of the roll.

5. In a crushing mill, a roll having a trunnion, a journal for the trunnion having a floating cap bearing on the trunnion and comprising one half of the journal, a pair of fluid pressure cylinders having plungers arranged to impose pressures upon the cap upon radial lines intersecting the axial center of the trunnion, and a fixed liner comprising the other half of the journal and also bearing on the trunnion, being so cut away as to confine the bearing within an arcuate area bounded at the sides by planes erected upon said lines and extending in the axial direction of the trunnion.

6. In a crushing mill, a roll having a trunnion, a housing in which the trunnion has bearing, a cap fixed upon the housing having cylinders extending in radial directions from the trunnion, means closing one end of each cylinder, plungers in the cylinders, means to introduce fluid under pressure into the cylinders to press on the plungers, a floating cap for the trunnion guided between the housing and the housing cap, and linkage means establishing a contact between the plungers and the cap.

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