CONSTANT TEMPERATURE MILL

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ABSTRACT OF THE DISCLOSURE

Mill apparatus for supplying uniform amounts of constant temperature stock by automatically increasing or decreasing the speed of mixing action of the mill apparatus inversely to indicated temperature changes in the mixed stock. As the speed of the mixing action increases or decreases, the amount of stock fed from the mill apparatus automatically increases or decreases inversely with respect thereto to maintain a constant volume of stock continuously being fed from the mixing apparatus.

This invention relates to mixing or warm-up mills for rubber and other plastics, and is particularly concerned with a mill which continuously supplies ribbons of the plastic at a constant temperature to a calender or other apparatus.

It is the general object of the present invention to provide apparatus of the designated character which automatically and efficiently performs to supply plastic stock in ribbon form and at a selected constant temperature to a calender or the like.

In the drawings,
Fig. 1 is a diagrammatic view, mostly in perspective, of a mill incorporating the invention;

Fig. 2 is an enlarged fragmentary plan view of the mechanism for controlling the position of the knives cutting the ribbons of stock from the mill; and

Fig. 3 is a schematic wiring diagram of the apparatus of the invention.

In the drawings, the numerals 10 and 12 indicate a pair of cooperating rolls of a conventional rubber or plastic mill turning in the direction indicated by the arrows and operating upon a bank 14 of rubber or plastic, hereinafter called stock. The rolls 10 and 12 are driven by variable speed motor 16 operating through a gear reducer 18 to drive a shaft 20 connected typically to roll 10. The shaft 20 carries gear 22 which engages with gear 24 carried on shaft 26 of roll 12.

Rolls 10 and 12 are appropriately chambered or made for the circulation of cooling liquid therethrough, the liquid being circulated from an input 28 by pump 30 driven by a motor 32 through appropriate conduits 34 to outlets 36, all in known manner.

The stock worked on the mill is formed into a sheet between the rolls which sheet passes continuously around roll 12 in the normal mixing operation. One or more pairs of knives 38 are mounted in front of the roll 12 and act to cut ribbons 40 of stock from the sheet thereof on roll 12, these ribbons 40 of stock passing one around or more guide rolls 42 and being fed continuously to the stock banks on a calender, for example, the calender operating continuously.

In order to obtain uniform calendering operating conditions, the ribbons 40 of stock fed to the calender should be maintained at a selected temperature. To this end, a temperature sensing device, such as an infrared pyrometer 44, is mounted closely adjacent the surface of the sheet of stock carried on roll 12, and this pyrometer transmits an electric voltage indication of temperature by way of lead 46 to a control box 48 which controls the operating voltage passed to motor 16 on lead 50 from the electrical input 52. In this manner, as the temperature of the stock on roll 12 increases for any reason, the driving motor 16 for the rolls slows down to maintain the temperature of the stock at the selected point. Alternatively, the pyrometer 44 sense a drop in the selected temperature of the stock on roll 12, a speed-up of the motor 16 is effected to bring the temperature of the stock on the roll back to the selected temperature.

In the apparatus of the invention, it is necessary to provide mechanism for supplying substantially a constant amount of stock to the continuously running calender regardless of the speeding up or slowing down of the mixing mill, as just described, to maintain the stock temperature constant. The volume of the supply of stock passed to the calender is maintained constant by increasing or decreasing the width of the stock ribbons 40. This is achieved, as seen in Figs. 1 and 2, by mounting each knife 38 on a block 54 slidably received upon a shaft 56 fixed in front of the roll 12, this shaft not being shown in Fig. 1. Each block 54 also provides a nut received upon a threaded shaft 58 likewise mounted in front of roll 12 and shown in Fig. 1. The threaded shaft 58 is formed with a right-hand thread in cooperation with one block 54 and with a left-hand thread in cooperation with the other block 54 of each pair of knives 38 so that rotation of threaded shaft 58 will move the knives 38 of each pair toward or from each other to increase or decrease the width of the stock ribbon 40 cut by each pair of knives. The threaded shaft 58 carries a gear 60 engaging with a gear or worm 62 mounted on shaft 64 driven by motor 66 which is in turn connected to control box 48. The operation of the motor 66 is such that if the speed of the rolls 10 and 12 is slowed down, the width of each stock ribbon 40 is increased, or if the roll speed is increased the width of the stock ribbon 40 is reduced. In this manner, the same volume of stock is passed in ribbon form to the calender.

Turning to Fig. 3, the control box 48 of Fig. 1 normally includes an amplifier 70, a servo 72, a voltage control 74, such as a rheostat, a following-reverser 76, and a temperature control 78, this last having a temperature selector knob 80. In the operation of the control circuit of Fig. 3, selection knob 80 of temperature control 78 is turned to the temperature desired, and this positions servo 72 to adjust the position of voltage control 74 so that the voltage passed from electric input 52 to the mill motor 16 causes the mill rolls 10 and 12 be driven at a speed which normally provides the selected temperature in the stock on the surface of roll 12. Fig. 3 illustrates that motor 32 for circulating pump 30 is driven to effect a constant circulation of cooling liquid through the mill rolls at all times. The pyrometer 44 measures the actual temperature of the stock on the mill roll 12 and passes an electrical indication thereof to amplifier 70 which amplifies this signal sufficient to effect repositioning of the servo 72 if the signal received from the amplifier does not agree with the setting of temperature control 78. If the signal from the pyrometer 44 moves up or down, the servo 72 acts to reposition the voltage control 74 changing the voltage supply to the mill motor 16 and increases or decreases the mill roll speed to bring the stock on the mill roll to the selected temperature. The servo 72 also acts through a connection 82 to move the following-reverser 76 forward or back as the speed of the mill motor 16 is changed, the following-reverser being connected to the electric input 52 by a lead 84 and passing electric current to the knife motor 66 to drive this motor either forward to increase a selected amount to increase or decrease the width of the stock ribbon 40 to maintain a constant volume of
stock in the ribbon or ribbons 40 to the calender regardless of the speedup or slowing down of the mill rolls. The operation of the following-reverser 76 is known per se and is simply one involving the repositioning of electric contacts via connection 82 from the servo 72 so that the motor 66 is driven forward or back a time interval sufficient to reposition the knives 38 in an amount to keep the flow of stock constant.

The mixing mill of the present invention works either on a batch of stock 14, or the mill is itself supplied with a continuous inflow of initially mixed stock. When working with a batch of stock, this will be initially mixed in a thorough manner on the mill before the stripping knives 38, said control 48, etc., are operated. Then a second mixing mill in accord with the invention positioned beside the first is worked alternately with the first to provide an alternate, but continuous flow of stock to the calender. When the mixing mill of the invention works continuously on the stock 14, rather than on the basis of the batch method described, then stock previously mixed on an adjacent mill is continuously fed to the mixing mill of the invention. What is claimed is:

1. In combination, in apparatus for supplying plastic stock to a calender, or the like, a pair of cooperating mill rolls adapted to receive stock between said rolls wherein the stock worked on by the rolls forms a sheet between the rolls which sheet passes continuously around one of the rolls, motor means driving said rolls, cooling means for circulating liquid through said rolls, temperature sensing means mounted adjacent to the surface of the roll which carries the sheet of stock, said temperature sensing means producing an electric voltage, a control means which receives the electric voltage from said temperature sensing means which varies the operating voltage passed to said motor means driving said rolls and alternately decreases the speed of said mill rolls when the temperature of the sheet rises past a predetermined point, or increases the speed of said mill rolls when the temperature of the sheet drops past a predetermined point, a pair of knives mounted in front of said rolls which act to cut a width of ribbon from the sheet passing around one of the rolls, said ribbon being adapted to be continuously fed to the calender, and means to automatically adjust the pair of knives cutting the ribbon from said sheet whereby the width of the ribbon is increased as the speed of the mill rolls is decreased and the width of the ribbon is decreased as the speed of the mill rolls is increased, thereby maintaining the same volume of stock passed in ribbon form passing from the rolls irrespective of the speed of said rolls.

2. Apparatus for continuously supplying a uniform amount of plastic stock at a constant temperature including a pair of cooperating mill rolls for mixing the stock, motor means driving said rolls whereby a sheet of stock passes continuously around one of the rolls, means for measuring the temperature of the sheet of stock, means responsive to the temperature measuring means for increasing or decreasing the voltage passed to said motor means to increase or decrease the mixing action on the stock in a direction inversely with respect to temperature changes indicated in the sheet of stock, a pair of knives mounted adjacent to the sheet of stock, said knives being adapted to cut a portion of stock from the sheet, and adjustable mounting means for the pair of knives responsive to the temperature measuring means to cause the space between the knives to increase or decrease inversely with respect to the means increasing or decreasing the voltage passed to said motor means.

3. The combination defined in claim 2 wherein the means responsive to the temperature measuring means for increasing or decreasing the mixing action on the stock are an amplifier which receives the electric voltage produced by the temperature sensing means, and a servo connected to the amplifier which adjusts the position of a voltage control wherein the voltage passed to a variable speed mill motor drives the mill motor at an increased or decreased rate inversely with respect to temperature changes in the stock.

4. In combination, a pair of cooperating mill rolls adapted to receive plastic stock, motor means driving said rolls and adapted to form a sheet of stock passing continuously around one of the rolls, and means for measuring the temperature of the sheet of stock, means responsive to the temperature measuring means controlling the speed of said motor means to increase or decrease the speed of said motor means and the drive of said rolls inversely with respect to temperature changes of the sheet of stock, means positioned adjacent the sheet of stock for continuously cutting a ribbon of stock from the sheet, and means responsive to the temperature measuring means controlling the width of ribbon cut from said sheet by said ribbon cutting means, said means causing the width of ribbon cut from the sheet of stock to increase or decrease inversely with respect to changes in the drive speed of said rolls, whereby the same volume of stock is cut in ribbon form from the sheet of stock irrespective of the drive speed of said rolls.

5. Apparatus for continuously supplying a uniform amount of plastic stock at a constant temperature including a pair of cooperating mill rolls for mixing the stock, motor means driving said rolls whereby a sheet of stock passes continuously around one of the rolls, means for measuring the temperature of the sheet of stock, means responsive to the temperature measuring means for increasing or decreasing the voltage passed to said motor means to increase or decrease the mixing action on the stock inversely with respect to temperature changes indicated in the sheet of stock, knife means operatively associated to the mill for continuously removing a portion of stock from the mixed stock, and control means operatively connected to the knife means to control its position for maintaining constant the volume of the removed portion passing a given point in a given time.

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