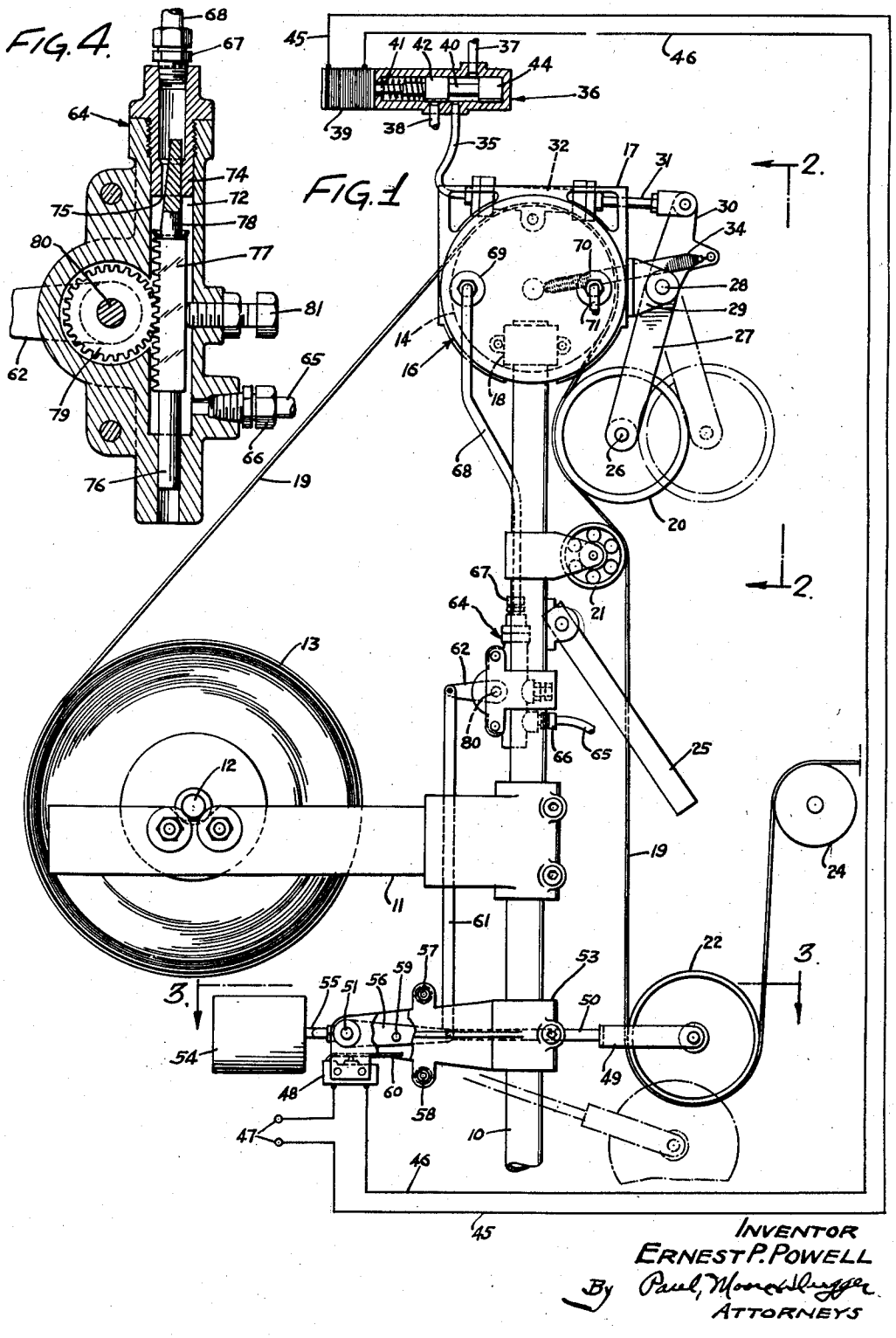
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DECURLING APPARATUS

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DECURLING APPARATUS

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FIG. 2.

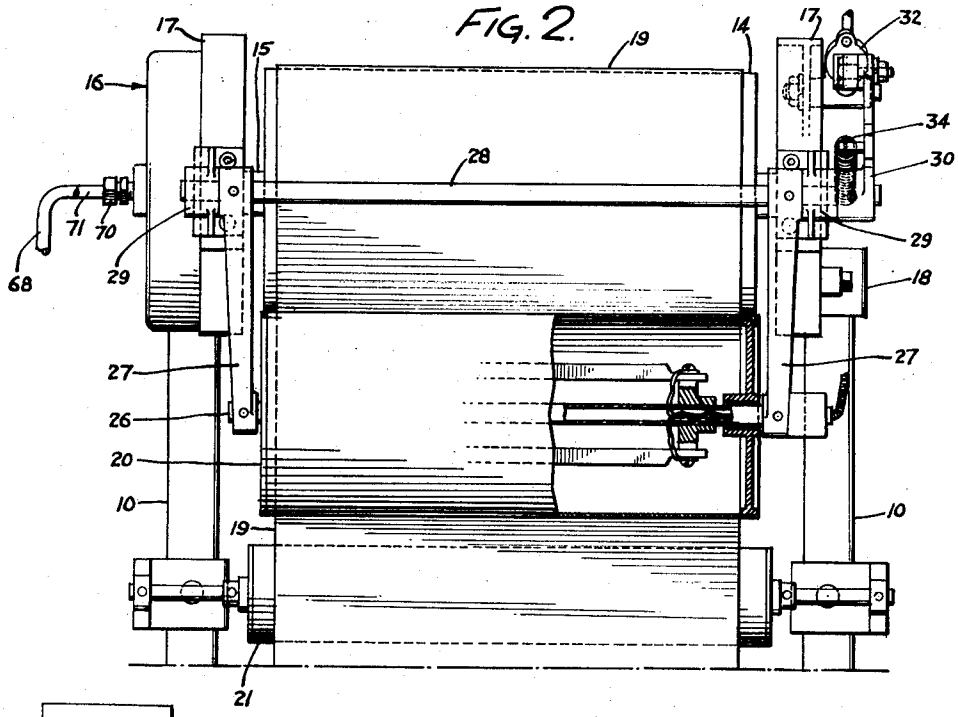
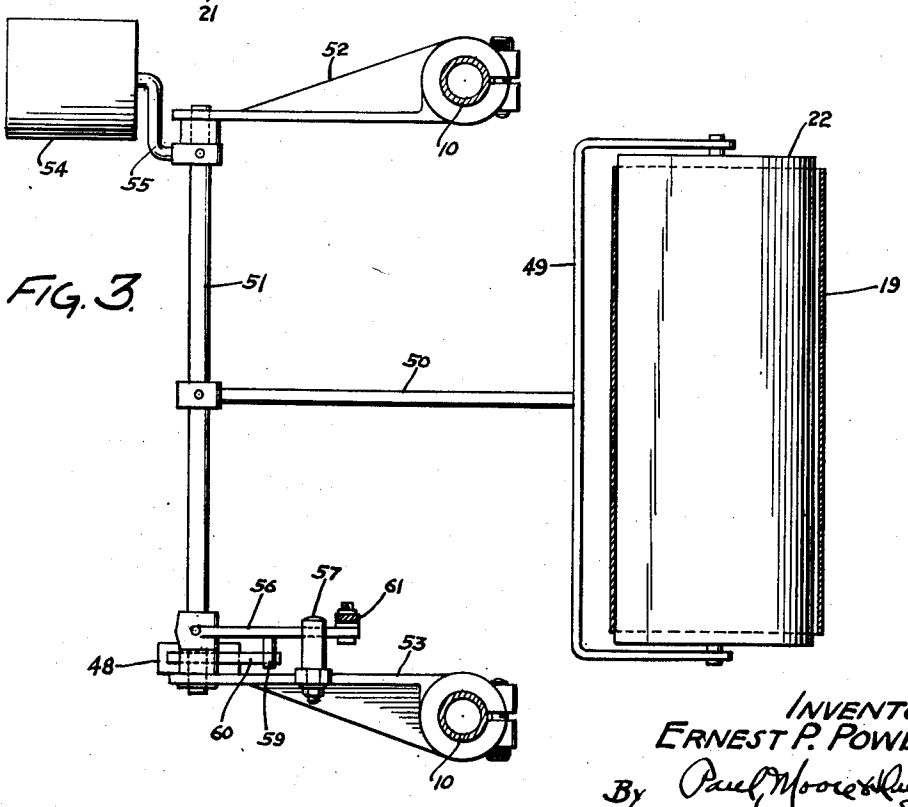


FIG. 3.



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DECURLING APPARATUS

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Application June 29, 1955, Serial No. 518,761

3 Claims. (Cl. 18—1)

This invention relates to a mechanism for decurling and leveling strip material such as plastic films, paper, cardboard, etc. More particularly this invention relates to apparatus for decurling and leveling thermoplastic strip material prior to feeding it to a box making machine.

The principal object of this invention is to provide apparatus for handling strip material from a supply roll for feeding the strip for further treatment in flat condition free from curls and surface irregularities.

Other objects of the invention will become apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated by the drawings in which the same numerals refer to corresponding parts and in which:

Figure 1 is a side elevation of the decurler mechanism of this invention;

Figure 2 is a fragmentary end elevation of the apparatus taken on the line 2—2 of Figure 1 and in the direction of the arrows;

Figure 3 is a transverse plan view, of the lower part of the apparatus, partly in section, taken on the line 3—3 of Figure 1 and in the direction of the arrows, showing the "floating" roll and associated parts; and

Figure 4 is an enlarged detail elevation, in section, of the metering valve.

Referring to the drawings, the apparatus for decurling strip material comprises a base (not shown) from the front end of which rises a pair of perpendicular laterally spaced posts or columns 10, preferably tubular in form. Connected to and supported by columns 10 are a pair of parallel horizontal supports 11 on which a shaft 12 for carrying a supply roll 13 of strip material is suitably mounted for rotary movement.

When the subsequent treating steps are those involved in making boxes from plastic, the strip material (from which the curl is to be removed to be delivered flat for further treatment) is a thermoplastic resinous substance such as cellulose acetate, plasticized vinyl chloride polymers, vinyl chloride-vinyl acetate copolymers and the like which are readily deformed by the application of heat and preferably are self-welding.

Although this apparatus is especially adapted for removing curls from thermoplastic sheet material, it is to be understood that it is likewise adapted for treating other strip materials, such as paper and cardboard, particularly resin coated or treated paper and cardboard, before they are subjected to further treatment, such as printing, blanking for making boxes and like operations, to remove any curls and surface irregularities and undulations. Although the apparatus is described with particular reference to decurling of thermoplastic sheet material, it will be understood not to be so limited.

A drive roll 14 carried on a shaft 15 is mounted on and supported by columns 10 at their upper ends. One end of shaft 15 is provided with a pinion (not shown) driven by a standard pneumatic motor 16. Motor 16 is mounted on a frame member 17 supported by bracket 18 at the top of one of columns 10. The opposite end of shaft 15 is journalled in a corresponding frame member 17 supported by a similar bracket 18 at the top of the other column.

The strip 19 of thermoplastic sheet material is drawn from supply roll 13 over drive roll 14 and thence downwardly over a pivotally mounted heated roll 20, over a fixed guide and cooling roll 21, around, a "floating" tension roll 22 and upwardly around a guide roll 24 to be fed to the treating apparatus. Arranged between the guide roll 21 and the "floating" roll 22 is a pair of laterally spaced guide fingers 25 carried by columns 10. These guide fingers engage the opposite edge portions of the strip 19 as the latter advances and may be curved to trough or cause the edge portions of the strip to be given a reverse curl, lengthwise of the sheet, for the purpose of assisting in straightening out the continuous sheet to obtain a strip which is as flat and free from undulations as possible.

Drive roll 14 is preferably provided with a cloth cover, such as felt, to improve traction with the strip 19 while at the same time providing a relatively soft surface over which the strip may pass freely without becoming scratched. Guide roll 21 acts to cool the strip as it passes from the heated roll. If necessary artificial cooling may be used, such as circulating brine, but in most instances it is sufficient merely to allow free circulation of air by providing openings in the ends of the roll.

Heated roll 20 is mounted on and rotates about a shaft 26 fixedly carried at its opposite ends by arms 27 which in turn are keyed to shaft 28 which is journalled for rotation in brackets 29 which are mounted on and supported by frame members 17. At one end of shaft 28 which extends beyond one of brackets 29 there is keyed a crank arm 30 extending generally upward as an extention of arms 27. The upper end of crank arm 30 is pivotally connected to the piston rod 31 of an air cylinder 32 pivotally mounted on one of frame members 17.

A coil spring 34, one end of which is mounted on crank arm 30 and the other end of which is fixed to one of frame members 17 adjacent the axis of drive roll 14, tensions crank arm 30 toward roll 14 and accordingly urges heated roll 20 and its accessory mounting away from the drive roll and the path of travel of the strip 19, as shown in broken lines in Figure 1. As will be explained hereafter, this prevents reverse curling due to overheating of the strip. Heated roll 20 is provided with a plurality of resistance heating elements connected to a suitable source of electrical energy by means of conductors passing through fixed shaft 26 and suitably insulated from the roll and shaft.

The air inlet end of cylinder 32 is connected by means of tube 35 to a solenoid operated valve 36. Valve 36 is provided with an air inlet 37 and an air outlet 38. When the solenoid 39 is not energized, the plunger 40 of the valve is urged forward by coil spring 41. Piston 42 is pushed free of the air inlet 37 but piston 44 shuts off the air outlet 38. In this position air from any suitable source of compressed air is free to pass through inlet 37, through the valve and tube 35 to cylinder 32 where it pushes piston rod 31 and crank arm 30 forward, acting against spring 34 and pivoting arms 27 and heated roll 20 backward toward drive roll 14, as shown in solid lines in Figure 1.

Solenoid 39 is connected by means of conductors 45 and 46 to a source of electrical energy 47 through a switch 48 actuated by "floating" roll 22 as will be explained in detail hereafter.

The "floating" tension roll 22 is carried in a yoke 49 which in turn is carried by a rigid arm 50 keyed to a rotatable shaft 51 journalled in brackets 52 and 53 mounted on column 10. A counterweight 54 for the "floating" tension roll 22 is carried on an arm 55 keyed to shaft 51.

A crank arm 56 is keyed to shaft 51 at one end thereof extending substantially parallel to yoke arm 50. Upper and lower stops 57 and 58 are provided on bracket 53 for limiting the movement of crank arm 56 and, accordingly, of the tension roll 22. Crank arm 56 has a projecting lug 59 which displaces spring arm 60 when the tension roll is lowered, thereby actuating switch 48 and energizing the solenoid 39, bleeding air from cylinder 32 and permitting spring 34 to retract heated roll 20 away from the path of moving strip 19.

Pivotally connected to the end of crank arm 56 is a link 61 in turn pivotally connected at its opposite end to an operating arm 62 which is part of a metering valve 64 which will now be described in detail with particular reference to Figure 4.

Metering valve 64 controls the supply of air to pneumatic engine 16. This air engine is of a type well known in the art and since the particular construction forms no part of this invention, it will not be described further except to state that it is provided with air under pressure from any suitable source through a tube 65 to air inlet 66 of the metering valve, through the valve to outlet 67 and thence through tube 68 to motor air inlet 69 and finally the air is discharged through outlet 70 to tube 71.

Metering valve 64 comprises a housing having a generally cylindrical passage 72 extending vertically therethrough. At its upper end there is a valve seat member 74 having a valve seat 75 and its lower end is narrowed to receive a guide member 76 with a sliding seal fit. Positioned within passage 72 is a rack 77 carrying a tapered valving member 78 at one end and guide 76 at the other. Meshing with the teeth of rack 77 is a pinion 79 rotatably mounted in a cavity in the valve housing keyed to a shaft 80 journalled therein, one end of which extends through the valve housing. Operating arm 62 is keyed to shaft 80, outside of the valve housing. Rack 77 is held against pinion 79 by a screw 81, but without restricting movement of the rack.

When "floating" tension roll 22 is lowered because it is released from the strip 19, due for example, to breakage of the strip or reaching the end of the supply roll, or any other reason, the switch 48 acts to energize the solenoid and disengage heated roll 20 in the manner heretofore described. At the same time, crank arm 56 moving downwardly with the tension roll assembly exerts a pull on link 61 which in turn lowers operating arm 62. Because operating arm 62 is keyed to the same shaft as pinion 79, the pinion is rotated and rack 77 is raised, pushing tapered valving member 78 against the valve seat and shutting off the supply of air to the air motor.

Because the decurler apparatus of this invention is especially adapted for use with a box making machine of the type described in a copending United States application Serial No. 265,734, filed January 10, 1952, by Luther Earl Sevison and other similar treating apparatus which imparts an intermittent step-by-step movement to the strip 19, it is necessary that air motor 16 operate at different rates of speed. It will be apparent from the description of the operation of the metering valve that the operation of the air motor is controlled by the movement of the "floating" tension roll 22.

When a pull is exerted on the strip 19 by the mechanism in advance of the guide roll 24, the tension roll 22 is caused to swing upwardly. This movement raises

crank arm 56, link 61, arm 62 and lowers rack 77 withdrawing tapered valving member 78 somewhat from the valve seat and permitting greater flow of air to the air motor. A slowdown in the treating mechanism in advance of the decurler causes tension roll 22 to lower somewhat and in turn decreases the supply of air to the motor.

Instead of the air motor illustrated and described, it will be apparent that a variable speed electric motor or similar variable speed drive could be used. Metering valve 64 would then be adapted to control the flow of electrical energy instead of air. For this purpose, a rheostat operated by arm 62 in response to movement of the tension roll would be substituted as the metering valve.

In the operation of the decurling device of this invention, the strip 19 is threaded from supply roll 13 over drive roll 14, in a reverse bend around heated roll 20, reversed again around cooling guide roll 21, around tension roll 22, up and around guide roll 24 and thence to the feeding mechanism of the boxmaking or other treating apparatus. The strip is pulled by the feeding device of the subsequent treating machine as well as being driven by drive roll 14.

The thermoplastic sheet is rendered somewhat pliable as it passes in contact with heated roll 20 while in a reverse bend from its position on the supply roll. While thus pliable, the strip as it leaves the heated roll is directly given another reverse bend and cooled as it passes over guide roll 20. This combination of treatment acts to restore the strip to its original substantially flat condition free of curls. A tendency of some materials to curl at their edges may be overcome by passing the strip between guides 25 curved and placed together closer than the width of the strip, to trough it slightly, thereby eliminating curling difficulties lengthwise of the sheet.

During normal operation the solenoid 39 is de-energized and the pistons of valve 36 are positioned to permit free passage of air from a source of air under pressure to inlet 37, through valve 36 and tube 35 to cylinder 32. The piston of the air cylinder pushing against crank arm 30 pushes and maintains the heater roll 20 and its accessory assembly pivoted on shaft 28 against the moving strip 19.

The "floating" tension roll 22 and its accessory assembly are maintained substantially level during normal operation by moving strip 19 and counterweight 54. In this position switch 48 is kept open and metering valve 64 is set so as to provide the requisite amount of air to the air motor 16 to drive it at the desired speed.

In the event of a speed-up in the treating mechanism in advance of the decurler the resulting pull on strip 19 raises tension roll 22 and, as heretofore explained, feeds more air to the air motor increasing the rate of speed of the drive roll 14. In the event of a slowdown tension roll 22 drops somewhat and causes the metering valve to reduce the flow of air to the air motor diminishing its speed.

If the slowdown is of a more serious nature, such as a stoppage in movement of the strip or a break in the strip or the end of a supply roll, then the tension roll drops down against lower stop 58 and in so doing causes lug 59 on crank arm 56 to depress spring arm 60 closing switch 48 and energizing solenoid 39. As described above, this causes the plunger of valve 36 to move shutting off the air supply to cylinder 32 and bleeding air out of the cylinder. This causes the heated roll to retract, avoiding damage to the strip due to over heating, or if the strip is broken or the supply roll is exhausted, it facilitates rethreading of the strip. At the same time, the tension roll in this lower position shuts off the supply of air to the air motor stopping the drive roll.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made

without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only and the invention is limited only by the terms of the appended claims.

I claim:

1. A decurling device for continuously treating the surface area of a continuous length of thermoplastic sheet material comprising means adapted to hold a source of supply of sheet material, a pivotally mounted rotary heater, a drive roll for advancing said sheet material past the rotary heater, a variable speed motor for driving said drive roll, guide means for changing the direction of movement of said sheet material in advance of the rotary heater, a counterweighted pivotally mounted tension roller responsive to changes in tension of said sheet material in advance of said guide means, control means for varying the supply of energy to said motor to vary the speed thereof, said control means being operatively connected to and responsive to changes in position of said tension roll, an air cylinder operatively connected to said pivotally mounted rotary heater to move the same toward and away from the path of travel of the sheet material, said rotary heater being moved out of contact with the sheet material in the event of breaking the continuity of the sheet, a solenoid actuated valve for controlling the supply of air to said cylinder and a switch for controlling flow of electricity for energizing said solenoid, said switch means being responsive to movement of said tension roller.

2. A decurling device according to claim 1 further characterized in that said valve for controlling the supply of air to said motor comprises a generally cylindrical passage, an air inlet at one end of said passage and an air outlet at the other end thereof, a valve seat adjacent the outlet end of the passage, a rack within the passage, a tapered elongated valving member carried at one end of said rack adapted to seat in said valve seat, a pinion engaging the teeth of said rack, said pinion being operatively connected to and rotatable in response to changes in position of said tension roller.

3. A decurling device for continuously treating the surface area of the length of sheet material without applying lateral tensile stress thereto comprising means adapted to hold a source of supply of sheet material, a heating element, drive means for advancing said sheet material past the heating element, said drive means including a drive roll, a pneumatic motor for driving the roll, and valve means for controlling the air supply to said motor, guide means ahead of the heating element for changing the direction of movement of sheet material, a pivotally mounted tension roller ahead of said guide means, control means responsive to the movement of said tension roller for varying the speed of said drive means and for retracting the heating element from the path of travel of the sheet material in the event of breaking the continuity of the sheet, said valve means being responsive to changes in position of said tension roller, and said valve means including a generally cylindrical passage, and air inlet at one end of said passage and an air outlet at the other end thereof, a valve seat adjacent the outlet end of the passage, a rack within the passage, a tapered elongated valving member carried at one end of said drive in cooperation with said valve seat, a pinion engaging the teeth of said latch, said pinion being operatively connected to and rotatable in response to changes in position of said tension roller.

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