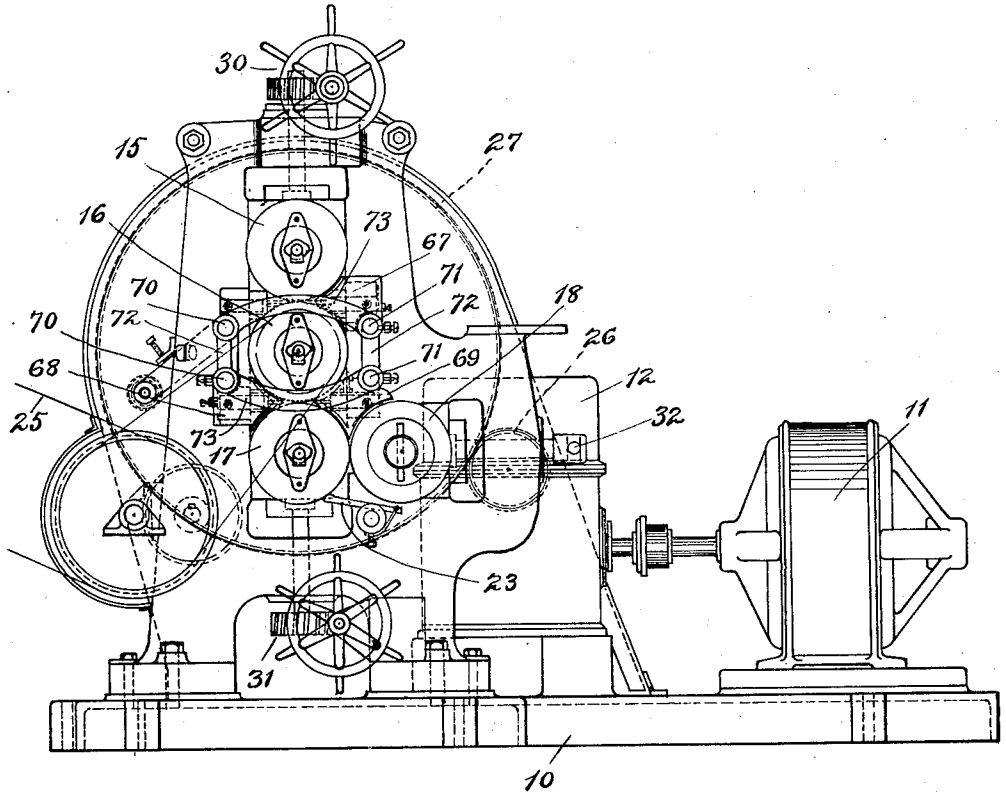
March 18, 1930. P. E. WELTON 1,751,116

RUBBER CALENDER

Filed Sept. 22, 1928 3 Sheets-Sheet 1

Fig. 1



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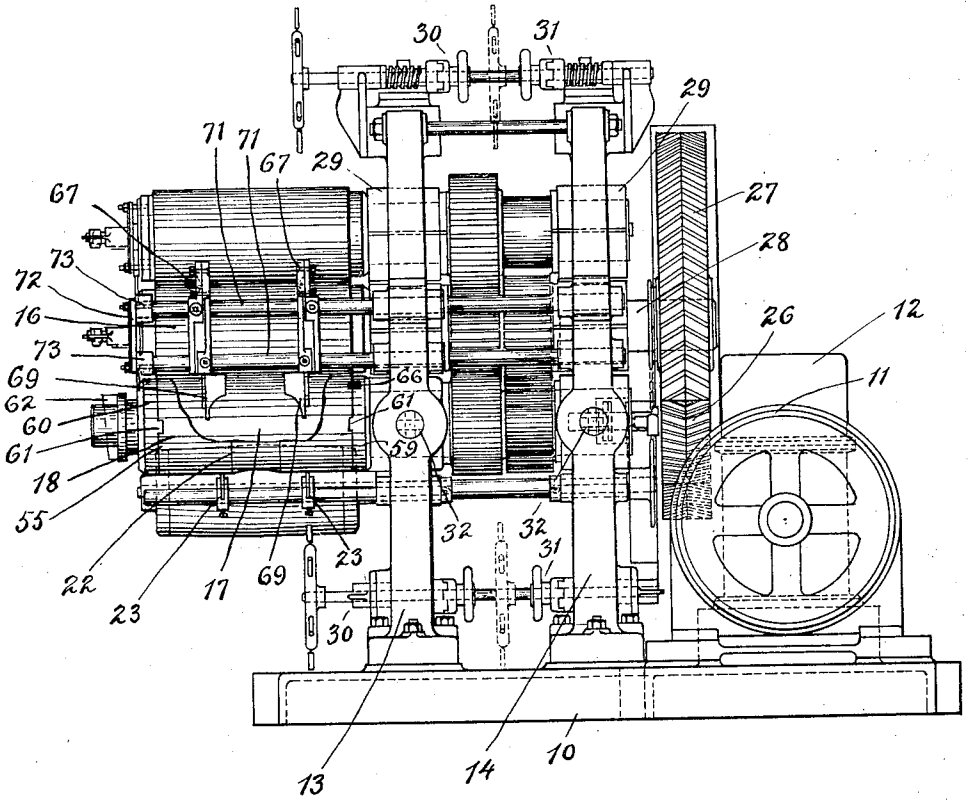
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Fig. 2.



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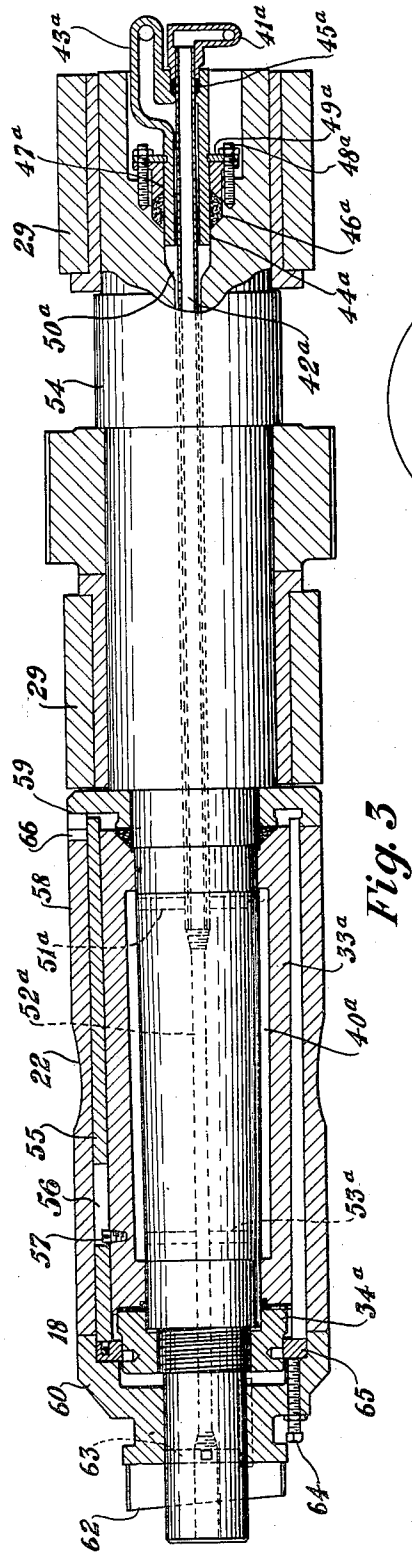


Fig. 3

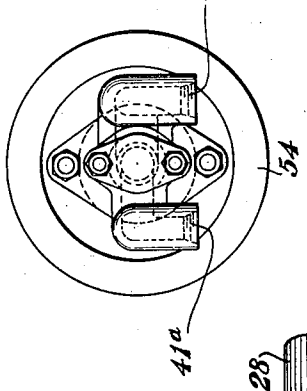


Fig. 4

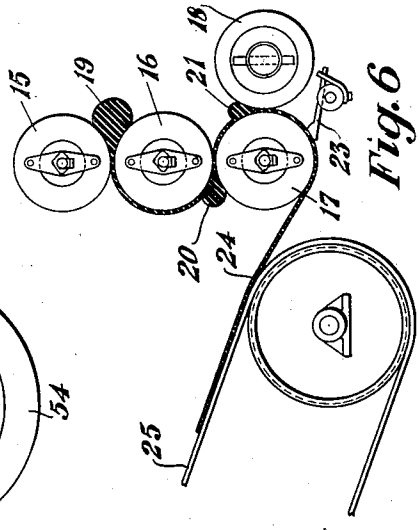


Fig. 6

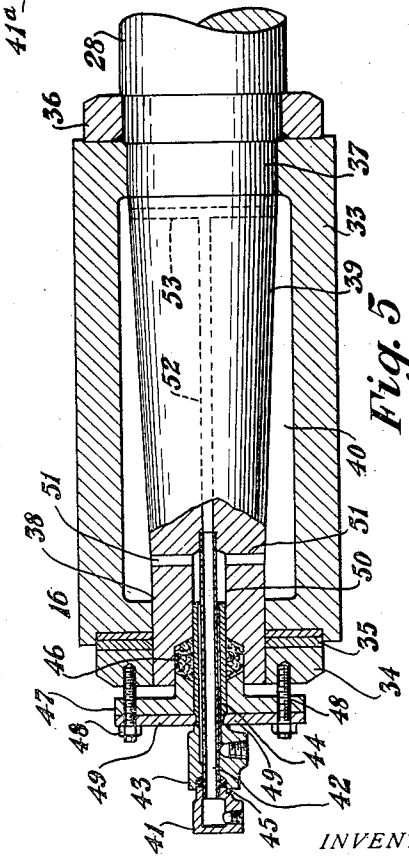


Fig. 5

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Patented Mar. 18, 1930 1,751,116

UNITED STATES PATENT OFFICE

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RUBBER CALENDER

Application filed September 22, 1928. Serial No. 307,765.

This invention relates to machines for calendering plastics such as rubber in sheet or strip form. Stocks of relatively stiff composition for making pneumatic tire tread strips can be more easily worked in a calender than in a tube machine, and the calender is often preferred for additional reasons, but when constructed in the usual manner, with rolls journaled in bearings at both ends, the changing of the grooved roll to one of a different profile involves considerable labor-expense and loss of production time as well as a large investment in costly rolls of various profiles.

The object of my invention is to reduce the time and expense of changing the rolls or roll parts and especially the profile roll in machines of this character. To this end I provide a calendering apparatus with overhanging rolls, journaled at one side only of the working zone or path of the stock, together with certain improvements in the roll structure whereby the exterior portion thereof is detachably mounted on the shaft and withdrawable endwise therefrom, and novel provision is made for circulating fluids such as steam and water through the roll structure for heating and cooling it.

Of the accompanying drawings, Fig. 1 is a side elevation of a calendering machine constructed according to my invention.

Fig. 2 is a front elevation thereof, partly broken away.

Fig. 3 is a longitudinal sectional view of the profile roll and connected parts.

Fig. 4 is an inner end view of the profile-roll structure, showing the pipe connections.

Fig. 5 is a longitudinal sectional view of one of the masticating rolls.

Fig. 6 is a diagrammatic end view of the rolls and take-off showing the course of the stock.

While the present invention is not confined to a particular number or arrangement of calender rolls I have here shown an arrangement of four walls of which the first three are arranged in a vertical series or tier and the last or profile roll is arranged horizontally alongside of the bottom roll in said tier.

In the drawing, 10 is the machine base carrying an electric motor 11, a reduction gearing housed in a casing 12, and a pair of frame standards 13, 14 supporting the calender parts. The several roll structures in progressive order are marked 15, 16, 17 and 18, the first three being arranged in a vertical tier and the profile roll structure 18 being mounted horizontally alongside the bottom roll 17 of said tier.

The working of the plastic rubber compound between these rolls takes place in a manner familiar to those skilled in the art, as illustrated diagrammatically in Fig. 6, 19 being the first bank at the front of the machine between the roll structures 15, 16, whereby it is sheeted and passes halfway around the roll structure 16; 20 being the second bank at the back between the roll structures 16 and 17 which have a narrower pass than the first two and cause the sheet of stock to be passed a quarterway around the bottom roll 17, and 21 being the third bank on top of the space between the rolls 17 and 18, from which the stock issues with the desired cross-sectional shape of a tire-tread strip imparted by the shape of the opening between said last two roll structures, said opening being formed in part by a profile groove 22 (Figs. 2 and 3) in the surface of the roll structure 18. The ends of the banks are confined by suitable stock guides, to be described, and the edges of the final strip are trimmed by a pair of knives 23 in passing around the underside of the roll 17, from whence the formed strip 24 passes onto a take-off conveyor 25.

Power is transmitted from the gears in the housing 12, through a pinion 26 and a large gear 27, to the extended shaft 28 of the middle calender roll structure 16, and from said

shaft is transmitted through suitable gearing, shown between the standards 13 and 14 in Fig. 2, to the upper and lower roll structures 16, 17 and from the shaft of the roll structure 17 through gearing to the profile roll structure 18. The vertical-tier rolls 15, 16, 17 may have the usual differential speeds for masticating the stock, roll 15 being somewhat faster, and roll 17 faster by a smaller amount, than the middle roll 16. Rolls 17 and 18 are preferably run at even speed. The profile opening may, if desired, be wholly cut in the roll 18 and the adjacent portions of the latter run in contact with the roll 17.

Each shaft is journaled on one side only of the zone or path of the stock being worked between the calender roll structures, in a pair of bearings 29, those for the upper and lower roll structures 15, 17 being mounted in vertical guides in the standards 13 and 14 and adjusted to vary the distance between the roll peripheries by means of hand-operated mechanisms 30 and 31, while the bearings for the shaft of the profile roll structure 18 are mounted in horizontal guides on said standards and adjusted by means of screws 32. Each bearing of any roll can be individually adjusted so as to get the proper clearance at both ends of the roll.

Each roll shaft has a roll body detachably mounted thereon and removable endwise from the shaft in an outward direction or leftward as viewed in Fig. 2. As an example of the preferred construction in the case of the three roll structures 15, 16 and 17 whose bodies have to be removed only occasionally, I have shown in Fig. 5 the construction of the middle roll device 16. A hollow roll body or sleeve 33 is held, by a nut 34 and washers 35 mounted on the reduced outer end of the shaft, against a fixed collar 36 at the inner end of the roll, and it has inner and outer cylindrical bores of respectively larger and smaller diameters which fit against cylindrical portions 37, 38 turned on the shaft. The end joints may be sealed by suitable packings. Between the portions 37, 38 the shaft is formed with a taper 39 separated from the inner periphery of the sleeve 33 by a space 40 forming a chamber for the circulation of a fluid such as steam for heating the roll when cold, and cooling water for thereafter keeping down excessive temperatures created by the kneading action of the rolls upon the stock.

The inlet and outlet connections for the heating and cooling fluids are both made at the same end of the roll, in this case its outer end, 41 being a fixed inlet-pipe elbow to which is connected a pipe 42 extending axially into the shaft 28, and 43 being a fixed tubular outlet fitting having a stem 44 surrounding the pipe 42 and also extending axially into the shaft. Fitting 43 is packed on the pipe 42 by a stuffing-box 45 for which the elbow 41 acts as a gland. The running joint between the shaft 28 and the hollow stem 44 is packed by a stuffing-box 46 whose gland 47 is connected with the nut 34 by adjusting bolts 48, said bolts also serving to fasten to the outer face of the gland a pair of retaining plates 49 let into a groove in the stem 44 and forming a running fit therewith to retain the fluid connections against axial movement. The stem 44 fits in a longitudinal counter-bore 50 in the outer end of the shaft from which extend a pair of return passages 51 drilled laterally in the shaft. The inner end of pipe 42 screws into the outer end of a longitudinal passage 52 drilled in the shaft which connects with a lateral drilled passage 53 leading to the chamber 40. Thus the heating or cooling fluid, as the case may be, is passed in by way of fitting 41 and pipe 42, longitudinally and laterally through the shaft 28 to chamber 40, and returning in reverse longitudinal direction through said chamber passes out by way of the fitting 43.

In Fig. 3 I have shown the preferred construction of the profile roll device 18. Its shaft 54 carries a removable sleeve 33^a, in general similar to the sleeve 33 of Fig. 4 but of relatively smaller outer diameter; there is a fluid chamber 40^a between said sleeve and the taper of the shaft, and said chamber has supply, discharge and packing connections 41^a, 42^a, 43^a, 44^a, 45^a, 46^a, 47^a, 48^a, 49^a, 50^a, 51^a, 52^a and 53^a generally similar to those described for the roll structure 16, except that the entrance and exit of the fluids takes place at the inner end instead of the outer end of the shaft so as to leave the outer end free for removal of the roll shell without disturbing the fluid connections. Inner-end connections could also, if desired, be applied to the rolls 15, 16 and 17.

Sleeve 33^a has its outer periphery tapered slightly in the direction of the free end of the roll to act as a wedging surface coacting with the complementally-tapered inner periphery of a longitudinally split wedging sleeve 55, the latter having a cylindrical outer periphery. Sleeve 55 is longitudinally slotted at 56 and held from turning on sleeve 33^a by a stud 57 projecting from the latter and occupying the slot.

Surrounding and in close mechanical and thermal engagement with the wedging sleeve 55 is an outer tubular shell 58 whose exterior constitutes the working face of the roll 18 and is formed with the profile groove 22. An inner end ring 59 seated on the shaft 54 and an outer end ring 60 in sliding engagement with the reduced end of said shaft are provided for clamping the shell 55 between them, and said rings and shell are castellated on their ends or formed with shallow interfitting projections and grooves shown at 61 in Fig. 2 for holding the shell from rotation on the shaft. A wedging key 62 passing through

a slot 63 in the end of shaft 54 is provided for acting against the ring 60 to force the shell 58 tightly into place, and its pressure is also transmitted through a set of adjustable screws 64 on the ring, of which one is shown in Fig. 3, to a ring 65 slidable on the nut 34ª which retains the sleeve 33ª, and therethrough to the outer end of the split wedging sleeve 55.

When the wedge 62 is driven into place, it simultaneously forces the wedging sleeve 55 and the outer shell 58 in a right-hand direction as viewed in Fig. 3, causing said sleeve 55 to be expanded on the tapered surface of the sleeve 38 and firmly securing these parts together upon the shaft. In this way the shell 58 is accurately centered upon the shaft and securely locked in heat-conductive relation to the inner roll parts so that its temperature may be controlled by the heating or cooling fluids within the chamber 40ª. When it is desired to substitute for shell 58 one of a different profile, said shell may very readily be loosened on its supports by knocking out the wedge key 62, removing the ring 60 and backing off the shell by means of a suitable prying tool inserted at a notch 66 between said shell and the ring 59, after which the shell is slid off endwise. This change occupies but a very small time as compared with taking out and replacing an ordinary calender roll, and the cost of the shell is naturally very much less than that of a complete roll and trunnions of the ordinary type.

Three pairs of stock guides for confining the rubber compound to the desired working zone of the calender rolls are provided at the three places where the banks 19, 20 and 21 are shown in Fig. 6, the guides for the upper bank being indicated at 67, those for the middle bank at 68 and those for the lower bank at 69, each of said guides being horizontally adjustable on its supports to vary the width of the corresponding bank. The guides 68 are slidingly fixed upon a pair of supporting rods 70 at the back of the machine and the guides 67 and 68 are similarly supported on a pair of rods 71 at the front of the machine.

The four rods 70, 71 are mounted on the frame standard 13 and project outwardly therefrom parallel with the rolls. These rods are tied together at their outer ends both vertically and horizontally, just beyond the rolls, by yoke members 72, 73 seen in Figs. 1 and 2, which, together with the vertical bracing provided by the stem portions of the stock guides prevents any undue amount of springing of said rods even though supported only at their inner ends.

The stock guides 69 for the profiling pass, whose working portions are shown in side elevation in Fig. 1 and exposed in front elevation in Fig. 2 by partially breaking away the roll 18, are inwardly curved horizontally as they recede from the roll pass, to gather the stock toward the center and thus provide for the increased thickness of the middle of the tread strip. Their lower faces and back edges are formed in receding curves as shown, to avoid tearing them from their supports in case of undue pressure of the stock against said guides in an upward and forward direction.

From the foregoing, it will be apparent that I have provided a machine for calendering tire treads and other profiled or plain strips, having many advantages over the ordinary type of rubber calender. It will be understood that the invention may be embodied in various ways and is not wholly confined to the particular forms of construction here shown.

I claim:

1. In a calender, a rubber working roll structure comprising an overhanging shaft journaled at one side only of the working zone, an external roll body detachably mounted on said shaft and removable endwise therefrom, and means for rotating said shaft.

2. In a calender, a pair of roll-structures adapted to work a body of rubber between them, one of said structures including an overhanging shaft journaled at one side only of the working zone; and a profile shell detachably mounted on said shaft and removable endwise therefrom, said shell having a circumferential groove for imparting a predetermined cross-sectional shape to the rubber issuing from between the rolls.

3. In a calender, the combination of a set of overhanging roll-shafts journaled at one side only of the working zone, and roll-bodies detachably mounted on said shafts and removable endwise therefrom, the last roll-body of the set being profiled to impart a predetermined cross-sectional shape to the issuing strip.

4. In a calender, the combination of a roll shaft journaled at one side only of the working zone, a roll body detachably mounted on said shaft and removable endwise therefrom, and pipe connections at the inner end of said shaft for supplying a fluid medium to the interior of the roll and discharging it therefrom.

5. In a calender, the combination of a set of overhanging roll-structures the last one of which includes a shaft and a profiled roll body detachably connected therewith, fluid inlet and outlet connections at the inner end of said shaft, and fluid inlet and outlet connections at the outer ends of the other roll structures.

6. In a calender, the combination of an overhanging rotary shaft formed with concentric inlet and outlet fluid passages at one end and with extensions of said passages opening at longitudinally separated points on the periphery of the shaft, and a sleeve detachably mounted on said shaft and form-

ing therewith a chamber through which fluid is longitudinally circulated between said shaft openings.

7. In a calender, the combination of an overhanging rotary shaft, a roll-body sleeve detachably mounted on said shaft and forming therewith a fluid chamber, stationary inlet and outlet fluid connections at one end of said shaft, and passages within the shaft for carrying fluid therethrough to the remote end of said chamber and returning it through the shaft from the opposite or near end of the chamber.

8. In a calender, the combination of an overhanging rotary shaft, an external body shell detachably mounted thereon, and a longitudinally-split sleeve within said shell for wedging and centering the shell in place.

9. In a calender, the combination of an overhanging shaft, a sleeve forming a chamber with said shaft, means for supplying a temperature-regulating fluid to said chamber, an external body shell, and means for detachably wedging said shell on said sleeve.

10. In a calender, the combination of an overhanging shaft, an inner roll body thereon having a tapered, wedging outer surface, a longitudinally-split wedging sleeve having a complementally-tapered inner surface in contact with the outer surface of said roll body and having a cylindrical outer surface, and an exterior body shell with a cylindrical inner surface, mounted on and secured by said wedging sleeve.

11. In a calender, the combination of an overhanging shaft having an inner roll body, an exterior shell, a wedging device interposed between said inner body and shell, and means at the outer end of said shaft for simultaneously forcing said shell and wedging device inwardly to secure them on said inner roll body.

12. In a calender, the combination of an overhanging shaft, an inner body sleeve, means for detachably securing said body sleeve on the shaft, means for supplying a temperature regulating fluid to the interior of said sleeve, an exterior body shell, and means for detachably wedging said shell on the sleeve.

13. In a calender, the combination of an overhanging shaft having a shell support, an exterior body shell having a wedge mounting on said support and removable endwise therefrom, and a wedging key transversely mounted on the outer end of the shaft for forcing the shell into wedged-on relation to said support.

14. In a calender, the combination of an overhanging shaft having a shell support, an exterior body shell, a longitudinally-split wedging sleeve interposed between said shell and support, a sliding abutment for forcing said shell and sleeve inwardly over said support to secure them on the shaft, and longitudinal adjusting means between said abutment and sleeve.

15. In a calender, the combination of an overhanging shaft having a shell support, a pair of longitudinally-spaced abutments thereon, and an endwise-removable body shell mounted on the support between said abutments, the shell and abutments having endwise-interfitting parts to prevent their relative rotation.

In witness whereof I have hereunto set my hand this 19th day of September, A. D. 1928.

PARK E. WELTON.