May 8, 1951 F. E. BROWN 2,551,872

RUBBER WORKING MACHINE

Filed Dec. 30, 1946 7 Sheets-Sheet 1

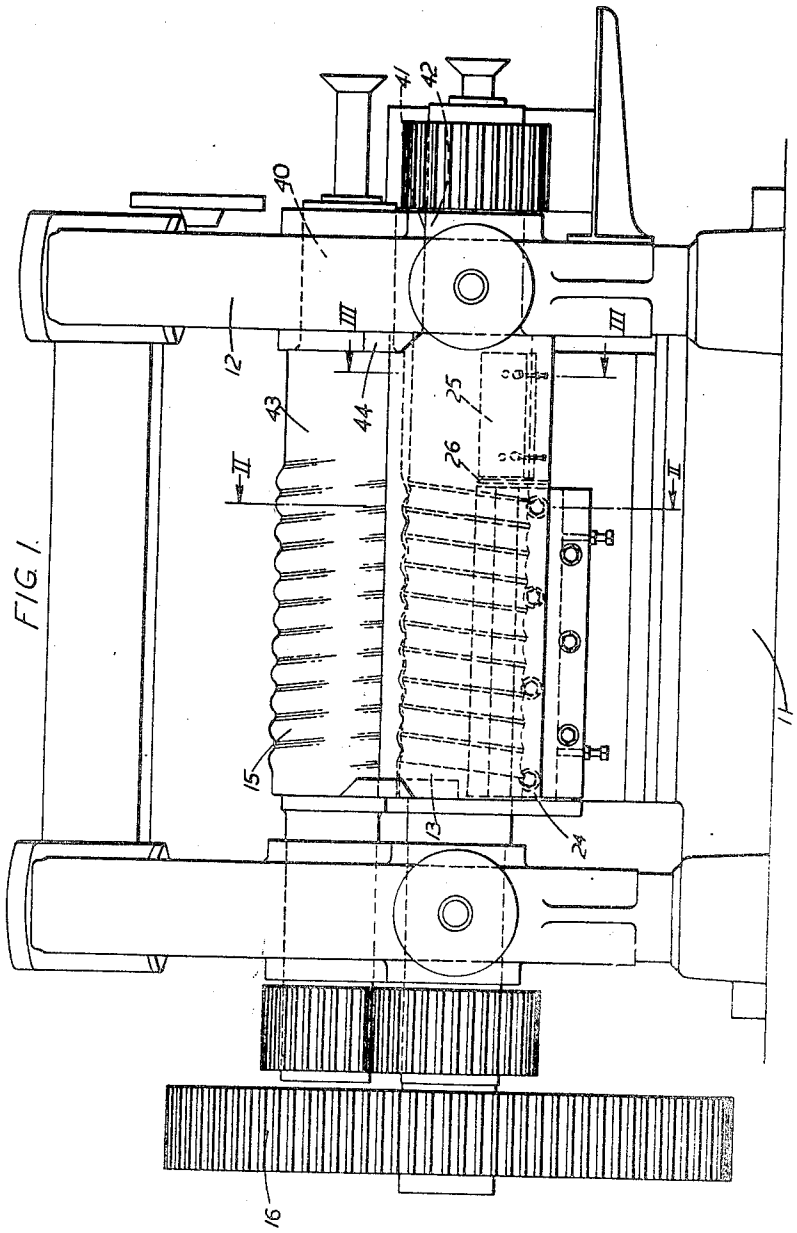


FIG. 1.

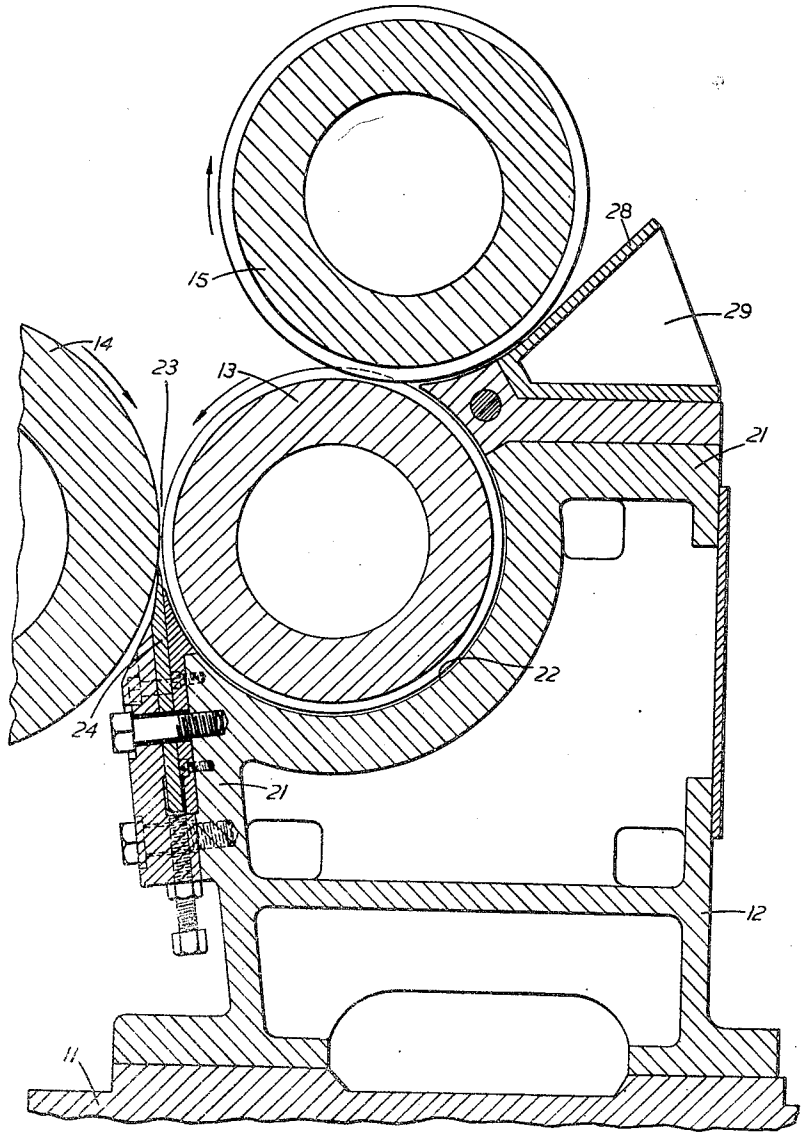
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RUBBER WORKING MACHINE

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FIG. 2.



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RUBBER WORKING MACHINE

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FIG. 3

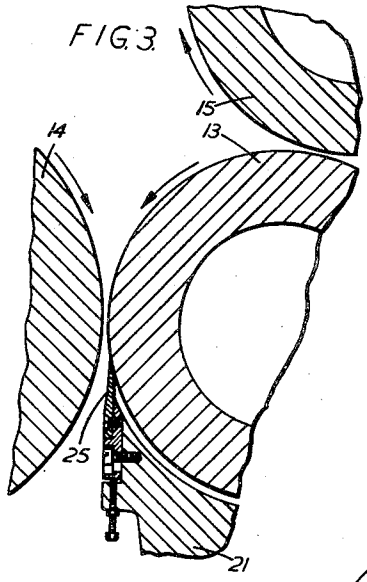
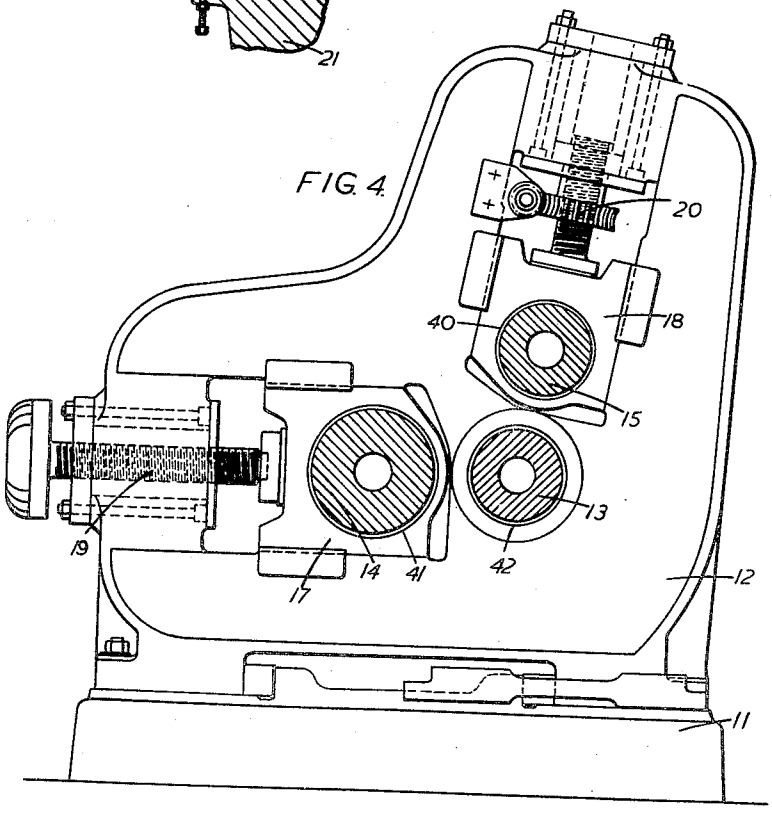


FIG. 4



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RUBBER WORKING MACHINE

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FIG. 5.

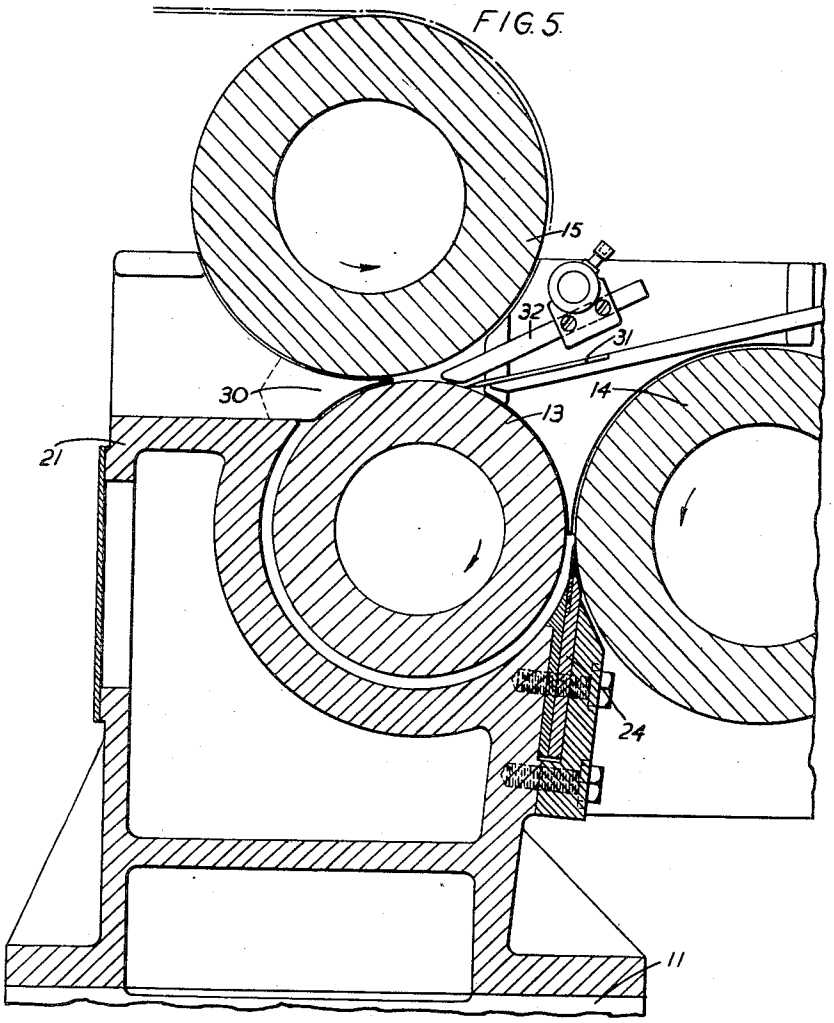
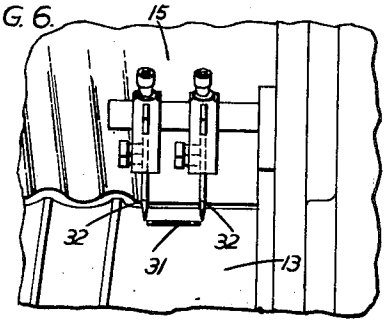


FIG. 6.



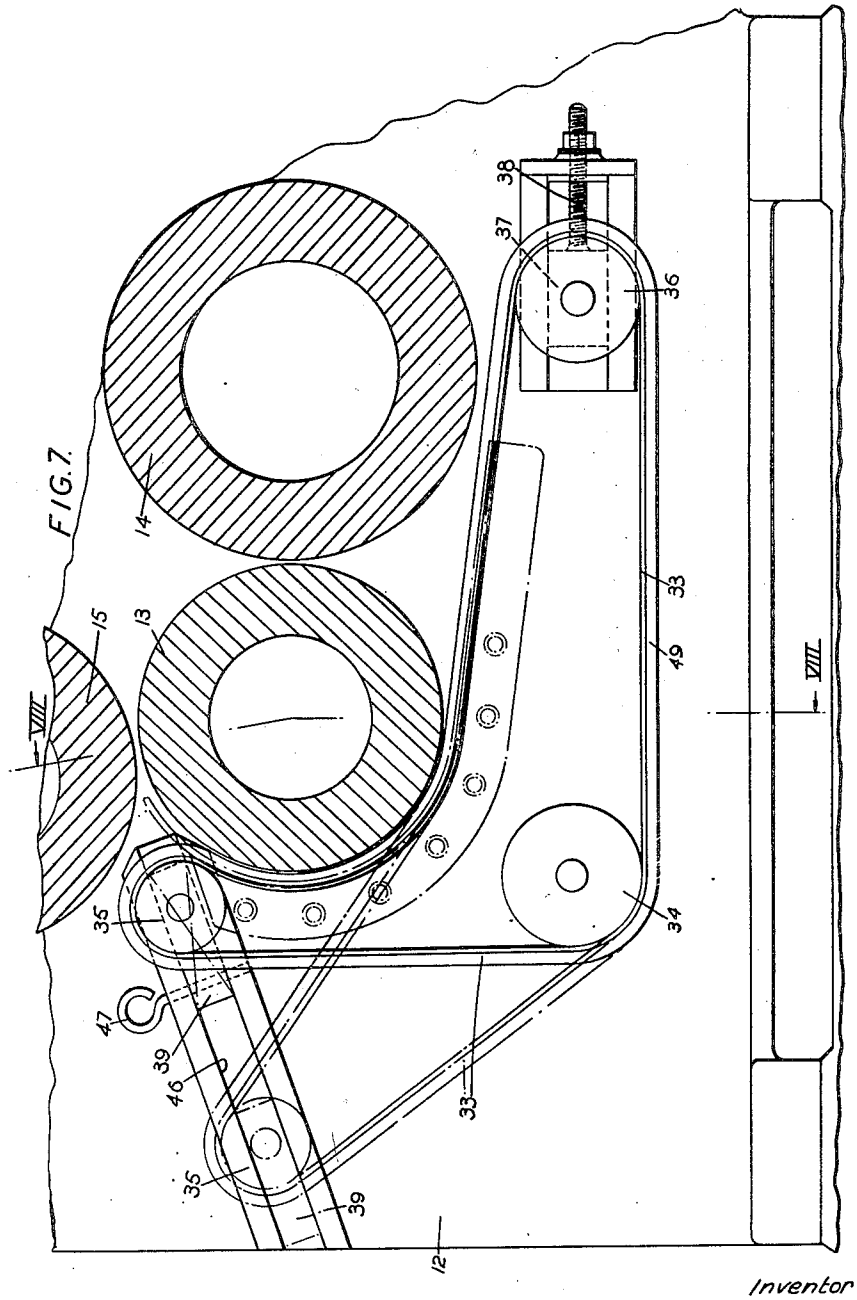
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FIG. 7.



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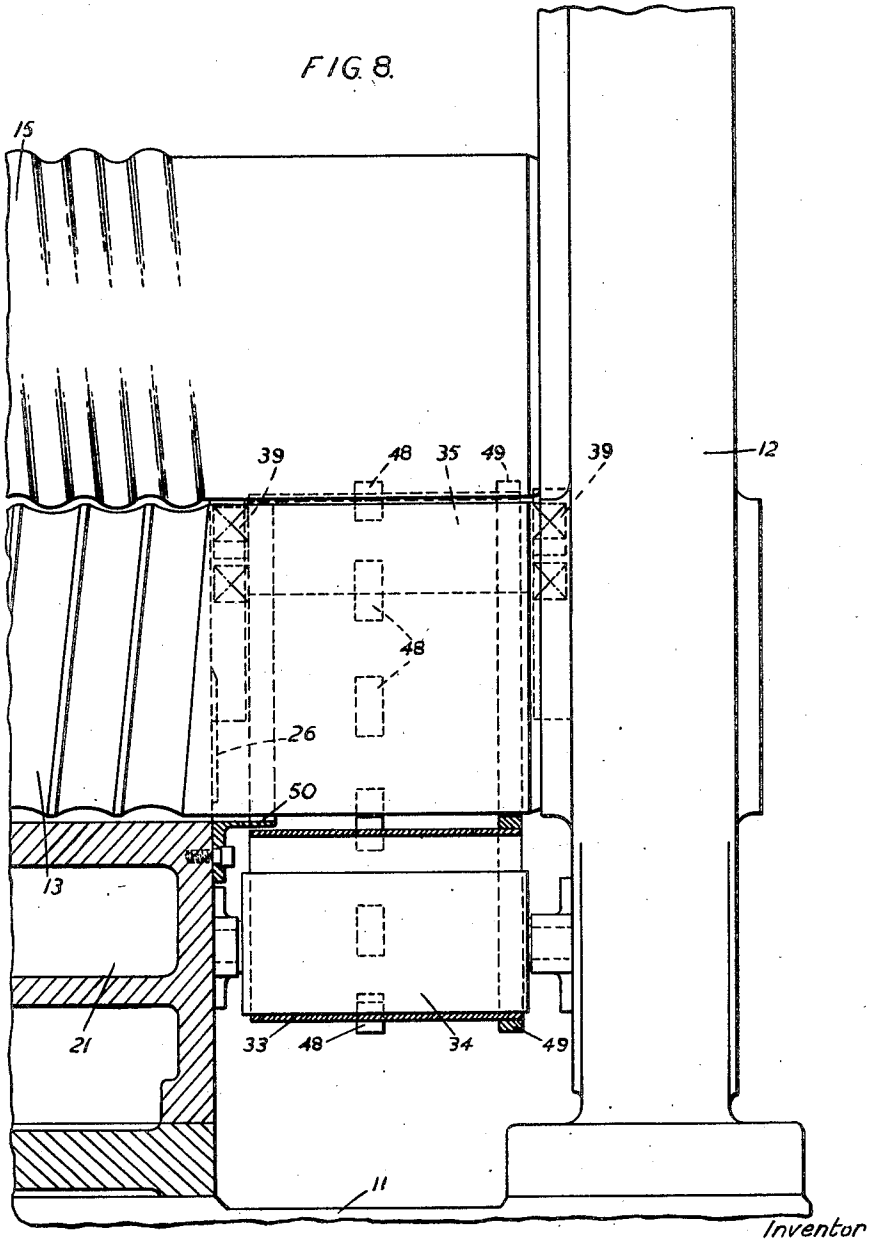
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FIG. 8.



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RUBBER WORKING MACHINE

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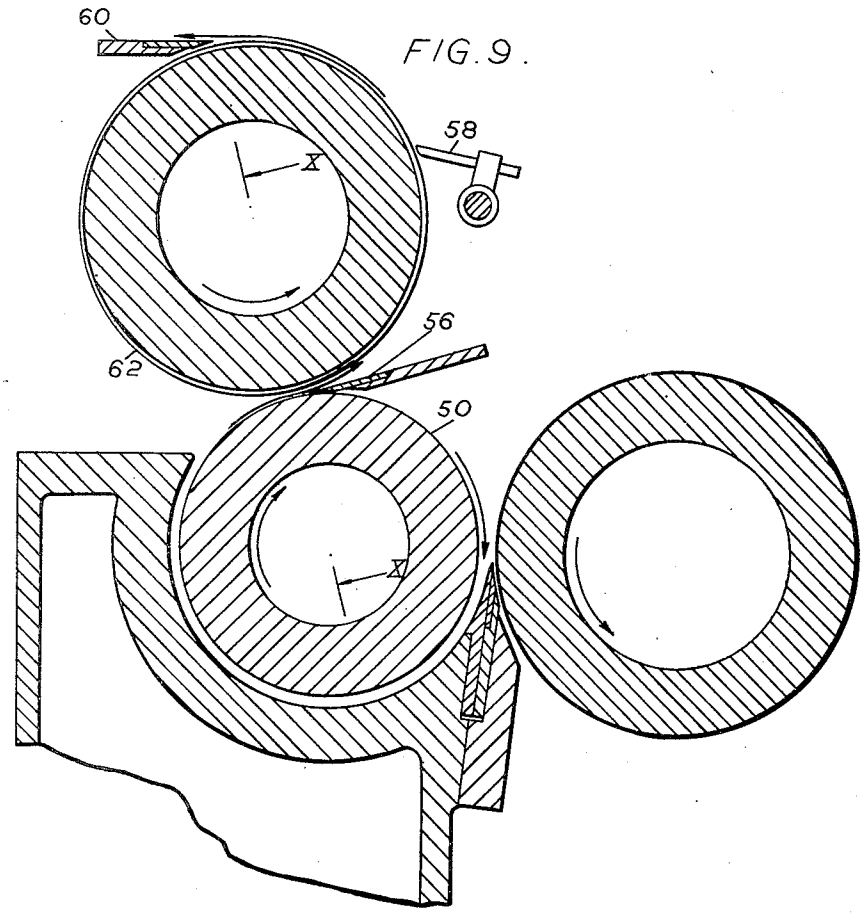


FIG. 9.

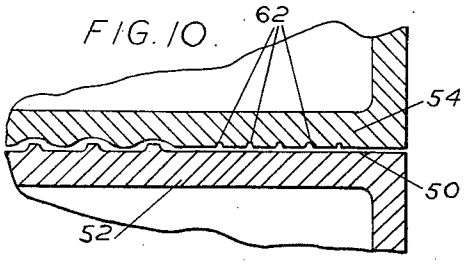


FIG. 10.

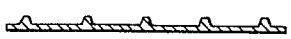


FIG. 11.

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Patented May 8, 1951

2,551,872

UNITED STATES PATENT OFFICE

2,551,872

RUBBER WORKING MACHINE

Frederick Edward Brown, Hyde, England

Application December 30, 1946, Serial No. 719,159
In Great Britain January 9, 1946

14 Claims. (Cl. 18—2)

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This invention relates to machines for working rubber or the like.

In the past the usual way of working rubber or the like has been to use two-roll mills in which the rubber is repeatedly forced through the nip between two plain rollers.

Anothed way of working rubber is disclosed in Patent No. 2,264,237 issued to me on November 25, 1941. Essentially this method involves the principle of turning the rubber over and over in a confined space between a roller and a stationary casing by the action of the roller, the rubber being forced into the space through a feed nip between the working roller and a co-operating roller which may be called a feed roller.

These machines can be used either for batch or continuous working and in the latter case the rubber is caused to move axially while being worked.

An object of this invention is to produce by a continuous process sheets of rubber which can be cut in the same way as those produced in a standard two-roll mill and yet obtain the great advantages of working the rubber in accordance with the general principles set forth above.

A further object of this invention is so to modify the machines of my said prior patent as to enable them continuously to produce rubber strip which may be of a desired profile or cross-section.

Another object of this invention is to provide in one part of the machine means continuously effective to work rubber and in another part of the machine continuously effective means by which rubber may be removed in sheet or strip form.

In my present invention I provide two continuously effective scraper blades of which one bears against the feed roller to ensure that the rubber after passing through the nip between the working and feed rollers moves round with the working roller, and the other extends over part of the working roller at its output end and bears against that roller to remove the worked rubber from the working roller as a continuous strip or to divert the worked rubber from the working roller to another roller (which may be the feed roller) from which the rubber is removed as a continuous strip or as sheets in a direction transverse to the axes of the rollers.

My invention will be more clearly understood by reference to the annexed drawings, which show the preferred embodiments of the invention and in which:

Figure 1 is a front elevation of one machine;

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Figures 2 and 3 are fragmentary sectional views on the lines II—II and III—III respectively of Figure 1;

Figure 4 is a corresponding end view;

Figure 5 is a sectional end view of a modification;

Figure 6 is a fragmentary part elevation of a detail of Figure 5;

Figure 7 is a sectional end view of a further modification;

Figure 8 is a sectional elevation on the line VIII—VIII of Figure 7.

Figure 9 is a sectional end view of a third modification;

Figure 10 is an axial section on the line X—X in Figure 9; and

Figure 11 is an end view of a strip produced by the machine shown in Figures 9 and 10.

The machine works the rubber on the principle described in my said prior patent.

The machine shown in Figures 1 to 4 has a bed plate 11 supporting a frame 12 in which three rollers 13, 14 and 15 are rotatably mounted. The roller 13 will be referred to as the working roller, the roller 14 as the feed roller, and the roller 15 as the delivery roller. All three rollers are driven in the sense indicated by the arrows in Figure 2 and 3 from a main gear wheel 16 which is driven in any convenient way. The working and delivery rollers 13 and 15 respectively have intermeshing helical ribs and grooves extending from the input end of the machine throughout the greater parts of their lengths, and the remaining parts are plain. The feed roller 14 is plain throughout its entire length. The feed and delivery rollers 14 and 15 are journalled in slide blocks 17 and 18 respectively which are adjustable towards and away from the axis of the working roller 13 by screw mechanisms 19 and 20 respectively. A jacketed casing 21 carried by the frame 12 has a plain curved surface 22 which follows closely the working roller 13 and extends from below the nip 23 formed by the working and feed rollers to a point at the rear of the roller 13 above the level of the roller axis. The casing 21 is shaped so that the space between it and the working roller increases slightly from the input to the output ends, i. e. from left to right of Figure 1. It extends along the working roller throughout the whole of the grooved part and also over most but not all of the plain part, leaving a small gap at the output end.

A scraper blade 24 as long as the grooved length of the working roller is adjustably carried at the forward edge of the casing 21 and forms an ex-

tension of it. The blade 24 is located directly opposite to the grooved part of the working roller 13 and bears at its upper edge against the feed roller 14 and prevents rubber along this part of the rollers from lapping round the feed roller thus ensuring that the rubber is directed into the space between the working roller 13 and the stationary surface of the casing 21. Another scraper blade 25 also adjustably carried at the forward edge of the casing 21 is placed to bear against the plain part of the working roller 13 and ensures that rubber which has emerged from the grooved part of the working roller is transferred to the feel roller. A slitting knife 26 is arranged between the adjacent ends of the two scraper blades 24 and 25 and extends radially into the nip at its lower side and serves to make a continuous cut in the rubber emerging from the grooved part of the working roller.

Rubber to be worked and converted into sheet form is delivered by hand to the zone above the nip 23 near the input end and is gripped by the rollers 13 and 14 and forced into the space between the working roller 13 and the casing 21. As the roller rotates and the casing is stationary, the rubber will be braked and will not move round as fast as the roller 13. The consequences of this are that there is relative circumferential movement between the rubber and the roller 13 on the one hand and the rubber and the casing on the other and there will also be axial movement of the rubber as a whole. The movement of the rubber relatively to the parts which bound the space in which it is enclosed, causes the rubber to be worked to a very considerable extent while it is passing to the nip formed by the delivery roller 15 with the working roller 13. When the rubber arrives at that nip, it is forced out of the groove in the working roller by the rib on the delivery roller and further worked in the process. It will be seen that the rubber not only travels axially but regularly emerges from the upper end of the space and is carried over the top of the working roller 13. Each time this happens the rubber is again gripped at the nip formed by the working and feed rollers and turned over on itself and reintroduced into the space. The function of the delivery roller is completed when the rubber reaches the plain part of the working roller 13 but it is convenient to mount the delivery roller in bearings 40 in radial alignment with bearings 41 and 42 for the feed and working rollers; accordingly the delivery roller 15 is made of the same length as these rollers, but opposite to the plain part of the working roller it is reduced in diameter as shown at 43 so that it does not act on the rubber when this reaches the plain part of the working roller. The axial thrust imparted to the rubber is effective throughout the whole machine, i. e. when the rubber reaches the plain part of the working roller it still continues to travel axially. It emerges from the end of the grooved part of the working roller as roughly conical-shaped pieces which are cut by the slitting knife 26 and diverted by the second scraper blade 25 onto the feed roller, being initially assisted to lap round the feed roller by the attendant until the pieces form a band. The part of the casing 21 over the plain part of the working roller ensures that the pieces shall not escape and that they are carried round this plain part into the nip between this part and the opposite part of the feed roller. The rubber is allowed to remain on the feed roller and quickly builds up into a covering uniform in thickness, whereupon by appropriate slitting, part of the covering is removed as a sheet. The outer side of the sheet is made straight by a side or limit guide 44 which extends into the nip. The inner side is preferably cut by the attendant so as to leave behind a narrow band on which fresh pieces can build up into another wide band or covering.

The temperature of the rubber may be controlled by circulating hot water or oil, steam or cold water through the jacketed casing 21. Thus at the beginning of the process it is desirable to warm up the machine and so accelerate the plasticising of the rubber and later to subject the rubber to a cooling action, a suitable two-way connection being provided to switch over the circulation at any instant. When the machine is being used for mixing and not solely for working the rubber, various ingredients are added as the mixture travels along and the increase in volume is allowed for by the slight enlargement of the space between the working roller 13 and the casing 21 already referred to. This enlargement also facilitates axial travel of the rubber. Any loose pieces of rubber which are carried over the top of the delivery roller 15 are caught in the space above a sloping surface 28 on an extension 29 at the upper part of the casing 21, so that the pieces are fed back onto the top of the working roller 13 to rejoin the bank of rubber at the top of the feed nip. Any small pieces which may be present at the output end of the machine are able to fall out through the gap left at the end of the casing 21.

An axial slot may be made in the bottom of the casing over a short distance from its end, or the lower edge of the casing may lie directly under the axis instead of under the nip through the same distance to allow detached pieces, if any, to escape. In addition to this slot it is also advisable that the casing should stop short of the end of the working roller to leave a space which allows access for a brush, should it be necessary to clean out any fragments when changing from one type of mixing to another type of mix.

The modified machine shown in Figures 5 and 6 has means whereby the worked rubber is removed as a continuous strip, either directly from the plain end of the working roller, or from the delivery roller. In order that the rubber may be removed as a strip from the working roller, the first scraper 24 extends throughout the full length of the feed roller and the second scraper shown at 31 bears against the working roller and does not extend throughout the full length of the plain part of the working roller, as clearly seen in Figure 6. A pair of edge trimming cutting knives 32 are provided, one at each end of the scraper 31. In this example, the upper extension on the casing 21 is omitted so that the rubber is left free to form a bank 30 at the inlet side of the nip formed by the working and delivery rollers 13 and 15 respectively. The rubber emerges onto the plain part of the working roller on which it forms a continuous band which is prevented by the extension to the first scraper 24 from being diverted onto the feed roller. As this band is formed, part of it is continuously being removed by the second scraper 31 leaving always a narrow band between the end of the grooved part of the working roller and the first encountered cutting knife 32 on the plain part. This narrow band builds up into a sufficiently

wide band by the time it reaches the second scraper 31 to enable both the cutting knives 32 to engage the widened band and cut a strip which passes away over the upper surface of the scraper 31. If it is desired to pass the strips away over the delivery roller 15, the two cutting knives 32 preferably extend well into the nip between the working and delivery rollers to prevent tearing of the rubber as it is pulled upwardly over the part of the delivery roller.

The thickness of the strip will be determined by the gap between the working and feed rollers, and the casing over the plain part of the working roller must not at this part have any working effect upon the rubber, accordingly the clearance between the casing and this part of the working roller is increased; the casing still serving to prevent any loose pieces from falling away.

In another modified machine shown in Figures 9 and 10 worked rubber on the output length 50 of the working roller 52 is transferred to the delivery roller 54 by a scraper 56 which extends the full length of the output length 50. A slitting knife (not shown) is provided at the input end of the scraper 56. Thus a band of rubber is built up on the delivery roller and out of this band a narrower strip is cut by edge-trimming knives 58, which may be adjustable axially of the rollers to determine the width of the removed strip. A scraper 60 may be provided to assist separation of this strip from the delivery roller. The action of the scraper 56 is comparable with that of the scraper 25 in the machine shown in Figures 1 to 4.

It is possible for all the machines described to deliver non-rectangular strips if the rollers between which the strip finally passes are suitably contoured. Thus in Figures 9 and 10 the delivery roller 34 is shown with annular grooves 62 and the section of the strip delivered is shown in Figure 11. Such a strip, made of ebonite, is suitable for use as a separator in an electric battery.

In Figures 7 and 8 the scraper blades are omitted for clarity of illustration and they may be the same as those shown either in Figures 1 to 4 or in Figures 5 and 6. The essential modification in Figures 7 and 8 is that the part of the casing 21 opposite the plain length of the working roller 13, i. e. the part beyond the working space, is replaced by an endless belt 33. This belt 33 passes over three guide rollers 34, 35 and 36 of which the guide roller 36 is movable by being journalled in slide blocks 37 under the control of an adjusting screw 38. Adjustment of this guide roller 36 serves to adjust the tension in the belt 33. The belt 33 normally occupies the position shown in full lines in Figure 7 in which it passes below and at the rear of the working roller 13 throughout the plain length of the latter. The uppermost guide roller 35 is journalled in slides 39 movable in channels 46. By removing pins 47, the slides 39 can be readily moved away from the working roller for cleaning purposes. The belt 33 carries along its outer surface a central series of spacers 48 which engage the working roller and so hold the belt a short distance away from the surface of the working roller. This provides space for pieces of rubber emerging from the grooved part of the working roller, and the belt serves to prevent the pieces from falling away and thus ensures that they are carried round the back of the working roller to reach the delivery and feed rollers. Rotation

of the belt is caused simply by the rubber pieces transmitting the drive from the working roller. At its outer edge the belt 33 carries a continuous strip 49 which axially seals the gap between the belt and the working roller 13. The inner edge of the belt 33 is overlapped by a flange of an angle iron 50 at the end of the casing 21, so that the rubber pieces cannot fall between the belt and casing.

It is to be understood that the term "rubber" used in this specification and claims includes artificial and natural rubber and also any substance having the same or similar physical characteristics such as would render the substance suitable for treatment in the machines.

I claim:

1. A machine for working rubber comprising a working roller formed as a working length extending from an input end adapted to receive rubber and merging into a shorter output length, a casing defining a space surrounding at least said working length over a substantial angle but not entirely, means axially coextensive with said working length for directing rubber into said space, a second roller forming a nip with at least said output length and a fixed scraper bearing on said output length and adapted to direct worked rubber from said nip onto said second roller.

2. A machine for working rubber comprising a working roller formed as a working length extending from an input end to which rubber is fed and merging into a shorter output length, a feed roller forming a nip with both said working and output lengths, a casing defining a space surrounding at least said working length over a substantial angle but not entirely, a first fixed scraper bearing on said feed roller and axially coextensive with said working length and adapted to direct rubber from said nip into said space, and a second fixed scraper bearing on and axially coextensive with said output length and adapted to direct worked rubber from said nip onto said feed roller.

3. A machine as claimed in claim 2 wherein a slitting knife is fixed in said nip at the point where said working length merges into said output length.

4. A machine for working rubber comprising a working roller formed as a working length extending from an input end to which rubber is fed and merging into a shorter output length, a feed roller forming a nip with both said working and output lengths, a casing defining a space surrounding at least said working length over a substantial angle but not entirely, a delivery roller forming a nip with both said working and output lengths and adapted to engage rubber emerging from said space, a first fixed scraper bearing on said feed roller and adapted to direct rubber into said space and a second fixed scraper bearing on and axially coextensive with said output length and adapted to direct worked rubber onto said delivery roller.

5. A machine as claimed in claim 4 wherein a slitting knife is fixed in the nip between said working and delivery rollers at the point where said working length merges into said output length.

6. A machine as claimed in claim 1 wherein said casing is so shaped that said space increases in thickness towards said output length.

7. A machine as claimed in claim 1 wherein a slitting knife is placed in the nip between said

rollers at the junction of said working and output lengths.

8. A machine as claimed in claim 1 wherein two knives are placed close to said second roller to cut slits in a band of rubber on said second roller and define a narrow strip of rubber to be detached from said second roller.

9. A machine as claimed in claim 1 wherein said output length and said second roller are adapted to form a band of rubber on said second roller of non-rectangular section.

10. A machine as claimed in claim 1 wherein said casing is axially coextensive with said working length only and comprising an endless conveyor belt defining an extension of said space surrounding said output length over a substantial angle but not entirely.

11. A machine as claimed in claim 10 in which said casing carries a flange which overlaps the input edge of said belt.

12. A machine as claimed in claim 10 in which said belt carries a continuous ridge on the output edge of its working surface, said ridge contacting said output length.

13. A machine as claimed in claim 10 in which said belt carries a plurality of spacers upon its working surface, said spacers contacting said output length and maintaining the thickness of said extension of said space.

14. A machine as claimed in claim 10 in which said belt is carried by other rollers, one at least of which is removable.

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