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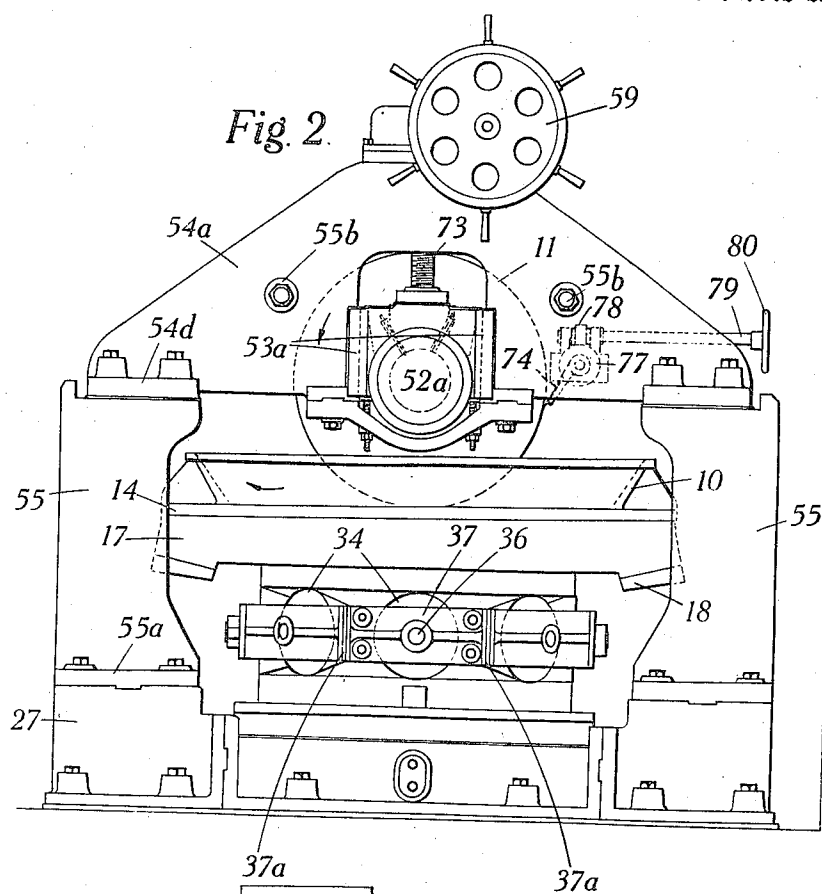
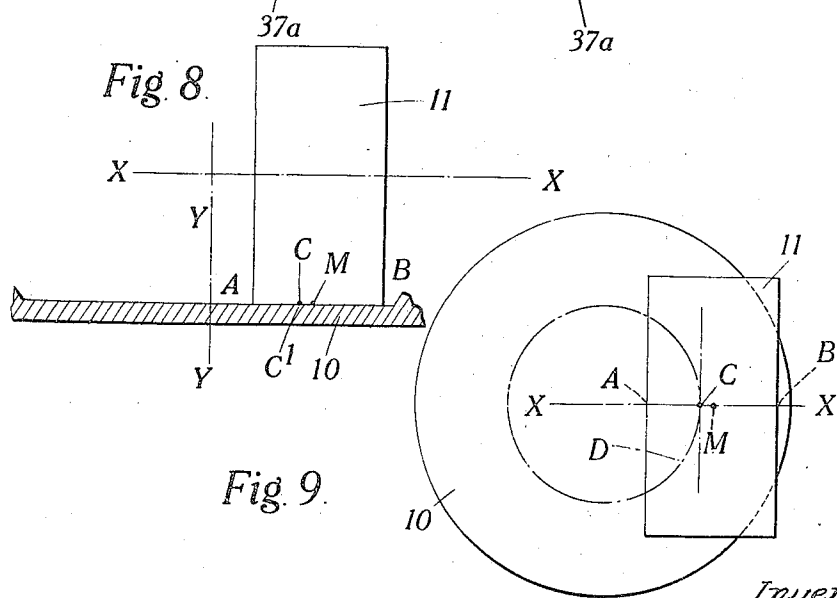
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2,135,754

MASTICATING MILL

Filed Dec. 14, 1936

5 Sheets-Sheet 2



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Nov. 8, 1938.

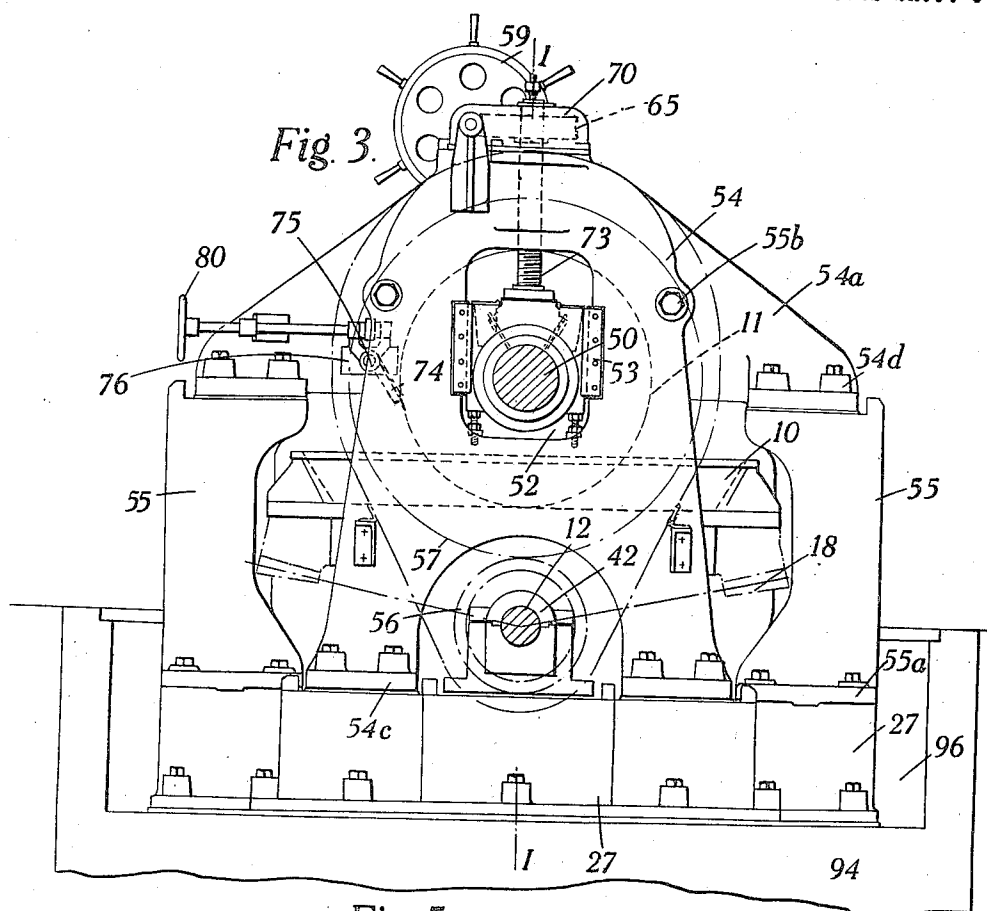
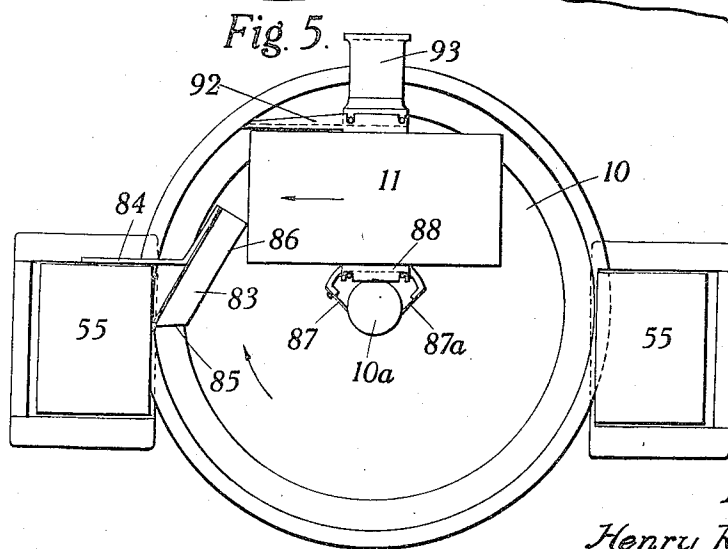
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MASTICATING MILL

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5 Sheets-Sheet 3



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MASTICATING MILL

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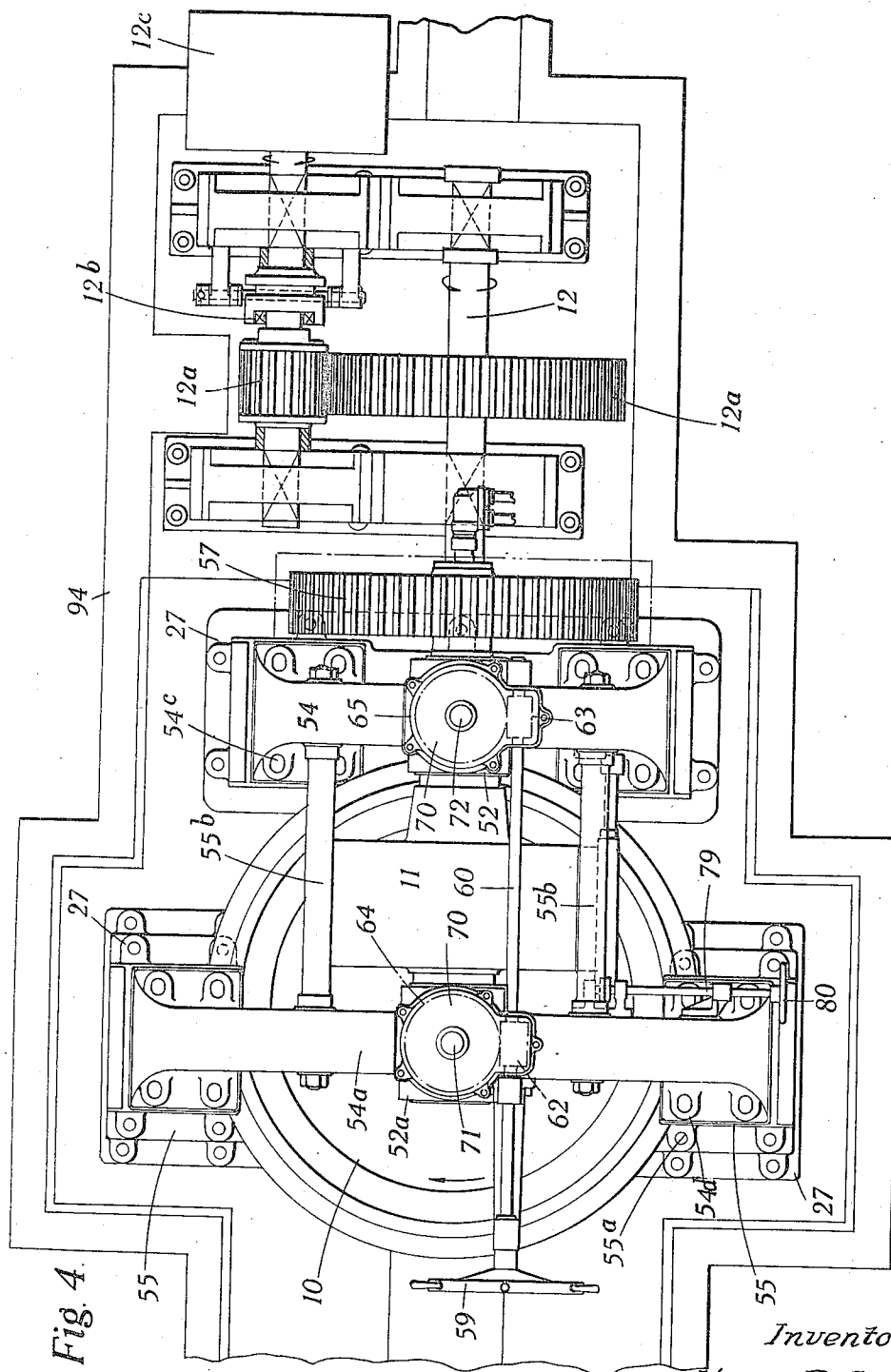


Fig. 4.

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Fig. 6.

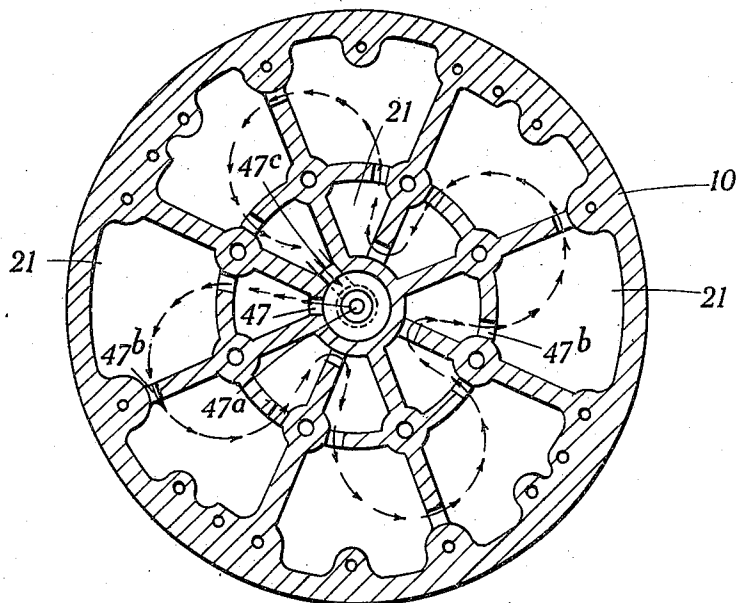
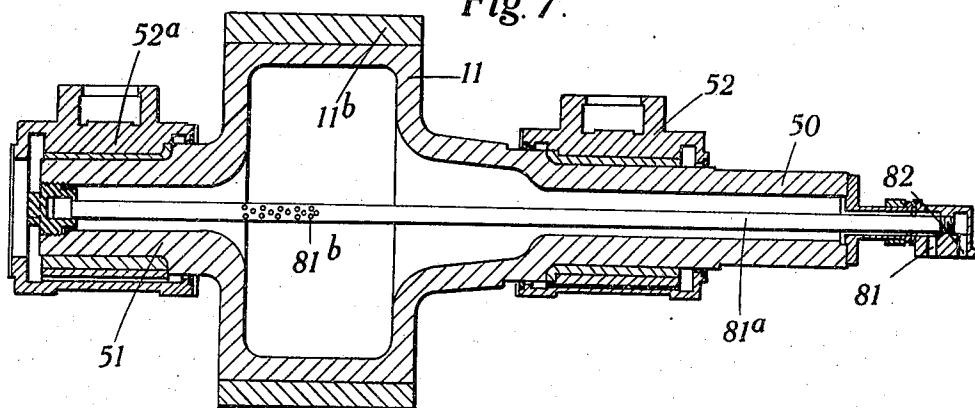


Fig. 7.



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UNITED STATES PATENT OFFICE

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MASTICATING MILL

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3 Claims. (Cl. 83—45)

This invention is for improvements in or relating to grinding, masticating, levigating and like mills. The invention is particularly applicable to mills for grinding, masticating, or mixing rubber.

One object of the present invention is to provide a mill by means of which a thorough mastication of materials such as rubber can be obtained and which is capable of withstanding the heavy pressure and rough usage to which mills dealing with rubber and like substances are subjected.

Other objects will be pointed out in the following description of one embodiment of a grinding, masticating, or like mill constructed according to the present invention and illustrated in the accompanying drawings. The example is particularly suitable for dealing with rubber and like substances.

On the drawings:—

Figure 1 is a front elevation of the mill with the pan and driving and supporting gear therefor and one of the bearings of the edge-runner shown in section on the line I—I of Figure 3,

Figure 2 is a side elevation of the mill shown in Figure 1 viewed in the direction of the arrow II,

Figure 3 is a sectional elevation on the line III—III of Figure 1 viewed in the direction of the arrow,

Figure 4 is a plan view of the mill shown in Figure 1,

Figure 5 is a diagrammatic plan view of an arrangement of scrapers for the pan and guides for directing the material under the roller,

Figure 6 is a transverse cross section of the base of the pan on the line VI—VI of Figure 1 showing the direction of circulation of a cooling fluid,

Figure 7 is a longitudinal sectional elevation through the roller,

Figures 8 and 9 are a diagrammatic elevation and plan respectively of the roller and pan of the mill shown in Figure 1.

Like reference characters refer to like parts in the drawings.

The mill comprises broadly a rotatable pan 10 and a roller or edge-runner 11 both of which are positively driven by a driving shaft 12 coupled to a power unit 12c through gearing 12a and a clutch mechanism 12b.

The pan 10 which is preferably constructed of cast iron has a flared peripheral rim 13 and is provided with a flange 14 to which is secured, by means of bolts 15, a bevel-wheel annulus 17 provided with gear teeth 18. The bottom of the

pan is recessed at 19 to receive an annular insert 20 which may be built up from sectors and which provides a replaceable working face on which the roller 11 runs. A hollow boss 33 is formed on the bottom of the pan and the axis of the boss 33 constitutes the axis of rotation of the pan, the boss being journaled in a bearing hereinafter described. In the mastication of rubber and like materials the pan 10 has to withstand heavy downward pressures and instead of supporting it vertically by journaling the boss 33 in a foot-step bearing, which in most cases would be inadequate to provide the necessary support for the pan, the pan is supported vertically by a cone-roller bearing arrangement. This arrangement comprises an annular bearing piece 22 having an inclined bearing face 23, bolted to the pan by means of bolts 24 the outer of which serve to hold the renewable parts 20 in position and a similar bearing piece 25 having an inclined bearing face 26, bolted to a base frame 27 by bolts 28, a flange 30 on a bearing sleeve 29 being located between the bearing piece 25 and the base frame 27. The annular bearing pieces 22 and 25 constitute a race for a set of conical rollers 34 mounted on bearing bushes 35 carried on spindles 36 secured in and extending radially between an outer ring 37 comprising a plurality of arcuate sections secured together at 37a, and an inner ring 38. The rings 37 and 38 constitute a cage which supports the conical rollers 34 in a similar manner to the cage of an ordinary roller bearing. The cage is rotatable about the axis of the pan and for this purpose the inner ring 38 is provided with a bush 39 and is mounted for rotation on the bearing sleeve 29. A bearing bush 31 is located within and bolted to the sleeve 29 by means of bolts 32 and this bush constitutes a bearing for the boss 33 on the bottom of the pan. The pan is driven positively from the driving shaft 12 by a bevelled pinion 41 which meshes with the teeth 18 of the bevel annulus 17, and the shaft 12 is journaled in a bearing 42 (see Figure 3) mounted on the base frame 27 of the mill. Lubrication of the hollow boss 33 on the pan 10 and of the journals of the conical rollers 34 is effected through ducts 44 and 45 respectively. The bearing piece 22 has its bearing face 23 so positioned in relation to the roller 11 that the centre of pressure of the roller on the pan lies near the pitch circle of the cone-rollers 34.

As the operation of grinding or "frictioning" the material in the pan generates, in most cases, considerable heat, it is desirable to circulate a cooling medium such as water through cavities

21 formed in the base of the pan. These cavities 21 are arranged as shown in Figure 6. Cooling water is supplied to the cavities 21 through a supply pipe 46 and a conduit 47 extending vertically through the hollow boss 33 and passing through a stuffing box 48 at the lower part thereof. The water passes into one of the cavities through an inlet 47a and circulates in a sinuous path from one cavity to another through transfer ports 47b, circulation of the water being assisted by the rotation of the pan. After the cooling water has circulated through the pan it is discharged therefrom through an outlet 47c and is returned to a discharge pipe 49 by way of the hollow boss 33. The aforesaid cavities may be used for the circulation of a heating medium such as steam where this is, having regard to the grinding operation, desirable.

As previously stated in the mastication of rubber the mill has to withstand relatively heavy stresses and for this reason the edge-runner or roller must be supported in a rigid frame and as the roller is located at one side of the pan it is not possible to journal the supporting shafts of the roller on both sides thereof in simple pedestal bearings supported on the base frame 27 of the mill. Furthermore it is desirable to support the roller so that it can be adjusted vertically with respect to the pan to vary the clearance between the pan and roller. Accordingly axles 50 and 51 of the roller are journalled in enclosed bearings 52 and 52a adjustable vertically in guides 53 and 53a (by means herein-after described) carried respectively by an end-frame 54, the feet 54c of which are bolted to the bed-plate 27, and a frame 54a the feet 54d of which are carried by columns 55, the feet 55a of which are bolted to the bed-plate 27. The bridge 54a straddles the pan 10 and the columns 55 are located on either side thereof. It will be seen that in the construction described the overhung axle 51 is carried so as to leave free access to the pan on the side opposite to the roller. To ensure rigidity and strength the bridge 54a and frame 54 are connected together by tie rods 55b.

Positive rotation of the roller 11 is effected by a toothed pinion 56 fixed on the driving shaft 12 and a gear wheel 57 fixed on an extension 58 of the axle 50 of the roller and the teeth of the pinion 56 and gear wheel 57 are of such a configuration and depth that the vertical adjustment of the roller and therefore of the gear wheel 57 can be effected without taking the gear wheel out of driving engagement with the pinion.

Vertical adjustment of the roller 11 is effected by hand by means of a hand wheel 59 fixed on a shaft 60 journalled in bearings 61 carried by the bridge 54a and the end-frame 54. The shaft 60 carries for rotation with it worms 62 and 63 which mesh respectively with worm wheels 64 and 65 located in housings 70. The worm wheels 64 and 65 which are held against vertical movement, are keyed to vertical feed-screws 71 and 72 provided with a screw thread 73. The lower ends of the screws 71 and 72 are provided with caps 73a housed in recesses 70a in the bearings 52 and 52a and by rotating the hand wheel 59 the screws 71 and 72 are rotated so as to traverse the bearings 52 and 52a and adjust the roller 11 vertically with respect to the pan.

For cooling the roller 11 which is provided with a chilled cast iron tire 11b, the roller is made hollow and cooling water is supplied (see Figure 7) from an inlet port 82 to the interior of the

roller by way of a pipe 81a which extends through the bore of the roller. The cooling water is discharged into the interior of the roller through perforations 81b in the pipe 81a and is returned to a discharge port 81 through the annulus between the pipe 81a and the bore of the roller.

To clear the roller of any material which may adhere to it a scraper 74 is provided which is mounted on a shaft 75 journalled in bearings 76 and one end of the shaft 75 is provided with a worm wheel 77 (see Figure 2) which meshes with a worm 78 mounted on a shaft 79 having a hand wheel 80. By turning the hand wheel 80 the angle of attack and the pressure of the scraper 74 on the roller can be adjusted.

For scraping the bottom and sides of the pan 10 and for guiding the material fed into the pan at the side opposite to the roller 11, the arrangement shown more particularly in Figure 5 is provided. This arrangement comprises an inclined scraper 83 mounted on a bracket 84 bolted to one of the columns 55. The scraper 83 has a scraping edge 85 which engages the inclined rim of the pan, and a scraping edge 86 which engages the bottom of the pan, and the inclination of the scraper 83 is preferably such that the material to be ground is directed towards the adjacent or contacting faces of the roller and the bottom of the pan. This scraper for the sake of clarity has been omitted in the other views. A hollow upstanding boss 10a at the centre of the pan is scraped and the material directed away therefrom by a scraper 87 and a shield 87a both of which are mounted on a guiding member 88 secured by bolts 89 (see Figure 1) to a bracket 90 bolted to the bearing 52a. A further guiding member 92 is located on the opposite side of the roller and is secured to a bracket 93 mounted on the bridge frame 54a. The grinding member 88 and the guiding member 92 serve to guide material to be masticated under the roller 11.

The foundations for supporting the mill are indicated at 94 and it will be seen that the lower part of the mill comprising the base frame 27, bearing pieces 25, and conical rollers 34 are mainly housed below the floor level 95 in a well 96.

The action of the apparatus will be explained with reference to Figures 8 and 9 which show the roller in the position it occupies when the pan is empty; AB is the line of contact between the roller and the pan, the peripheral surface of the roller being generated by the revolution of the line AB about the axis XX of the roller; C is any point in the periphery of the roller; C' is a point on the surface of the pan with which the point C contacts as the roller rotates; D is a circle struck from the axis of rotation of the pan YY and passing through the point C'. It will be seen that as the roller rotates the point C makes contact with the roller at points C' located on the circle D, which will be termed the complementary circle, to the point C, and in this specification the "complementary circle" to any point C on the periphery of the roller is the circle struck from the axis of rotation of the pan and passing through a point C' in the surface of the pan with which the point C contacts as the roller rotates.

In the ordinary construction of edge-runner mills where the roller is driven by the pan or vice versa there will be a point C on the periphery of the roller which moves at a circumferential speed equal to that of its comple-

mentary circle, and it will be seen that the masticating action at the point C and at points on each side of point C for a short distance, is comparatively small since there is comparatively small relative movement between the said points and their complementary circles. In carrying out the invention the pan and the roller are positively driven at such relative speeds as shall ensure that every point C in the periphery of the roller moves at a circumferential speed differing from that of the circumferential speed to its complementary circle on the pan, and in order to ensure that this ratio of speed shall be maintained the driving shaft in the construction described and illustrated is geared both to the pan and to the roller.

In the drawings a cylindrical roller has been shown but it is obvious that the roller may have a conical or curvilinear peripheral configuration provided that the condition above referred to in relation to the speed ratio between a point in the periphery of the roller and its complementary circle on the pan be maintained.

In the example described the roller and the pan rotate in the same direction, and the peripheral speed of any point on the periphery of the roller is made to exceed the circumferential speed of the corresponding complementary circle on the pan because when the apparatus is used for masticating rubber the material being treated tends to adhere to the element having the lower speed, and it is desired that the material should adhere mainly to the pan and not to the roller. To take a specific example with reference to Figures 8 and 9, if the driving mechanism for the pan and roller and the gearing therebetween is so arranged that the roller has a peripheral speed of 100' per minute and runs on an annulus of the pan having an outer diameter of 64" and an inner diameter of 16" and the pan rotates at 4.5 revolutions per minute, the speed of the pan at the point B on the line of contact AB is 75' per minute, at the point M which is midway between the points A and B is 47' per minute, and at the point A is 19' per minute. Thus, the ratio of the peripheral speed of point A with respect to its complementary circle is 5.3 to 1, of point M in relation to its complementary circle is 2.14 to 1, and of point B in relation to its complementary circle is 1.3 to 1; thus, in the example described the slip between the roller and the pan increases towards the axis of rotation of the pan.

The relative speeds of the roller and the pan may be adjusted by using gear wheels 56 and 57 having the desired velocity ratio. The pan may be provided with a cover by which the material to be treated is effectively enclosed within the pan. This cover may be supported in sliding engagement with the upper peripheral edge of the pan from the bearing 52a and the cover would be cut away to provide an aperture through which the edge-runner or roller 11 works. Furthermore a chute may be provided which is inserted in the pan when the cover is removed and through which the milled or masticated materials are delivered into a receiving hopper or the like. In cases where the rubber or like material being treated has to be combined with other material, hoppers may be provided for delivering at each charge, a definite quantity of such material or materials. Instead of passing a cooling medium such as water through the cavities in the base of the pan and through the hollow roller as above described, in carrying out a process which requires that the pan and/or roller should be heat-

ed a heat-transfer medium at an elevated temperature may be circulated through the pan and/or roller instead of cooling water. While the mill has been described as particularly suitable for treating rubber it is also suitable for the grinding, levigating and mixing of pigments and like substances and details of construction and the size of the mill will be modified if necessary to suit particular substances to be dealt with.

I claim:—

1. The combination, in a mill of the type comprising a pan and an edge runner and means for positively driving both the pan and edge runner about their axes, of a hollow edge runner, means for circulating a heat transfer medium through said hollow runner during rotation thereof, a pan having at least two concentric rows of cavities in its base, transfer ports between adjacent cavities of the respective rows to form a sinuous passage for the circulation of a heat transfer medium through the inner and outer cavities successively during rotation of the pan, and an inlet conduit for the heat transfer medium, communicating with one end of said passage and an outlet conduit therefor communicating with the opposite end of the passage.

2. The combination, in a mill of the type comprising a pan and an edge runner and means for positively driving both the pan and edge runner about their axes, of a hollow edge runner, means for circulating a heat transfer medium through said hollow runner during rotation thereof, a pan having at least two concentric rows of cavities in its base, transfer ports between adjacent cavities of the respective rows to form a sinuous passage for the circulation of a heat transfer medium through the inner and outer cavities progressively and in succession, a hollow axle on said pan communicating with the cavity at one end of said passage, a stuffing box in said hollow axle, and a conduit extending through said stuffing box and axially located in the hollow axle and communicating with the cavity at the opposite end of said passage, said conduit and hollow axle forming an inlet and an outlet for the heat transfer medium.

3. The combination in a mill of the type comprising a pan arranged to rotate about a vertical axis and an edge runner arranged to rotate about a horizontal axis, and means for positively driving both the pan and the edge runner about their axes, of a hollow edge runner, means for circulating a heat transfer medium through said hollow edge runner during rotation thereof, a pan having concentric rows of cavities in its base including an inlet cavity and an outlet cavity both of which are located adjacent the center of the pan, transfer ports between the cavities and arranged to form the cavities into a sinuous passage for the circulation of a heat transfer medium through the base of the pan, the sinuousness of the passage preventing the heat transfer medium being thrown directly to the periphery of the pan by the action of centrifugal force, a hollow vertical axle on the pan, a bearing for said axle, a stuffing box in said hollow axle, a conduit extending through said stuffing box and coaxially located in the hollow axle, and means for connecting the hollow axle and said conduit to a heat transfer medium circulating means, the conduit and the hollow axle communicating with the inlet and outlet cavities in the base of the pan whereby a heat transfer medium can be circulated through the pan during rotation thereof.

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