March 3, 1964 R. J. NADHERNY 3,122,791

CURLING MACHINE FOR PLASTIC BINDING ELEMENTS

Filed March 27, 1961 4 Sheets-Sheet 1

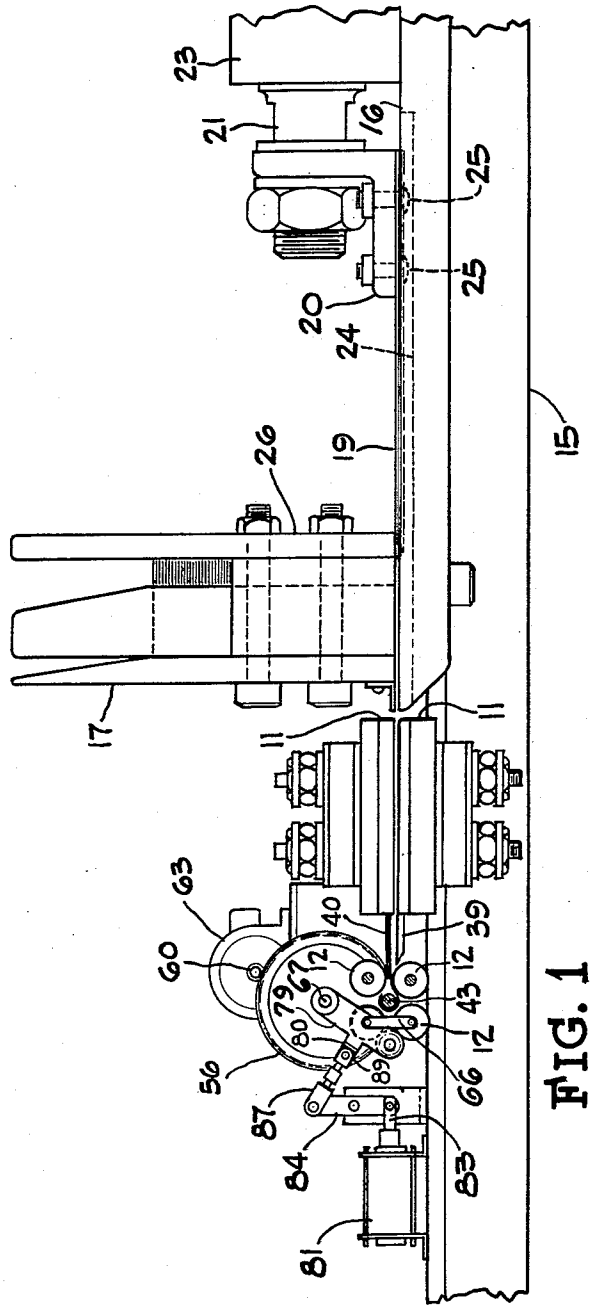


FIG. 1

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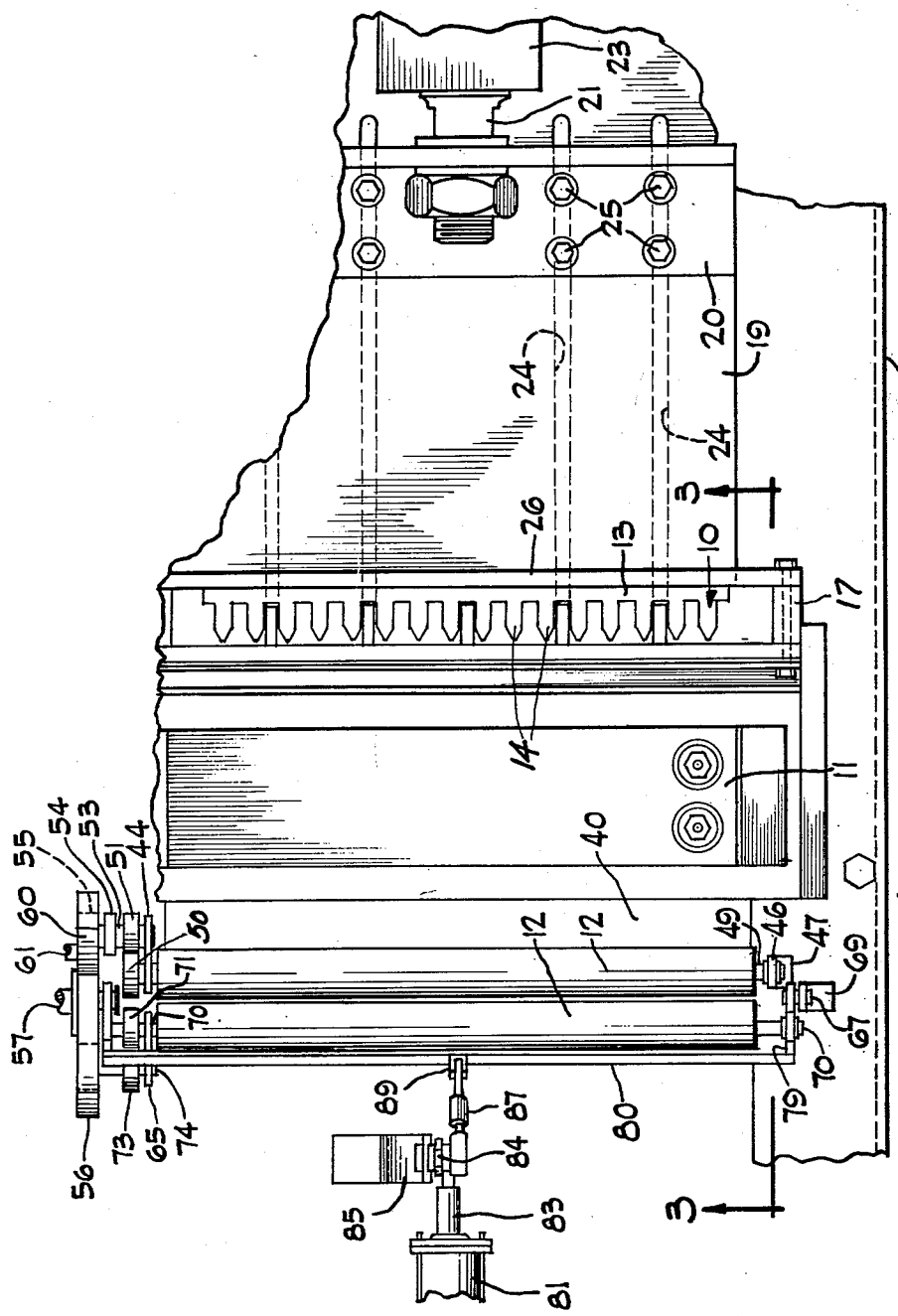


FIG. 2

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CURLING MACHINE FOR PLASTIC BINDING ELEMENTS

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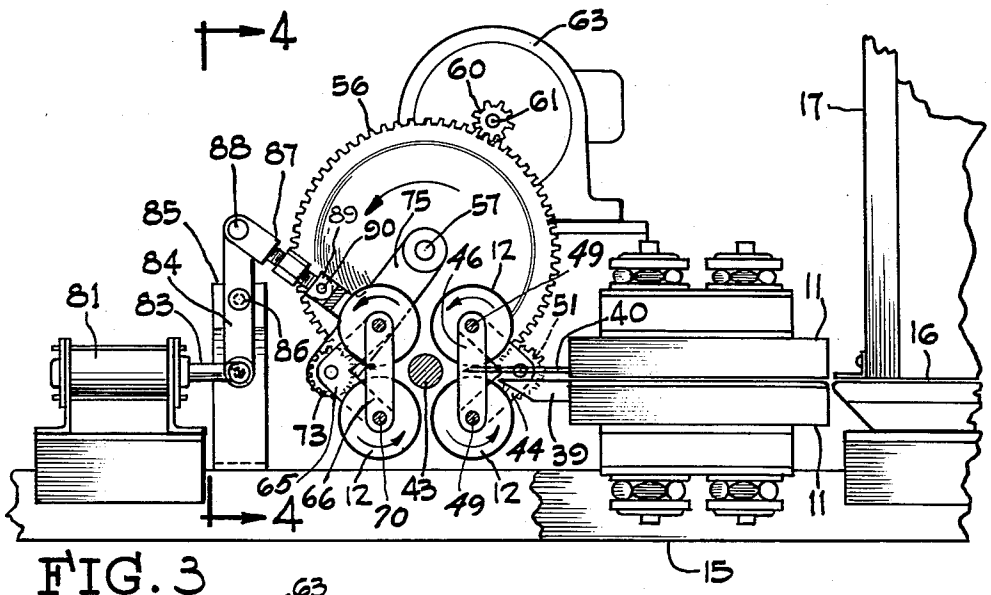


FIG. 3

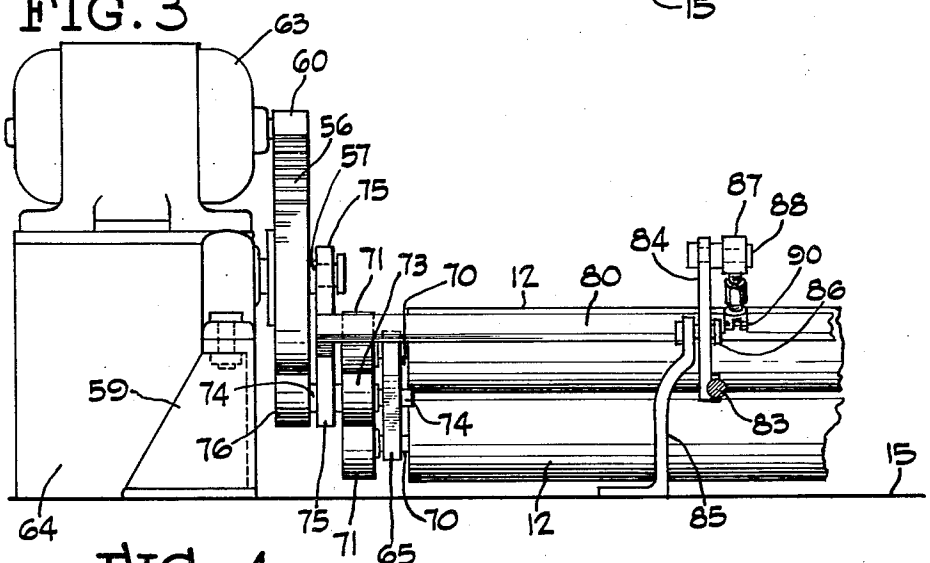


FIG. 4

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CURLING MACHINE FOR PLASTIC BINDING ELEMENTS

Filed March 27, 1961 4 Sheets-Sheet 4

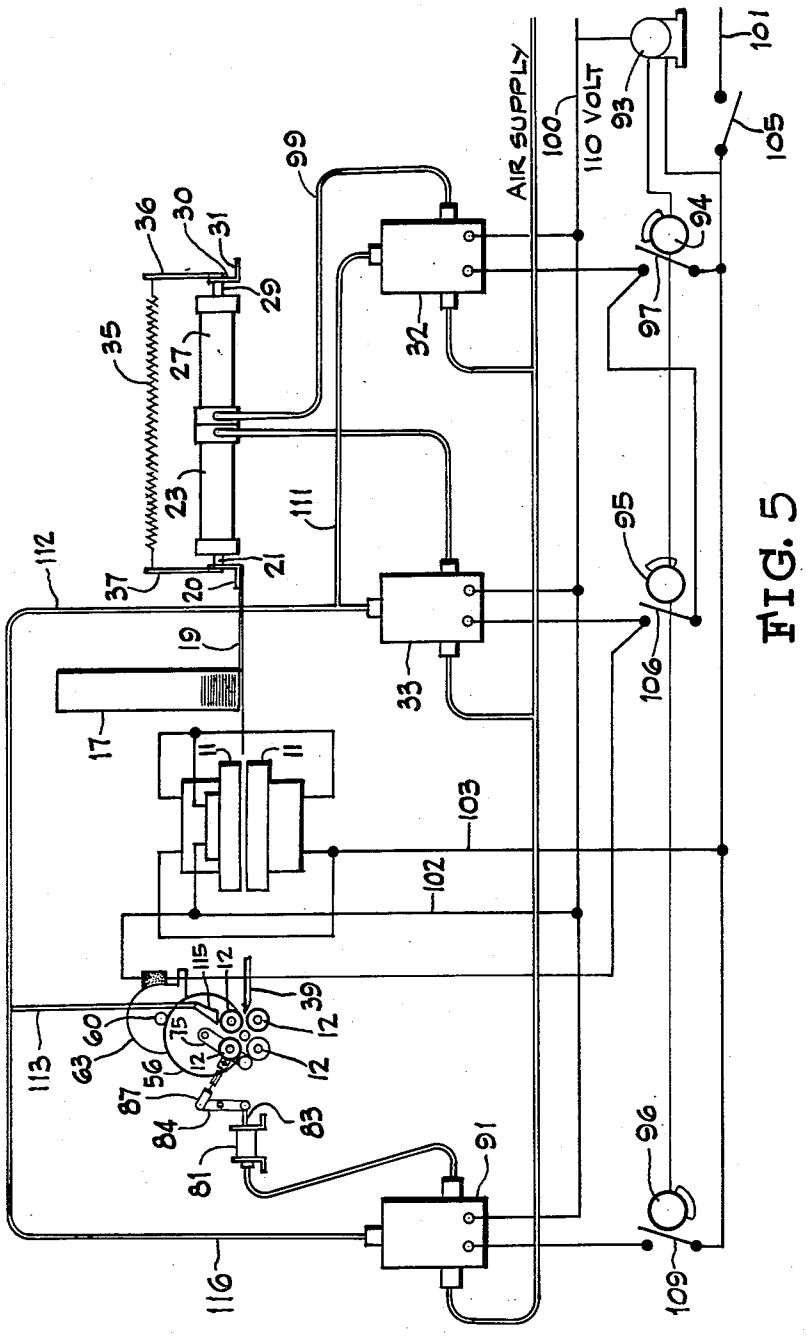


FIG. 5

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United States Patent Office 3,122,791 Patented Mar. 3, 1964

3,122,791

CURLING MACHINE FOR PLASTIC BINDING ELEMENTS

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Filed Mar. 27, 1961, Ser. No. 98,678
4 Claims. (Cl. 18—19)

This invention relates to an improved form of apparatus for forming comb-like plastic blanks in the forms of ring-like binding elements for binding books and the like.

A principal object of the invention is to provide an improved form of curling apparatus for curling comb-like plastic blanks into the form of ring-like binding elements in a simpler and more expeditious manner than formerly.

Another object of the invention is to improve upon prior curling apparatus for curling comb-like plastic blanks into ring-like binding elements by automatically feeding a succession of plastic blanks for heating and then continuing feeding movement of the plastic blank to a continuously rolling curling die, curling the softened heated blanks and then cooling and hardening the blanks prior to removal thereof from the apparatus.

Still another object of the invention is to provide an automatic curling apparatus for curling comb-like plastic blanks into ring-like binding elements for binding books and the like, in which the curling die comprises a series of radially spaced curling rolls rotating in the same direction of rotation, to form a plastic blank fed into the space between said rolls into binding elements of ring-like form.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a fragmentary view in side elevation of an illustrative form of curling apparatus constructed in accordance with the invention, with certain parts shown in section;

FIGURE 2 is a partial fragmentary plan view of the apparatus shown in FIGURE 1, with certain parts broken away;

FIGURE 3 is an enlarged partial sectional view looking along line III—III of FIGURE 1 and illustrating certain details of the invention not shown in FIGURE 1;

FIGURE 4 is a fragmentary sectional view of the apparatus looking along line IV—IV of FIGURE 3 and illustrating the drive to the curling rolls; and

FIGURE 5 is an electrical and fluid diagram illustrating the sequence of automatic control of the apparatus of the invention.

In the embodiment of the invention illustrated in the drawings, I have shown in FIGURE 2 a portion of a comb-like blank 10 in the process of being advanced into the space between two vertically spaced heating blocks 11 to a curling die in the form of a series of spaced curling rolls 12, 12, curling the blank in the form of an elongated ring-like plastic binding element.

The blank 10 is of a well known form and has a backbone 13 from which extends a plurality of parallel spaced relatively long fingers 14, curled by rotational movement of the curling rolls 12 in the same direction, as will hereinafter more clearly appear as this specification proceeds.

The blank 10 may be made from a sheet of thermoplastic material, such as the vinyl chlorides or vinyl acetates, known to the trade as "Vinylite," or the cellulose acetates, butyrates and ethyl-cellulose. It may also be made from various other vinyl resins and from nylon compounds, as well as any other suitable material desired.

The illustrative form of curling apparatus shown herein, includes a base 15 having a table or top plate 16 having a magazine 17 for a stack of blanks 10 mounted thereon and projecting upwardly therefrom. The magazine 17 is spaced above the table 16 a distance slightly greater than the thickness of a blank 10 to accommodate a pusher plate 19 to engage the backbone of a blank 10 in the space between the table top 16 and the bottom of the magazine 17, and advance the blank 10 between the vertically spaced heater blocks 11, to be heated thereby. Said heater blocks may be of a well known form having resistor heaters carried therein (not shown).

The pusher plate 19 is shown in FIGURE 1 as being bolted or otherwise secured to the horizontal leg of the angle 20, the vertical leg of which is secured to a piston rod 21 extensible from a fluid operated cylinder 23 suitably mounted on the table top 16. A slot 24 extends along the table top 16 in registry with the heads of bolts 25 securing the pusher plate 19 to the horizontal leg of the angle 20, to accommodate the pusher plate 19 to be moved along the table top 16 flush with the top thereof.

The pusher plate 19 normally extends beneath a rear vertical frame member 26 of the magazine 17, when the piston rod 21 and cylinder 23 are in their retracted positions.

As shown in FIGURE 5 the head end of cylinder 23 abuts and is suitably secured to the head end of a cylinder 27 in alignment with the cylinder 23. The cylinder 27 has a piston rod 29 extensible therefrom in an opposite direction from extensible movement of the piston rod 21 from its cylinder 23. The piston rod 29 is suitably secured to a vertical leg 30 of an angle 31 secured to the table top 16 and projecting upwardly therefrom.

Fluid under pressure, such as air, may first be admitted to the head end of the cylinder 27 under the control of a valve 32, shown in FIGURE 5 as being electrically operated. This will extend said cylinder for the length of stroke thereof and move the cylinders 23 and 27 along the table top 16 to feed or advance a blank 10 from the magazine 17 into the space between the heater blocks 11. Fluid under pressure may then be held in the cylinder 27 and admitted to the head end of the cylinder 23 under the control of a valve 33 which is also shown as being electrically operated. The piston rod 21 will then be extended from the cylinder 23 for the length of its stroke to advance the blank 10 into the space between the advance curling rolls 12.

The cylinders 23 and 27 and piston rods 21 and 29 are returned to their retracted positions diagrammatically shown in FIGURE 5 by a tension spring 35, upon the release of fluid under pressure from said cylinders. Said tension spring as diagrammatically shown in FIGURE 5, is connected at one end to an upright connector 36 extending vertically of the vertical leg 30 of the angle 31 and is connected at its opposite end to an upright connector 37, connected to and extending upwardly of the vertical leg of the angle 20.

Referring now to the curling die in the form of the curling rolls 12, a support and guide plate 39 extends from the lower heater block 11 toward the lower roll 12 adjacent the heater block 11 and has a top surface extending generally tangentially of the upper surface of the lower curling roll 12. A deflector plate 40 is shown in FIGURE 1 as spaced above the top surface of the plate 39 and extends into the space between the advance rolls 12 and deflects the blank to pass under a mandrel 43 to the next adjacent lower curling roll 12, curling the blank upwardly to the uppermost curling rolls 12 which continue the curling of the blank to its completed form.

The vertically spaced curling rolls 12 adjacent the heater blocks 11 will be referred to herein as the advance curling rolls, while the forwardly spaced curling rolls 12 will be referred to as the back up curling rolls.

The advance curling rolls 12 are carried at one end in a carrier 44 suitably supported in vertically spaced rela-

tion with respect to the base 15. The advance rolls 12 are carried at their opposite ends in a carrier 46, stationarily supported in vertically spaced relation with respect to the base 15 on a support 47.

As shown in FIGURES 2 and 3, the carriers 44 and 46 form bearing supports for shafts 49 for the upper and lower curling rolls 12. The shafts 49 extend outwardly of the carrier 44 and have spur gears 50 suitably secured thereto meshing with and driven from a pinion 51 on a shaft 53. The shaft 53 is rotatably journalled at one end in said carrier and intermediate its ends in an upright bearing support 54 mounted on and extending upwardly of the base 15. A pinion 55 of the same diameter as the pinion 51 is mounted on the shaft 53 on the outside of the upright bearing support 54 and meshes with and is driven from a spur gear 56 rotatably mounted on a transverse shaft 57, mounted on and extending inwardly of a support member 59, extending upwardly from the base 15. The spur gear 56 is driven from a pinion 60 on a shaft 61 for a motor 63. The motor 63 is in turn mounted on an upright support 64 extending upwardly from the base 15. The motor 63 may be a speed reducer type of motor carrying speed reducer gearing in the casing thereof and driving the shaft 61.

The back up curling rolls 12 are mounted at their opposite ends on swingable carriers 65 and 66 mounted for movement about the shaft 57 and about a coaxial shaft 67 at the opposite side of the base 15 from the motor 63. The shaft 67 is mounted on an upright support 69, projecting upwardly from said base.

The carriers 65 and 66 form bearing supports for shafts 70 for the rolls 12. The shafts 70 extend outwardly beyond the outer side of the carrier 65 and have spur gears 71 keyed or otherwise secured thereto meshing with and driven from a spur pinion 73 on a transverse shaft 74. The transverse shaft 74 is mounted in the carrier 65 at one end, on one side of the spur pinion 73 and extends through and is journalled in a lever arm 75 and has a spur pinion 76 at its outer end meshing with and driven from the spur gear 56. The lever arm 75 also forms a support for the upper roll shaft 70 and is rockingly mounted at its upper end on the shaft 57 for the gear 56.

The carrier 66 supporting the opposite end of the shafts 70 and rolls 12 from the carrier 65 is likewise carried on a lever arm 79, rockingly mounted on the shaft 67, mounted on and projecting inwardly of the upright support 69. The lever arms 75 and 79 are connected together by a cross bar 80 which may be formed integrally with said lever arms, to effect pivotal movement of said lever arms together during the operation of opening and closing the curling rolls 12.

A fluid pressure operated cylinder such as an air cylinder 81 is provided to open and close the curling rolls 12. The air cylinder 81 is suitably mounted on the base 15 in advance of the curling rolls 12 and has a piston rod 83 pivotally connected to the lower end of a lever arm 84. The lever arm 84 is pivotally mounted intermediate its ends to the upper end portion of an upright support 85 on a pivot pin 86. The upright support 85 is mounted and projects upwardly of the base 15 and the support 85 and pivot pin 86 form a fixed fulcrum for the lever 84. An adjustable link 87, which may be in the form of a turnbuckle is pivotally connected to the upper end of the lever 84 on a pivot pin 88. The link 87 is pivotally connected to a connector lug 89 projecting outwardly from the transverse bar 80 on a pivot pin 90.

The admission of fluid under pressure to the head end of the air cylinder 81 under the control of an air valve 91, shown in FIGURE 5 as being electrically operated, will thus swing the carriers 65 and 66 about the axis of the shaft 57 and move the pinion 76 along the face of the gear 56 and open the rolls 12 to accommodate a withdrawal of a curled plastic binding element therefrom. Upon the release of fluid under pressure from the cylinder 81, a spring (not shown) within said cylinder will return the curling rolls 12 to their blank curling positions shown in FIGURES 1, 3 and 5. The positions of the back up curling rolls 12 with respect to the advance rolls 12 may be adjusted by adjusting the length of the link 87.

It should here be understood that while I have shown a mandrel 43 about which the blank 10 is curled into the form of a plastic binding element, that the mandrel need not necessarily be used and may be dispensed with, particularly when curling small diameter binding elements. It should further be understood that the curling rolls 12 and their carriers may be interchangeably mounted on the machine in accordance with the diameter of plastic binding elements to be curled and that smaller or larger rolls and varying spacings of rolls may be used for various diameters of plastic binding elements.

Referring now in particular to FIGURE 5 diagrammatically illustrating the operating and control circuit for the apparatus, I have shown a timer motor 93 driving three timer cams 94, 95 and 96 under the control of a switch 105 in a main line conductor 101. The timer cam 94 closes a switch 97 completing an energizing circuit to the valve 32 to open said valve and supply fluid under pressure, such as air, to the head end of the cylinder 27 through a conduit 99. This will effect movement of the cylinder 27 along the piston rod 29 and advance a lowermost blank 10 of the stack of blanks in the magazine 17 into the space between the heater blocks 11 to effect heating of the blank. As the switch 105 is closed, the heater blocks 11 are energized through main line conductors 100 and 101 and conductors 102 and 103 connected with said main line conductors, and energizing resistor heaters (not shown) carried in said heater blocks.

The timer switch 97 is held in a closed condition to continue the supply of fluid under pressure to the cylinder 27 and retain the piston rod 29 in extended relation with respect to said cylinder as a timer switch 106 is closed. Closing of switch 106 by the timer cam 95 will effect opening of the valve 33 to supply air under pressure to the head end of the cylinder 23. It will also energize the motor 63 and effect rotation of the curling rolls 12. The piston rod 21 will then extensibly move from the cylinder 23 and advance a heated blank 10 from the heater blocks 11 along the top surface of the plate 39 and beneath the deflector 40 into the space between the advance rolls 12 to be carried by said rolls to the back up curling rolls 12 to be curled thereby about the mandrel 43.

As the blank 10 is curled, the timer cams 94 and 95 will have moved to a position to accommodate opening of switches 97 and 106. Air will then be released from the air cylinders 23 and 27 and the spring 35 will return said air cylinders to the retracted position shown in FIGURE 5. Upon opening of the timer switches 97 and 106, the timer cam 96 will close a switch 109. This will effect energization of the electrically energizable valve 91 and open said valve to supply air to the air cylinder 81 to effect opening of the curling rolls 12 and accommodate the ready release of the binding element, either by dropping into a container where no mandrel is used, or by removing the binding element from the end of its mandrel where the binding element is curled about a mandrel.

During opening of the valve 32 and the valve 33, air is supplied through air supply lines 111 and 112 to an air line 113 leading to an air jet 115 supplying air to the curling rolls 12 to cool said rolls and the plastic binding element curled thereby. As the valves 32 and 33 close, to release air from the cylinders 23 and 27, air under pressure is supplied from the valve 91 through an air line 116 to continue the flow of cooling air to the curling rolls 12 and the curled plastic binding element, and to thereby continue cooling of the plastic binding element to effect setting of the binding element in its curled form and also to accommodate ready removal of the binding element from the mandrel 43.

The automatic curling operations may then be repeated as long as the switch 105 is closed.

While I have herein shown and described one form in which my invention may be embodied, it will be understood that various modifications and variations in the invention may be effected without departing from the spirit and scope of the novel concepts of the invention as defined by the claims appended hereto.

I claim as my invention:

1. In an apparatus for curling plastic binding element blanks having a backbone and parallel spaced fingers extending forwardly therefrom into the form of ring-like binding elements, a frame having a base, a plate spaced above said base the top surface of which defines a line of travel of plastic binding element blanks, said plate having a discharge end, a stationary mandrel spaced in advance of the discharge end of said plate in general alignment therewith a series of curling rolls radially spaced about said mandrel equal distances from the center thereof, said plate being tangential to the periphery of a lower roll of said series of rolls and extending closely adjacent to said roll, baffle means spaced above said plate and extending into the space between an upper and lower roll of a series of rolls and deflecting the blank to be progressed by said lower roll under said mandrel to be curled thereabout by said series of rolls, and means feeding a heated plastic blank along said plate beneath said baffle to be picked up by said rolls and curled thereby.

2. In an apparatus for curling plastic binding element blanks having a backbone and parallel spaced fingers extending forwardly therefrom into the form of a ring-like binding element, a frame having a plate, the top surface of which defines a line of travel of the plastic binding element blanks, heating means spaced from said plate, feeding means for feeding a plastic blank to said heating means, a stationary mandrel mounted on said frame at one end, a series of curling rolls spaced in advance of the discharge end of said plate in radially spaced relation with respect to the center of said mandrel, the upper surface of said plate being tangential to the upper surface of a lowermost of said rolls, a motor, means driven by said motor for simultaneously driving said rolls in the same direction, a baffle spaced above and extending along said plate into the space between said rolls, said feeding means advancing a blank along said plate beneath said baffle to be picked up by said rolls and deflected beneath and curled about said mandrel into a ring-like form, and means for supplying an air jet to said rolls for cooling to curled plastic binding element and maintaining said rolls cool.

3. In an apparatus for curling plastic binding element blanks having a backbone and parallel spaced fingers extending forwardly therefrom, a base, a plate spaced above said base, the top of which forms a line of travel for plastic binding element blanks, said plate having a discharge end, a stationary mandrel mounted in advance of the discharge end of said plate and having a center spaced above the top surface of said plate and extending parallel to the discharge end of said plate, means for feeding heated blanks along said plate beyond the discharge end thereof, at least four curling rolls mounted in advance of the discharge end of said plate for rotation about axes spaced radially about the center of said mandrel, the top surface of said plate extending closely adjacent and tangential of the upper surface of a lowermost of said curling rolls, a motor, a gear driven by said motor, spaced gears driven by said gear and having geared drive connection with said rolls, and means for mounting two of said rolls and the drive gears therefor for movement about the axis of said first mentioned gear to accommodate opening of said rolls to remove a plastic binding element blank therefrom.

4. In an apparatus for curling plastic binding element blanks having a backbone and parallel spaced fingers, a frame, a plate, a top surface of which forms a line of travel of the blank, said plate having a discharge end, a stationary mandrel mounted in advance of said plate and having a center extending parallel to the discharge end of said plate and above the top surface thereof, means for feeding the blank along said plate beyond the discharge end thereof, at least four curling rolls in advance of the discharge end of said plate, spaced equally about the center of said mandrel, said plate extending closely adjacent and tangential of the lowermost roll of said series of rolls, stationary bearing support means for two of said rolls adjacent the discharge end of said plate, movable bearing support means for two other of said rolls spaced in advance of said two rolls, a motor, a gear driven by said motor, spaced pinions mounted in said support means and meshing with said gear, gears coaxial with the adjacent upper and lower rolls, and meshing with said pinions for driving said rolls, a bearing support for the movable support means coaxial with the axis of rotation of said gear, and power means operatively connected with said movable support means for moving said rolls apart and accommodating the removal of a plastic binding element from said mandrel.

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