

Sept. 17, 1940.

C. A. DICKHAUT ET AL

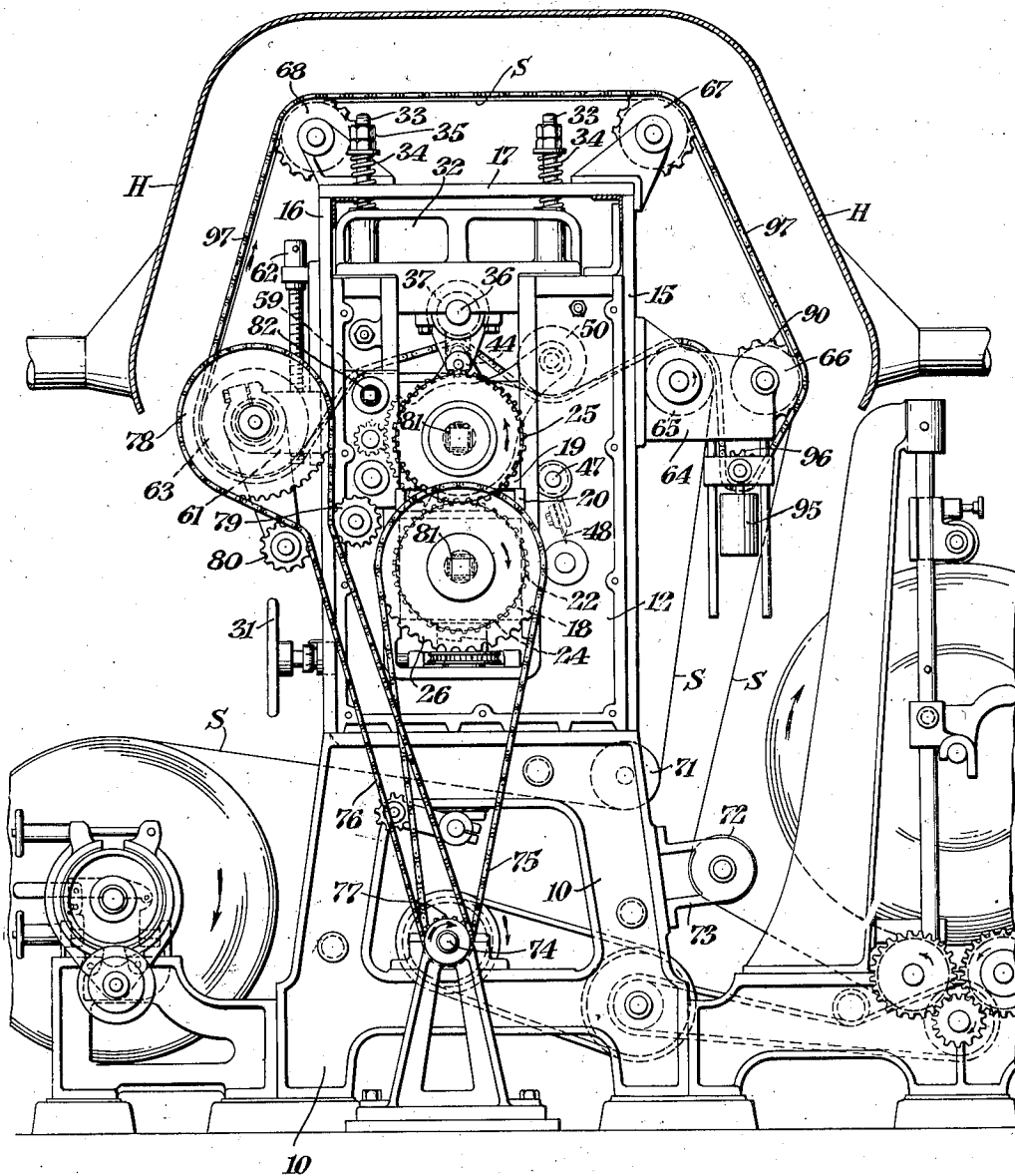
2,214,787

COATING MACHINE

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7 Sheets-Sheet 1

Fig. 1.



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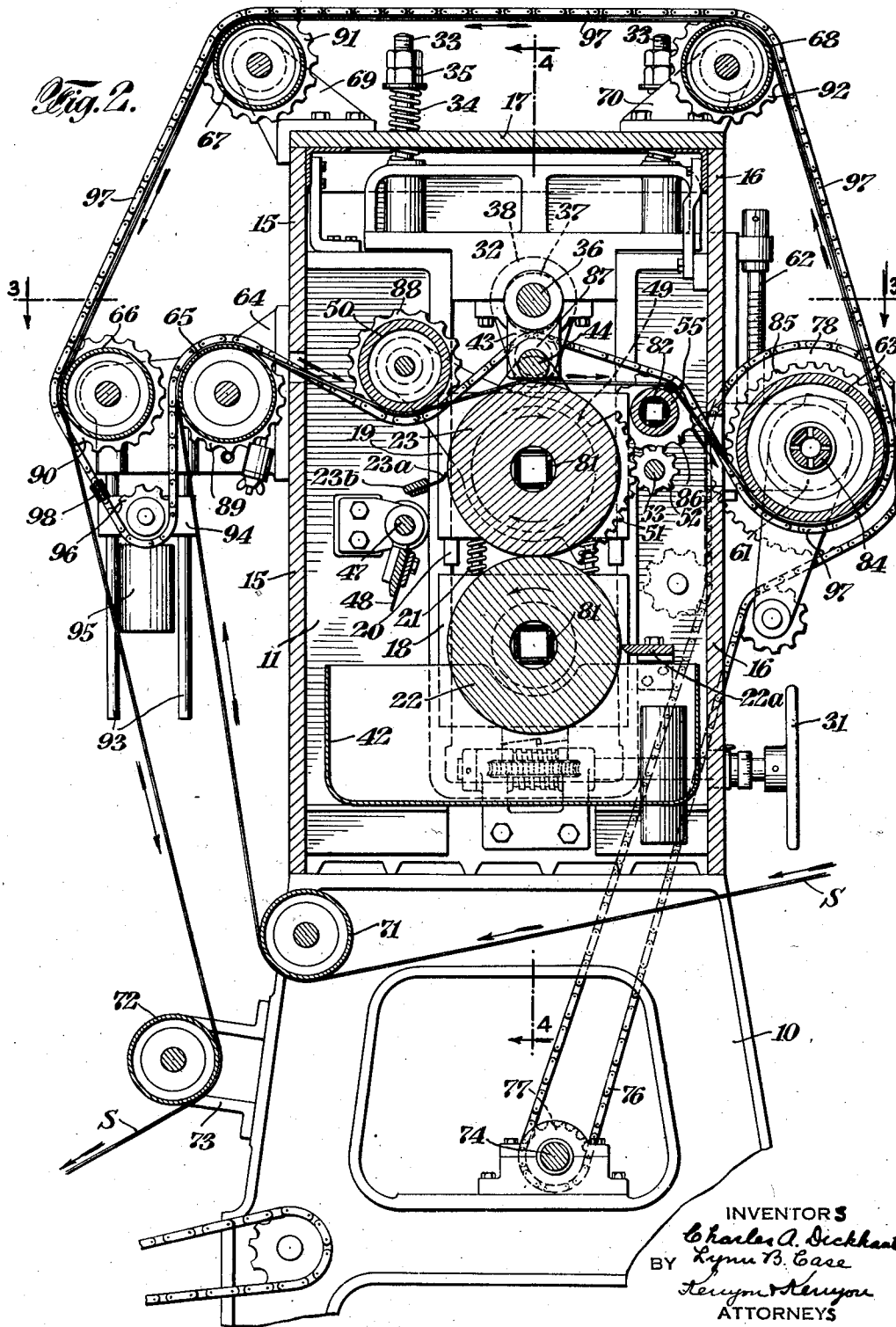
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COATING MACHINE

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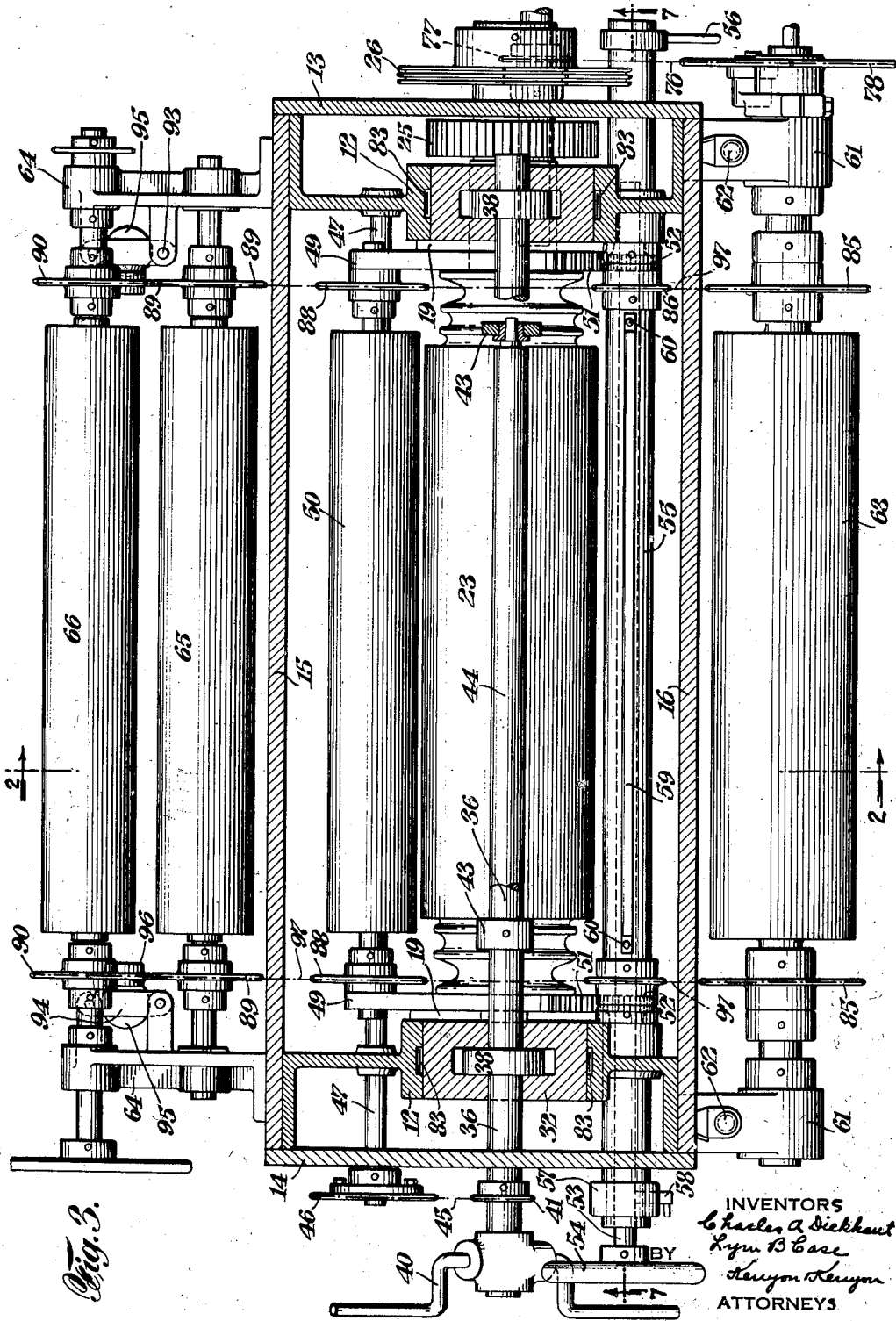
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COATING MACHINE

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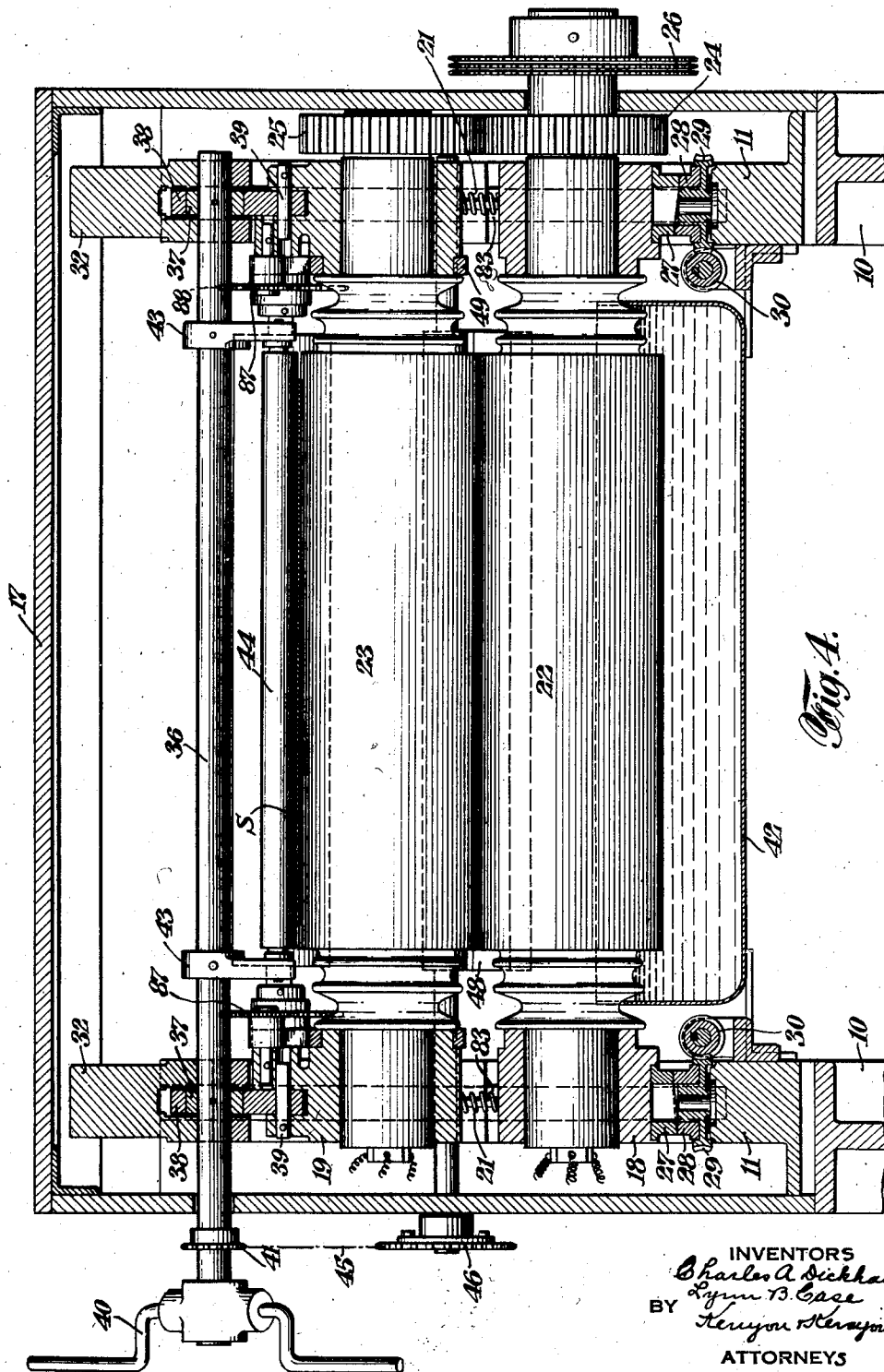
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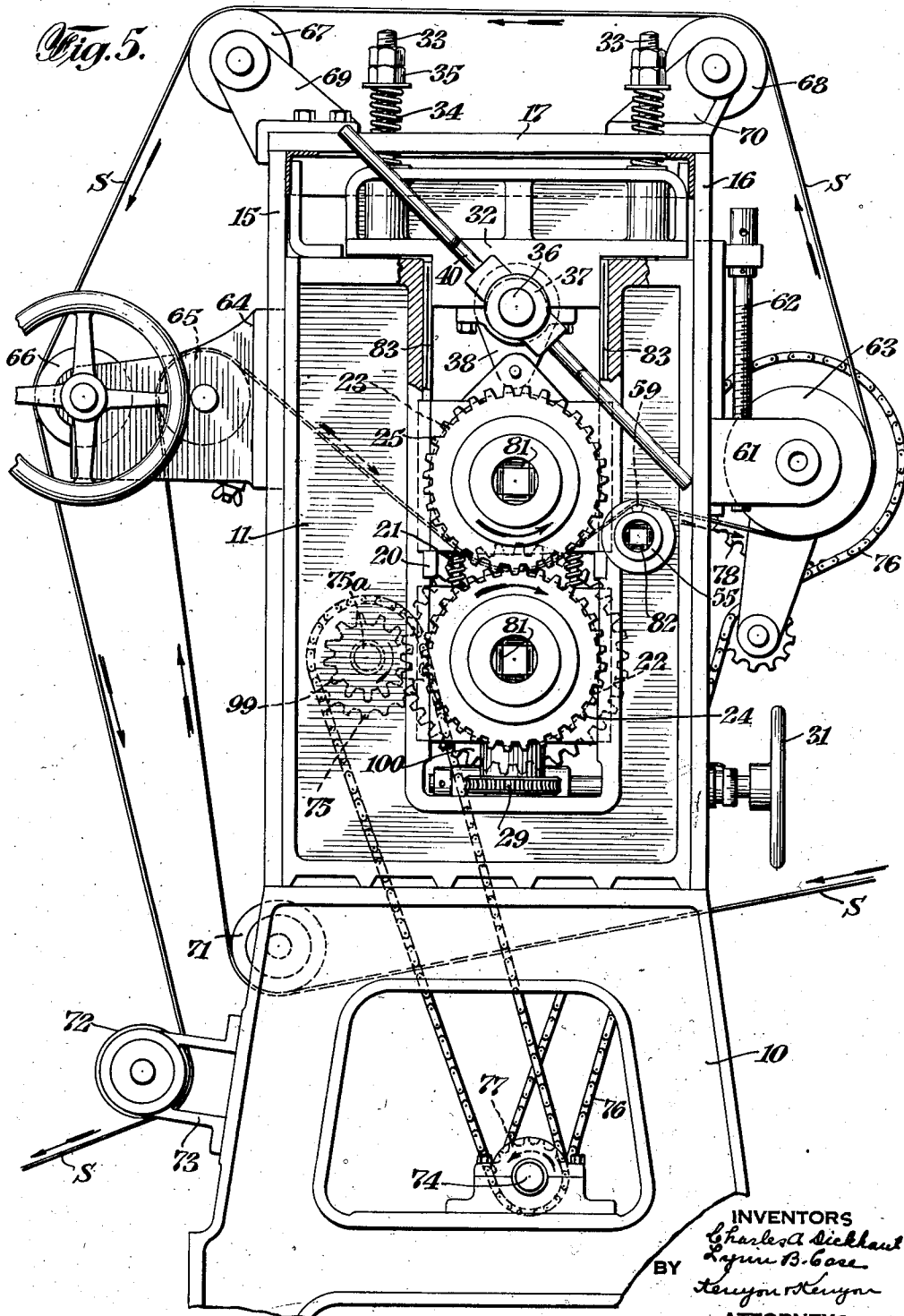
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COATING MACHINE

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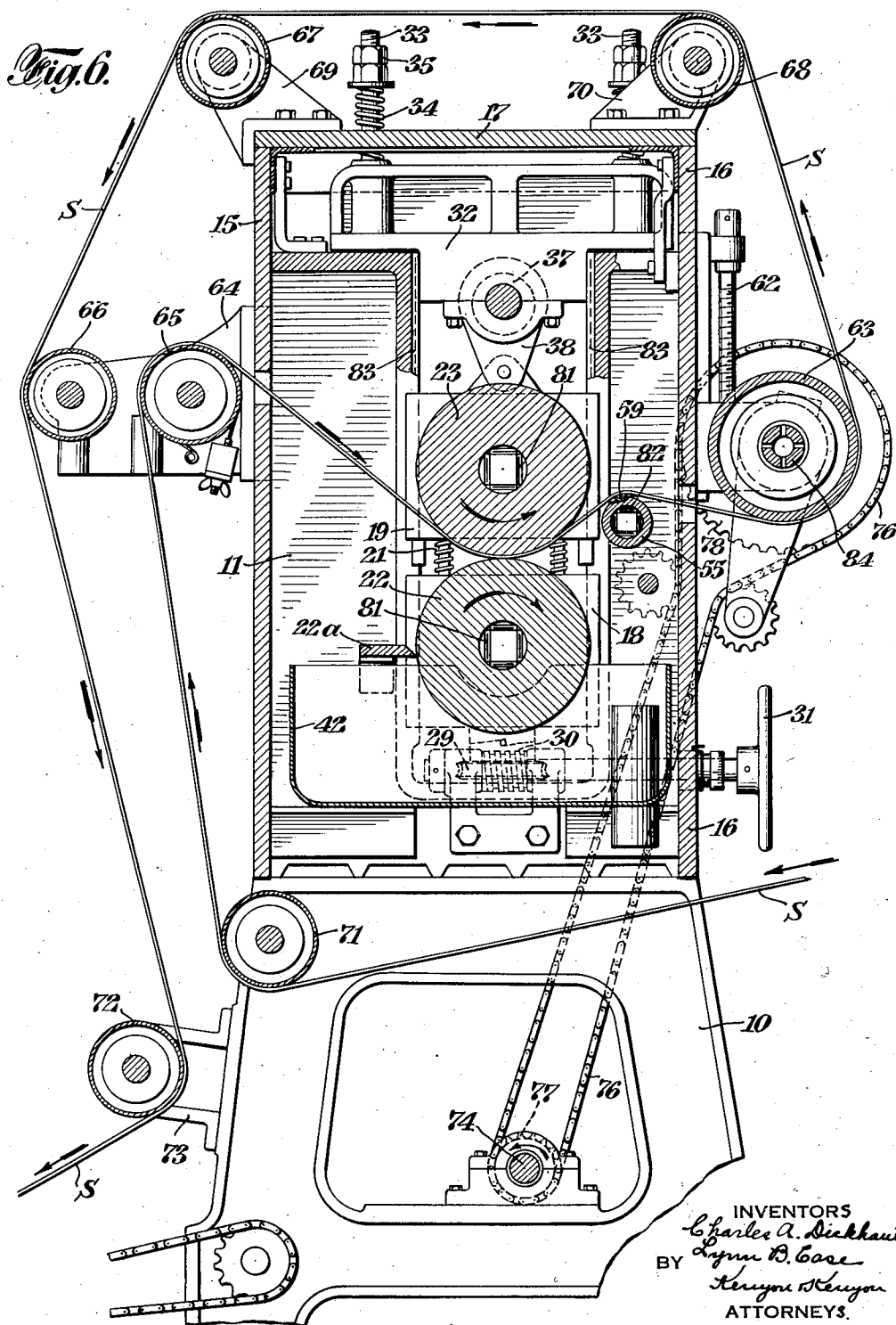
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COATING MACHINE

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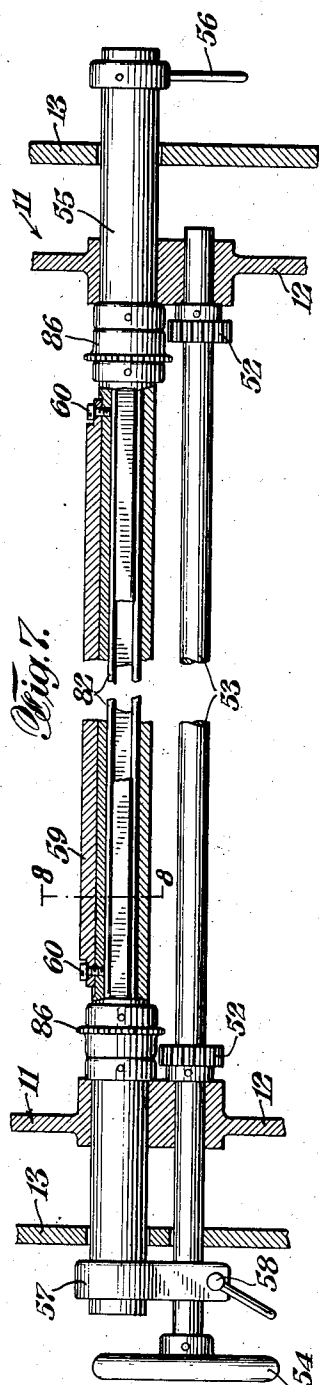
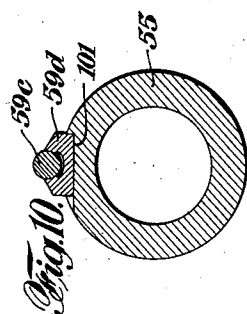
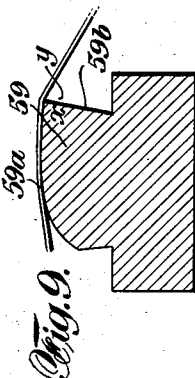
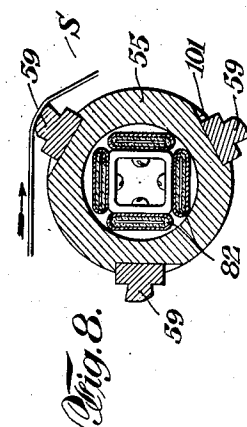
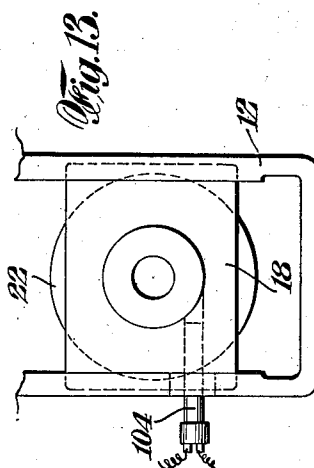
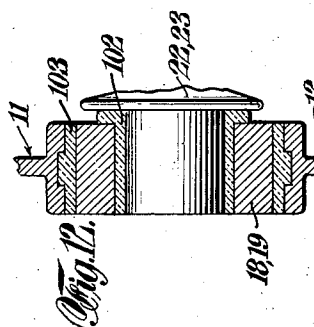
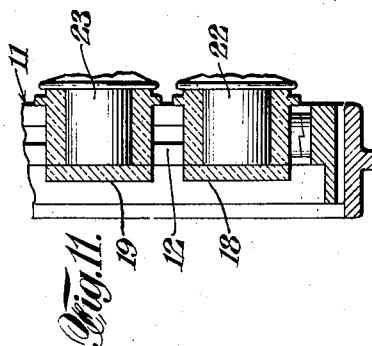
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COATING MACHINE

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2,214,787

COATING MACHINE

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Application March 3, 1938, Serial No. 193,698

25 Claims. (Cl. 91—33)

This invention relates to coating machines and more particularly to a machine for coating a web or strip of sheet material with a material which is solid at atmospheric temperature but softens or liquefies at elevated temperature, such material being exemplified by any resinous material which is normally solid but becomes fluid at elevated temperature, has no sharp melting point and is amorphous in solid state.

An object of this invention is a machine which will rapidly and efficiently apply a smooth-surface uniform thickness coating of resinous or other similar material to a strip of sheet material such, for example, as paper, cardboard and the like.

According to the present invention, the coating material is liquefied or sufficiently softened for application by heat and is applied to the strip of sheet material through the intermediary of one or more heated rolls having extremely smooth surfaces. The coating is then smoothed and chilled to solidify the applied material and produce a smooth coating. In the manufacture of the coating rolls, the cylindrical surfaces are machined to a high degree of accuracy while the rolls are heated uniformly throughout their length to approximately the expected temperature of the coating operation. In order that these rolls apply a coating of uniform thickness to a strip of sheet material, it is desirable that during coating operation the rolls be of substantially uniform temperature throughout their length. Otherwise, the spacing of the rolls will not be uniform and the coating applied to the strip of sheet material will be of greater depth along one longitudinal section than along the remainder. For example, if the center of the coating roll is of higher temperature than the ends and as a consequence expands to a greater extent than the ends, the central longitudinal section of coating on the strip of sheet material will differ in depth from the side sections. Uniform spacing of the roll surfaces may be effected either by using truly cylindrical rolls and uniformly heating each roll throughout its length or by conforming the rolls so that their surfaces form true cylinders when brought to the elevated operating temperature. Preferably, the coating roll or rolls are equipped with suitable heating means and provision is made for preventing escape of heat from the ends of the rolls so that the same are maintained at substantially uniform temperature throughout their length. Such escape of heat may be prevented either by supplying heat to the supports for the rolls or by employing heat-insulating

means between the ends of the rolls and the supports or bearings therefor. The coated surface is smoothed preferably by means of a bar provided with a curved top surface terminating in an edge formed by a rear face inclined to the tangent of said curved surface at slightly less than 90°. The surface of the smoother is highly polished and has low specific adhesiveness for the coating composition and is of such hardness that it will not be scratched by the coating material. For resinous coatings, a contact surface of chromium has been found very satisfactory.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, showing illustrative forms of apparatus embodying the invention and wherein:

Fig. 1 is a front elevation of a machine embodying the invention with an enclosing panel removed;

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 3 with certain parts in the rear of the machine not shown and with certain other parts shown diagrammatically;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is a front elevation of a modified form of apparatus;

Fig. 6 is a vertical section through the apparatus of Fig. 5;

Fig. 7 is a section on the line 7—7 of Fig. 3;

Fig. 8 is a section on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged section of the smoother bar shown in Fig. 8;

Fig. 10 is a view similar to Fig. 8 of a modification;

Figs. 11 and 12 are fragmentary sectional views illustrating modifications in parts of the machine, and

Fig. 13 is a fragmentary section illustrating arrangement of the temperature controller for the machine.

Referring to Figs. 1 to 4 inclusive, a base 10 supports a housing 11 which consists of two U-shaped frames 12, front and rear panels 13 and 14, side panels 15 and 16, and a top panel 17 suitably interconnected (the front panel 13 being omitted from Fig. 1 for clarity sake). A bearing 18 is slidably mounted in the slot of each U-shaped frame 12 near the bottom of said slot and a second bearing 19 is slidably mounted in the slot of each U-shaped frame member 12 in the upper portion of said slot, each frame member being provided with a stop 20 upon which the bearing 19 rests. A spring 21 is interposed between each

pair of bearings 18 and 19. A roll 22 is journaled in the bearings 18 and a roll 23 is journaled in the bearings 19, the surfaces of the rolls being spaced to an extent depending upon the thickness of coating to be applied. The shaft of the roll 22 is provided with a pinion 24 which meshes with a pinion 25 carried by the shaft of the roll 23. The shaft of the roll 22 is provided with a sprocket 26 arranged exterior of the housing 11.

Each bearing 18 is supported by a post composed of an upper section 27 and a lower section 28 having complementary spiral contacting surfaces (Fig. 4). The section 27 is fixed against rotation, but the section 28 is supported by the worm wheel 29 journaled about a vertical axis in the bottom portion in the casing 11. A worm gear 30 suitably journaled in the casing 11 meshes with the worm wheel 29 and is provided with a hand wheel 31. Vertical adjustment of the bearings 18 is effected by operation of the hand wheels 31 with consequent adjustment of the roll 22.

A head 32 rests upon the top of each frame 12 and has a portion depending into the slot in said member. Stud 33 anchored to each frame member 12 extend through each head 32 and are provided with springs 34, the lower ends of which engage the head 32 and the upper ends of which engage nuts 35 on the studs. The springs 34 exert pressure on the heads 32 tending to oppose upward movement of the same and keep the bearings 19 engaged with the stops 20 but yielding to permit upward movement of the roll 23 away from the roll 22 to prevent damage to the rolls in the event of the passage therebetween of material of larger size than the spacing between the rolls. A shaft 36 (Fig. 4) is journaled in the heads 32 and is provided with a pair of eccentrics 37. An eccentric strap 38 surrounds each eccentric 37 and is connected to a bearing 19 by a pin 39. The shaft 36 is provided with an operating handle 40 and a sprocket 41. Rotation of the shaft 36 is effective to lift the bearings 19 to move the roll 23 upwardly away from the roll 22.

A pan 42 (Fig. 4) is supported by the casing 11 in position to receive the roll 22, the ends of the pan being slightly cut away to accommodate the shaft portion of the roll. This pan contains the coating material and suitable means (not shown) are provided for heating the contents of the pan. A doctor blade 22a is associated with the roll 22 to limit the amount of coating material carried by the roll 22 out of the pan 42. A thin flexible doctor blade 23a extends across the surface of the roll 23 in position to engage a film of coating material on the roll 23. The blade is supported at one edge by a rod 23b from which the blade extends upwardly.

The shaft 36 carries depending arms 43 in the outer ends of which is journaled a small diameter roll 44. The roll 44 normally engages the strip of material to be coated to press it against the roll 23, but is moved out of contact therewith upon rotation of the shaft 36 to lift the roll 23.

A chain 45 (Figs. 3 and 4) extends from the sprocket 41 to a sprocket 46 mounted on a shaft 47 journaled in the frames 12. A doctor blade 48 is carried by the shaft 47 and is swung into engagement with the roll 23 upon elevation of the latter, the rotation of the shaft 47 being effected upon rotation of the shaft 36 through the intermediary of the sprocket 41, chains 45 and sprocket 46.

A ring 49 (Figs. 2 and 3) is rotatably mounted on a hub on each bearing 19 and is provided with

an arm in which is journaled one end of the shaft of a roll 50. Each ring 49 is provided with a segmental gear 51 which meshes with a pinion 52 mounted on a shaft 53 journaled at each end in a frame member 12. A hand wheel 54 is provided for operating the shaft 53. Adjustment of the roll 50 is effected by rotation of the hand wheel 54.

A hollow shaft 55 (Figs. 7 and 8) is journaled in the frames 12 and has its ends projecting through the casing 11. At one end of the shaft is provided an adjusting handle 56 and at the other end is provided a clamp 57 having an eye through which the shaft extends. The arms of the clamp enclose the shaft 53 and a threaded member 58 is provided for tightening and releasing the clamp. This clamp arrangement locks the shaft 55 in any position of adjustment. A smoother bar 59 is set into a groove in the shaft 55 and is held in place by bolts 60. The shaft 55 and roll 50 are arranged at either side of the roll 23 above the center line of the roll. As shown in Figs. 8 and 9, the bar is provided with a curved top surface 59a which terminates in an edge formed by the face 59b of the smoother bar which forms with the curved surface an angle X less than a right angle (Fig. 9). The curved surface 59a is highly polished and has low specific adhesion for the coating composition and is of sufficient hardness so that it will not be scratched by the coating material. For resinous coatings the surface 59a preferably is composed of chromium or other similar material having a minimum hardness in excess of 150 Brinell, thereby reducing to a minimum the coefficient of friction between such surface and the coating film which contacts it. The extent of the curved surface 59a and its curvature depends upon the viscosity of the coating, its thickness, the tension applied to the strip and the pressure to which the coating is to be subjected by the smoother.

A pair of carriages 61 (Figs. 1 and 2) are slidably mounted on the panel 16 and lead screws 62 are provided for effecting vertical adjustment of said carriages. A roll 63 is journaled in said carriages and an aperture is provided in the panel 16 in substantial alignment with the roll 63. A pair of heads 64 are supported by the panel 15 and in said heads are journaled rolls 65 and 66. Rolls 67 and 68 are journaled in brackets 69 and 70 supported by the top panel 17; a roll 71 is journaled in the base 10, and a roll 72 is journaled in brackets 73 attached to the base 10.

A shaft 74 is journaled in the base 10 and constitutes the main driving shaft of the machine. A chain 75 passes around a sprocket (not shown) on the shaft 74 and around the sprocket 26 to drive the roll 22. A chain 76 passes around a sprocket 77 on the shaft 74 and around a sprocket 78 on the shaft of the roll 63. Fixed and adjustable idler rollers 79 and 80 are provided for engagement by the chain 76.

The strip S of material to be coated passes from a supply roll shown at the left of the machine in Fig. 1 under the roll 71 over the roll 65, through the panel 15, under the roll 50, between the rolls 44 and 23, over the smoother 59, through the panel 16, under the roll 63, over the rolls 68, 67, 66 and under the roll 72 to the roll-up mechanism shown at the right of the apparatus in Fig. 1. The roll 22 supplies liquefied coating material from the tank 42 to the roll 23 which in turn applies such coating material to the under surface of the strip S. The rolls 22 and 23 are

properly adjusted to apply the desired thickness of coating to the strip and the roll 44 holds the strip firmly in contact with the coating roll 23.

Each of the rolls 22 and 23 is provided with a central chamber in which is arranged one or more heating elements which may be of any suitable type but which are here shown for illustrative purposes as being electrical resistance units 81. The shaft 55 is provided with a central aperture in which a similar heating element 82 is provided. In each of the frames 12 (Figs. 3 and 4), a heating unit 83 is provided in a groove in each surface of the central slot, such heating units extending the full length of the slot. The roll 63 is hollow (Fig. 2) and means 84 are provided for circulating cooling liquid through the roll 63. The rolls and smoother are heated to the proper temperature by their respective heating elements 81 and 82, while the roll 63 is maintained at the atmospheric temperature or below by the passage of cooling liquid therethrough. Also, the frames 12, together with the bearings 18 and 19, are heated by the units 83 to the same temperature as the rolls 22 and 23. By reason of the bearings being thus heated, there is completely eliminated all tendency for heat to escape from the ends of the rolls 22 and 23 so that these rolls are uniformly heated throughout their entire length, thus causing them to expand uniformly.

The position of the roll 50 is adjusted to deliver the strip to the roll 23 at the proper angle of contact and the shaft 55 is adjusted to set the smoother 59 in the proper position, depending upon the coating material used, the nature of the strip being coated and the thickness of the coating. When it is desired to interrupt the coating operation without stopping the rolls 22 and 23, the shaft 36 is operated by the handle 50 to lift the bearings, thus moving the roll 23 sufficiently distant from the roll 22 that the latter supplies no coating material to the former. At the same time, the doctor blade 48 is swung into engagement with the roll 23 to remove any coating material that may remain on the surface of the roll. Likewise, the roll 44 is moved out of contact with the strip S.

Sprockets 85 (Fig. 2) are rotatably mounted on the shaft of roll 63, sprockets 86 are rotatably mounted on the shaft 55, sprockets 87 are rotatably supported on the bearings 19, sprockets 88 are rotatably mounted on the shaft of the roll 50, sprockets 89 are rotatably mounted on the shaft of the roll 65, sprockets 90 are rotatably mounted on the shaft of the roll 66, sprockets 91 are rotatably mounted on the shaft of roll 67 and sprockets 92 are rotatably mounted on the shaft of roll 68. A pair of guide rods 93 depend from each head 64 and a carriage 94 provided with a weight 95 is mounted on each pair of rods. A sprocket 96 is rotatably supported by each carriage 94. A chain 97 passes around the sprocket 85, over the sprockets 86 and 87, under the sprocket 88, over the sprocket 89, under the sprocket 96, over sprockets 90, 91, 92 and back to the sprocket 85 and a cross bar 98 extends between the chains 97. The chains, together with the cross bar, constitute means for threading the strip S around the various rolls. The end of the strip S is attached to the bar 98 and the chains with the bar are moved through the path of the chains, drawing the strip through the path which it follows in passing through the machine. The threading operation is effected with the shaft 36 rotated to lift the roll 44 above the top of the

sprockets 87 so that the strip will lie between the roller 44 and the roll 23. The weight 95 takes up any slack that may be produced in the chain by reason of change of position of the sprockets 88 upon adjustment of the roll 50.

In the operation of this machine, the rolls 22 and 23 together with the smoother bar 59 are heated to the proper temperature. In the event that a resinous coating is to be applied, the rolls are heated to approximately 350° F. and the smoother bar is heated to a slightly higher temperature. Also, each frame 12 is heated to the same temperature as the rolls. The resinous coating material is likewise heated to approximately 350° F. in the pan 42. With the roll 23 elevated and the roll 44 lifted, the strip S of paper or the like is threaded through the machine and around the cooling roll 63 and over the rolls on top of the machine to the take-up rolls. The furnisher roll 22 delivers a film of liquefied coating material, the thickness of which is determined by the spacing between the surfaces of rolls 22 and 23 and is uniform through its entire width. The flexible doctor blade 23a levels out the ripples or unevenness produced in the film during its transfer from the furnisher roll 22 to the applicator roll 23. The applicator roll supplies the film to the strip S to which the film adheres. The film is compressed with a wedging action between the curved surface 59a of the bar 59 and the strip S. The highly polished surface 59a has a low specific adhesion for the coating and is of sufficient hardness that it effectively resists scratching. The coated strip is drawn over the smoother bar 59 and the edge formed by the intersection of the curved surface 59a on the rear face 59b in such manner that the strip leaves the curved surface 59a at such angular relationship that the angle Y between the strip and the rear face 59b is less than 90°. With such relationship existing between the coated strip and the rear face 59b, the film of coating material is smoothed to produce a surface which is free from lines or other irregularities which would otherwise result due to tendency on the part of the coating material to adhere to the smoother. The coated strip then passes through the aperture in the panel 16 and around the cooling roll 63 from where it passes over the rolls 68, 67 and 66 to the take-up roll. The roll 63 effects a material reduction in the temperature of the coated strip and return of the coated strip to normal temperature is effected by the circulation of cool air through the hood H enclosing the upper portion of the machine.

If heavy stock is to be coated, the roll 65 preferably is provided with a heater so that the strip S is heated before entering the housing as otherwise an undesirable amount of heat is transferred from the coating film to the strip. The furnisher roll 22 and the applicator roll 23 may operate at the same surface speeds or the applicator roll may operate at a higher surface speed than the furnisher roll.

The apparatus illustrated in Figs. 1 to 4 is designed for operation as a kiss coater while the apparatus illustrated in Figs. 5 and 6 is designed for operation as a pressure coater. The structure of the pressure coater is similar in most respects to the kiss coater. However, the strip S instead of passing over the top of the roll 23 passes between the rolls 22 and 23 and the roll 22 applies the coating material to the strip. The roll 50 of Figs. 1 to 4 and its supporting arrangement are omitted as are also the doctor blade

48 and the roll 44 and its supporting means. The shaft 55 with the smoother 59 is arranged at a lower position than in Figs. 1 to 4. The strip S otherwise follows the same path as previously described. The sprocket 75 is journaled on a shaft 75a supported by the casing 11 and a gear 99 fixed to the shaft 75a meshes with a gear 100 fixed to the roll 22. The direction of rotation of the rolls 22 and 23 is thus just the reverse of their rotation in Figs. 1 to 4. Also, the threading chains and their associated sprockets are omitted as in this form of the machine, the strip may be threaded between the rolls 22 and 23 without the use of chains. The remaining features of the apparatus of Figs. 1 to 4 are included in the apparatus of Figs. 5 and 6.

As shown in Fig. 8, the shaft 55 is provided with one or more longitudinal grooves 101 in each of which is located a smoother bar 59. The shoulder formed by the groove rigidly supports such smoother in proper position and the bolts 60 hold it against the bottom of the groove. The various smoother bars may be of the same configuration so that a worn smoother may be substituted by a fresh smoother with minimum effort or each of the smoother bars may be of different configuration for use with different types of coating.

In Fig. 10, the smoother comprises a circular rod 59c seated in a channel in a holder 59d which in turn fits into the bearing groove 101. The surface of such channel is cut away as shown so that downward pressure on the rod 59c results in intimate contact of the edges of the channel with the surface of the rod to act as doctor blades. Means (not shown) may be provided for rotating the rod either clockwise or counterclockwise in contact with the coating. For resinous coatings, the surface of the smoother rod is highly polished and has low specific adhesion for the coating material and is of sufficient hardness that it will not be scratched by the coating material. Preferably, for such coatings, the rod has a minimum surface hardness in excess of 150 Brinell and preferably the rod surface is composed of chromium.

Instead of providing heating elements in the frames 12, escape of heat from the ends of the rolls 22 and 23 may be prevented in other ways. As shown in Fig. 11, the bearings 18 and 19 may be composed of heat-insulating material or material having very low heat conductivity. Also, as illustrated in Fig. 12, the bearings 18 and 19 may be composed of iron and be provided either with bushings 102 of heat-insulating material surrounding the rollnecks or with heat-insulating liners 103 placed between the bearings and frames 12 or a combination of both.

The rolls are maintained at constant temperature through the action of one or more thermostats 114 arranged to receive heat therefrom as, for example, in the bearing 18 as shown in Fig. 13. The sensitive end of the thermostat may be located directly adjacent the shaft or neck of the roll and suitable electric connections (not shown) are provided so that the supply of electrical energy to the heaters in the respective elements is controlled to regulate their temperature and keep it uniform.

It is of course understood that various modifications may be made in the structure of the device without in any way departing from the spirit of the invention as defined in the appended claims.

We claim:

1. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a roll, means for supplying heat to the interior of said roll, and means for heat-insulating the ends of said roll.
2. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a roll, means for supplying heat to the interior of said roll, and means for supplying heat to the ends of said roll.
3. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a roll, means for supplying heat to the interior of said roll, and bearings of heat-insulating material for said roll.
4. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a roll, bearings for said roll, means for supplying heat to the interior of said roll, and heat-insulating members in said bearings for preventing loss of heat from said roll through said bearings.
5. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving web, a cylindrical roll having a cylindrical projection of reduced diameter at each end, means for supplying heat to the interior of said roll, means co-operating with said projections for rotatably supporting said roller, and heat repellant means associated with said projections for maintaining the surface of said roller at substantially uniform temperature throughout its entire length.
6. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving web, a cylindrical roll having a cylindrical projection of reduced diameter at each end, means for supplying heat to the interior of said roll, means co-operating with said projections for rotatably supporting said roller, and means for supplying heat to said projections for maintaining the surface of the roller at substantially uniform temperature throughout its entire length.
7. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a pair of adjacent rolls, one of which applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, and means for heat-insulating the ends of said rolls.
8. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a pair of adjacent rolls, one of which contacts the strip to be coated, means for supplying heat to the interior of each roll, means for supplying hot liquefied coating material to one roll for application to said strip, and means exterior of said rolls for supplying heat to the ends of said rolls.
9. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a pair of adjacent rolls, one of which applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, and bearings of heat-insulating material for said rolls.
10. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a pair of adjacent rolls, one of which applies hot liquefied

coating material to the strip, means for supplying heat to the interior of each roll, a heated smoother over which the coated strip passes with its coated surface contacting the smoother, and a housing enclosing said rolls and smoother.

11. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a frame, two pairs of bearings mounted on said frame, a roll journalled in each pair of bearings, one of which rolls applies hot liquefied coating material to the strip, means for supplying heat to the interior of said rolls, and means for heat-insulating said rolls from said frames.

12. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a frame, two pairs of bearings mounted on said frame, a roll journalled in each pair of bearings, one of which rolls applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, and means for supplying heat to said bearings.

13. In a machine for applying material liquid at elevated temperature and solid at normal temperature to a continuously moving strip, a frame, two pairs of bearings mounted in said frame, a roll journalled in each pair of bearings, one of which rolls applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, and heat-insulating members between said frame and bearings for preventing loss of heat from said rolls through said bearings.

14. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a pair of adjacent rolls, one of which applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, a heated smoother over which the coated strip passes with its coated surface contacting the smoother, a housing enclosing said rolls and smoother, and means for preventing loss of heat from the ends of said rolls.

15. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a pair of adjacent rolls, one of which applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, a heated smoother over which the coated strip passes with its coated surface contacting the smoother, a housing enclosing said rolls and smoother, means for preventing loss of heat from the ends of said rolls, a roll exterior of said housing over which the coated strip passes with its coated surface contacting the roll, and means for circulating cooling liquid through said last-named roll.

16. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a pair of superposed rolls, one of which applies hot liquefied coating material to the strip, means for supplying heat to the interior of each roll, a heated smoother over which the coated strip passes with its coated surfaces contacting the smoother, a housing enclosing said rolls and smoother, bearings for each roll, and means for supplying heat to said bearings.

17. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a roll, bearings supporting said roll, means for supplying heat to the interior of said roll, a thermostat arranged with its sensitive portion in close juxtaposition to one of said bearings, and means responsive to said thermostat for controlling operation of said heating means.

18. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a roll, bearings supporting said roll, means for supplying heat to the interior of said roll, means to heat-insulate the ends of said roll, and thermostatic means for controlling the operation of said heating means to maintain uniform the temperature of the entire surface of said roll.

19. In a machine for coating a strip with coating material which liquefies at elevated temperature but is solid at normal temperature, a frame, two pairs of bearings mounted in said frame in adjacent relation, rollers journalled in said bearings, means for supplying heat to the interior of said rolls, means for supplying heat-liquefied coating material to one roll and transferring the same in a film of uniform thickness to said second roll, means in said frame for supplying heat to said bearings, a heated smoother over which the coated strip passes with its coated surface contacting said smoother, a housing enclosing said rolls and smoother, a roll exterior of said housing over which the coated and smoothed strip passes, and means for circulating cooling liquid through said last-named roll.

20. In a coating machine, a frame, two pairs of bearings mounted in said frame, a roll journalled in each pair of bearings, means for simultaneously adjusting one pair of bearings, a doctor blade adapted to engage said one roll but normally arranged out of contact therewith, and means for swinging said blade into operative relation with said last-named roll upon adjustment of the latter.

21. In a coating machine, a frame having a vertical slot, two pairs of bearings mounted in said slot in superposed relation, a roll journalled in each pair of bearings, means for simultaneously lifting the upper pair of bearings, a roll normally arranged to engage a strip of material passing over the upper roll, and means for swinging said last-named roll out of such relation to the upper roll upon lifting of said upper roll.

22. In a machine for coating a strip with resinous coating material, a pair of spaced superposed rolls, the upper of which contacts the strip to be coated, means for applying hot liquefied resinous material to the lower roll for transfer to the upper roll, means for supplying heat to the interior of each roll, a thin flexible doctor blade associated with the upper roll to engage the film of resinous material thereon, and a heated smoother bar over which the coated strip passes, said smoother bar having a curved contact surface and a rear face forming less than a right angle with said curved surface.

23. In a machine for coating a strip with resinous coating material, a pair of spaced superposed rolls, the upper of which contacts the strip to be coated, means for applying hot liquefied resinous material to the lower roll for transfer to the upper roll, means for supplying heat to the interior of each roll, a thin flexible doctor blade associated with the upper roll to engage the film of resinous material thereon, and a heated smoother bar over which the coated strip passes, said smoother bar having a curved contact surface and a rear face forming less than a right angle with said curved surface.

24. In a machine for coating a strip with coating material which liquefies at elevated temperature

ture but is solid at normal temperature, heated means for applying the coating material to the strip and heated smoother means over which the coated strip passes, said smoother means comprising a bar consisting of a base member and a head having a curved contact surface terminating in a sharp edge formed by a rear face defining less than a right angle with said curved surface, a support for said bar having a channel in which said base member is received, and means for detachably retaining said base member in said channel.

25. In a machine for coating a strip with coating material which liquefies at elevated tempera-

ture but is solid at normal temperature, heated means for applying the coating material to the strip and heated smoother means over which the coated strip passes, said smoother means comprising a bar consisting of a base member and a head having a curved contact surface of low specific adhesion for the coating material and minimum hardness of 150 Brinell, a support for said bar having a channel in which said base member is received, and means for detachably retaining said base member in said channel.

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