June 25, 1946. J. A. LA HATTE ET AL 2,402,559

METHOD FOR APPLYING CARBON TO SHEETS

Original Filed June 20, 1942 6 Sheets-Sheet 1

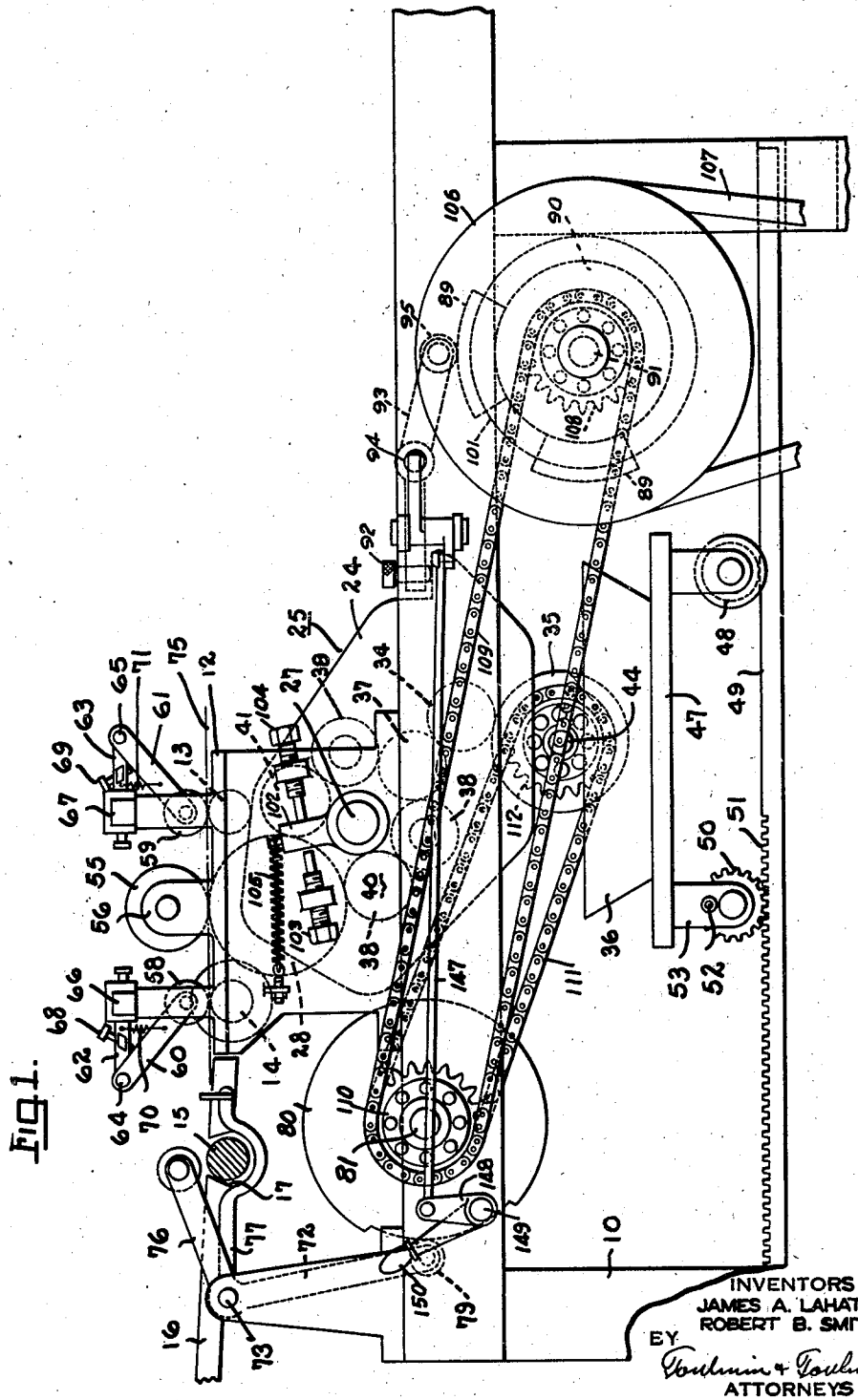


Fig. 1.

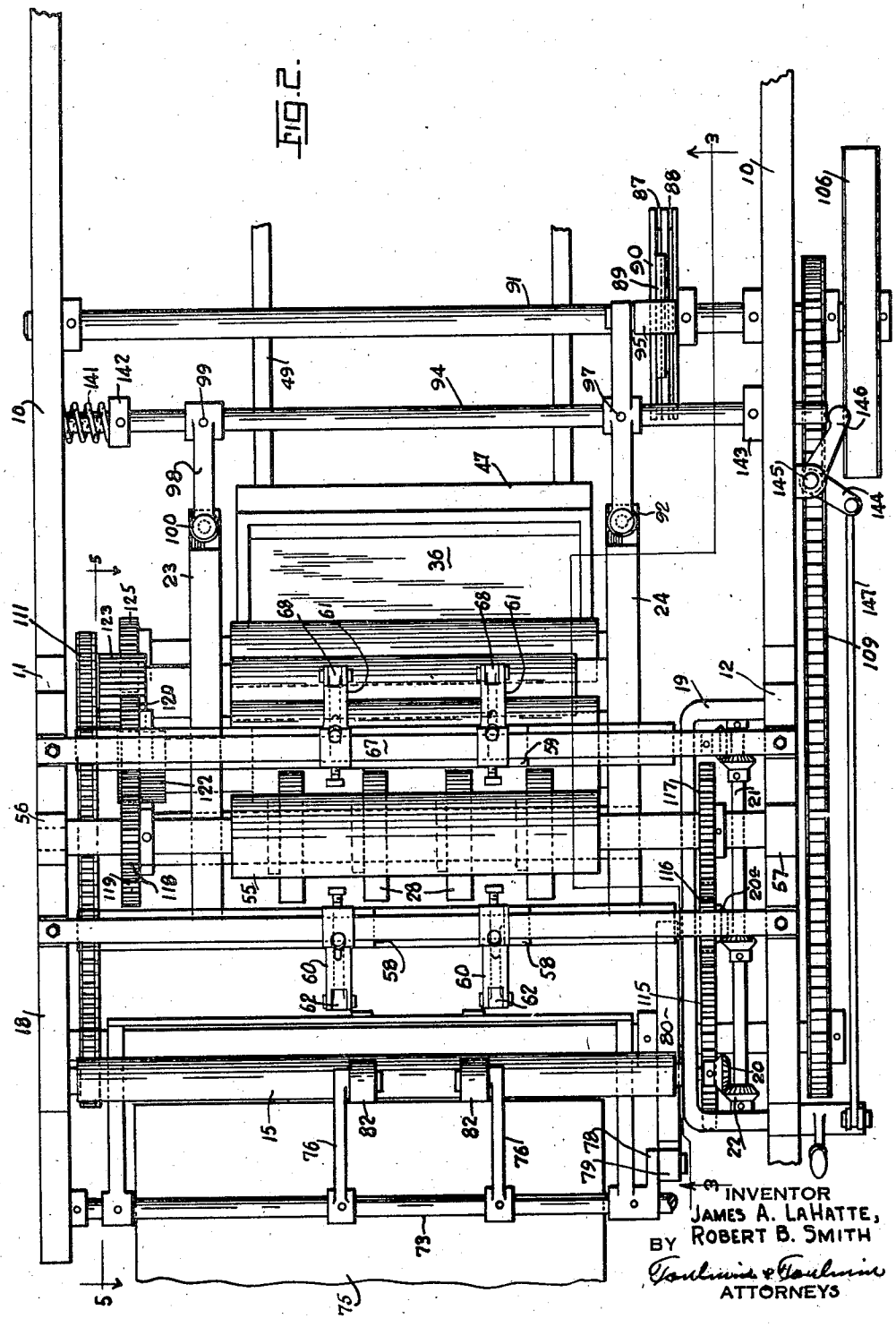
INVENTORS
JAMES A. LAHATTE
ROBERT B. SMITH
BY
Toulmin & Toulmin,
ATTORNEYS

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METHOD FOR APPLYING CARBON TO SHEETS

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FIG. 2.



INVENTOR
JAMES A. LAHATTE,
BY ROBERT B. SMITH
Faulkner & Faulkner
ATTORNEYS

June 25, 1946. J. A. LA HATTE ET AL 2,402,559

METHOD FOR APPLYING CARBON TO SHEETS

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FIG. 7.

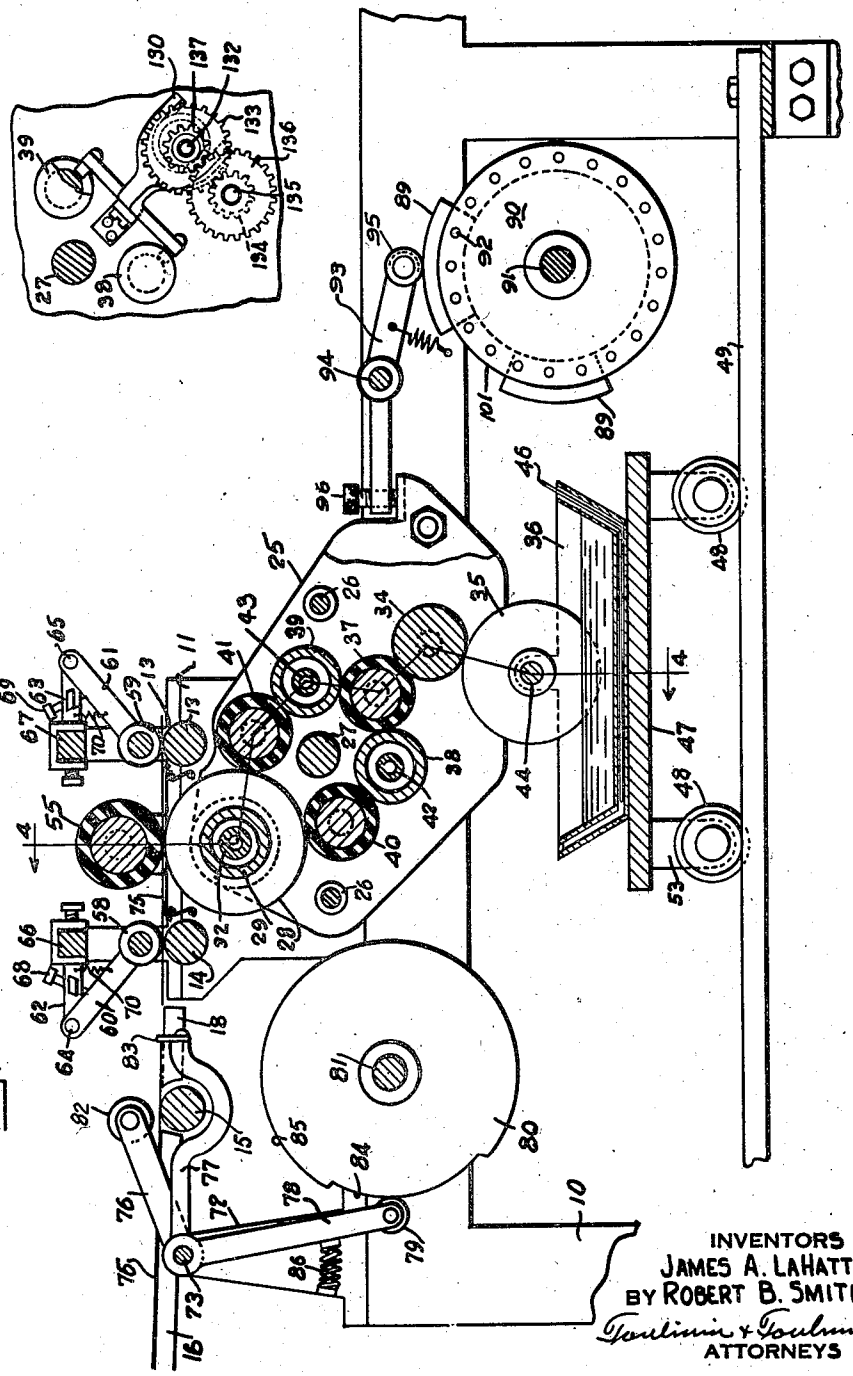


FIG. 3.

INVENTORS
JAMES A. LAHATTE,
BY ROBERT B. SMITH
Toulmin & Toulmin
ATTORNEYS

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FIG. 4.

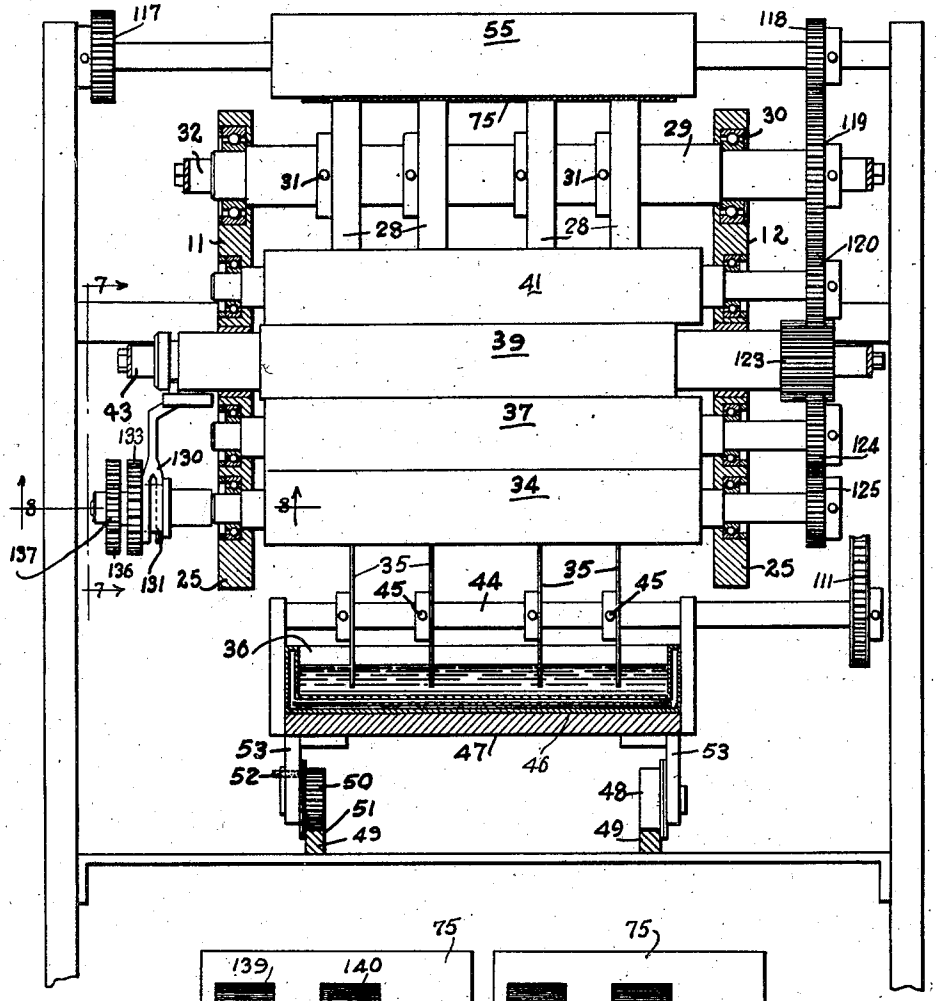
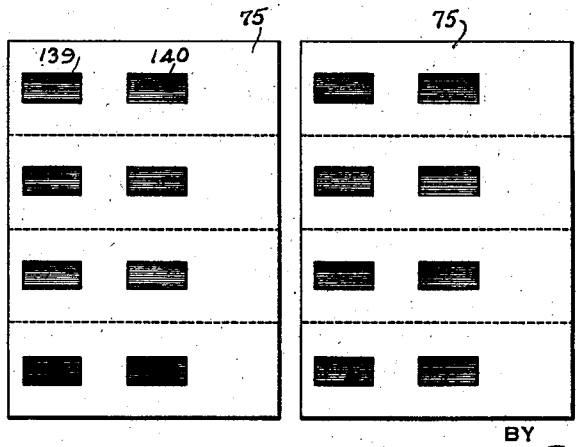


FIG. 9.



INVENTORS
JAMES A. LAHATTE
ROBERT B. SMITH
BY
Toulmin & Toulmin
ATTORNEYS

June 25, 1946. J. A. LA HATTE ET AL 2,402,559

METHOD FOR APPLYING CARBON TO SHEETS

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Fig. 6.

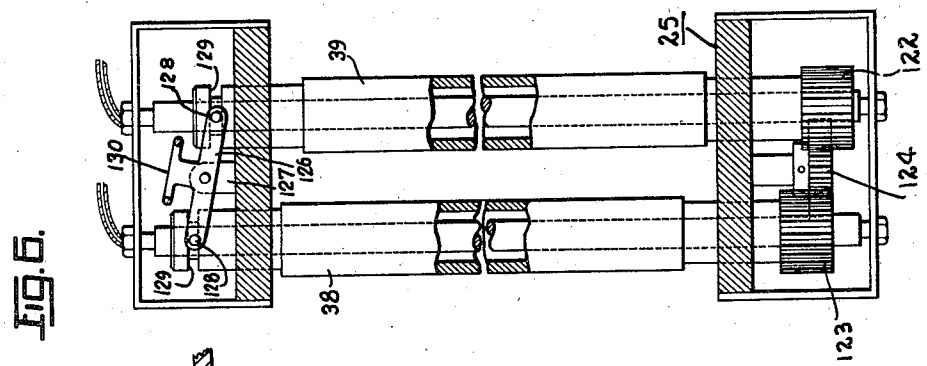


Fig. 5.

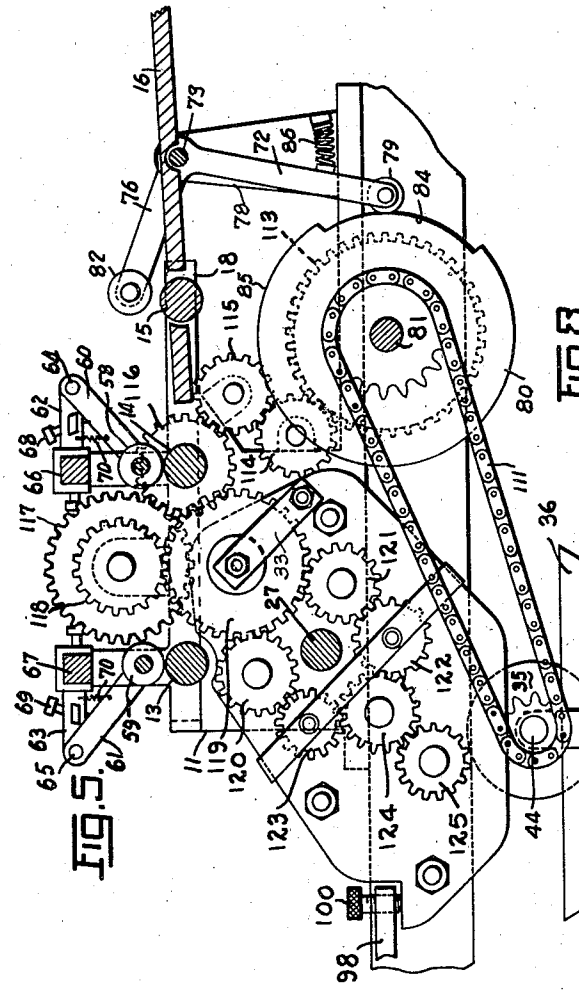
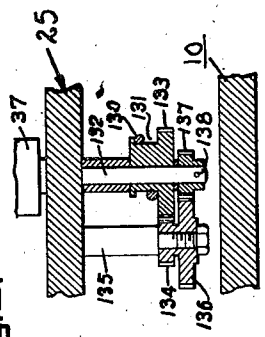


Fig. 8.



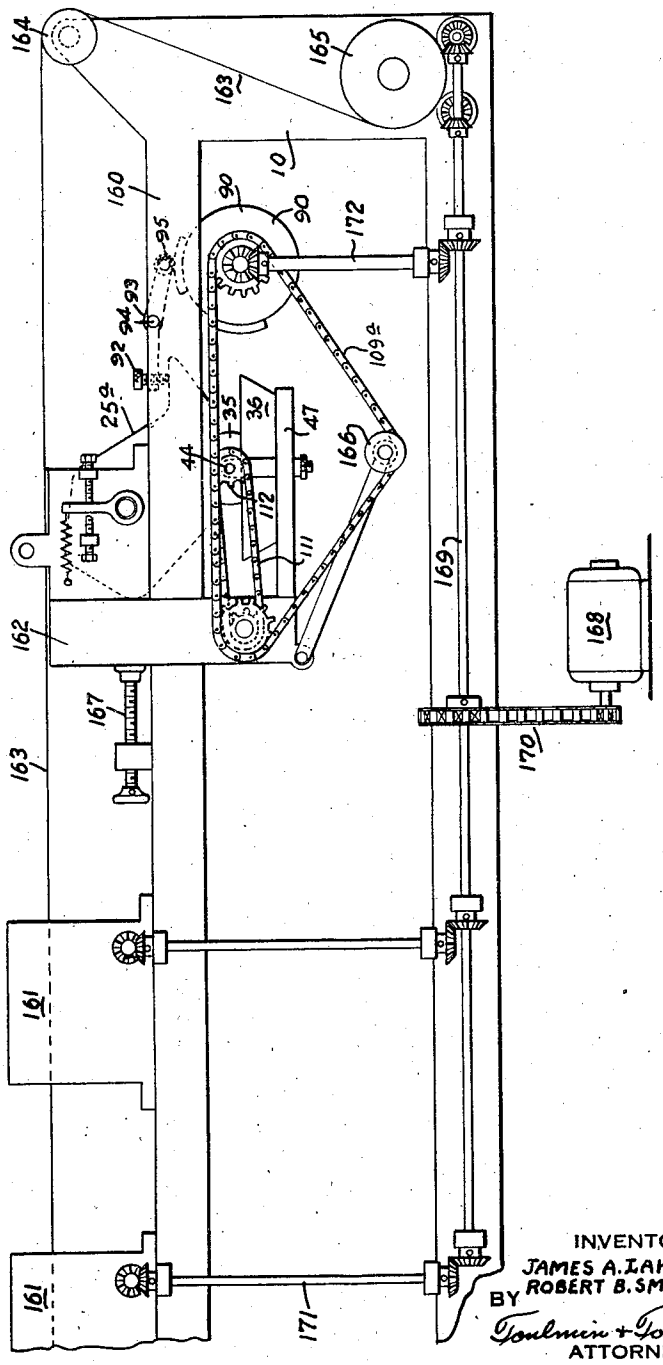
INVENTORS
JAMES A. LAHATTE
ROBERT B. SMITH
BY
Toulmin & Toulmin
ATTORNEYS

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Fig. 10.



INVENTORS
JAMES A. LA HATTE,
ROBERT B. SMITH,
BY Toulmin & Toulmin
ATTORNEYS

Patented June 25, 1946 2,402,559

UNITED STATES PATENT OFFICE

2,402,559

METHOD FOR APPLYING CARBON TO SHEETS

James A. La Hatte, Atlanta, Ga., and Robert B. Smith, Dayton, Ohio, assignors to The Reynolds & Reynolds Company, Dayton, Ohio, a corporation of Ohio

Original application June 20, 1942, Serial No. 447,850. Divided and this application January 11, 1943, Serial No. 472,012

4 Claims. (Cl. 117—36)

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This invention relates to a method for applying carbon spots upon sheets of paper in predetermined areas, repeating the performance on any number of sheets or upon a continuous web.

It is another object of the invention to provide an improved method for applying areas of carbon upon a paper sheet or web.

It is another object of the invention to provide a method of applying liquid carbon upon a paper sheet or web wherein the carbon applying apparatus is adapted to apply carbon upon the paper sheet or web simultaneous with receiving carbon from a suitable source of supply.

It is another object of the invention to provide a method for applying liquid carbon upon a paper sheet or web wherein the carbon applying apparatus is moved with respect to the paper sheet or web and with respect to a carbon supply apparatus periodically to apply the carbon upon the paper web or sheet at periodic spaced intervals, and to supply the carbon applying apparatus with liquid carbon only when carbon is being applied upon the paper sheet or web.

It is a further object of our invention to provide a method to apply carbon to limited, regularly recurrent areas of a moving strip of material, such as paper, by imparting positive rotation, with a surface speed equal to that of said moving strip, to rotatable carbon-applying means closely adjacent said strip, then positively moving said applying means into and out of contact with said strip in timed sequence with the movement thereof, whereby carbon areas of the exact dimension desired are applied in precisive relation to said strip and any datum line, perforations, and/or printed matter thereon.

Further objects and advantages will become apparent from the drawings and the following description.

In the drawings:

Fig. 1 is a side elevational view of the carbon applying apparatus of this invention.

Fig. 2 is a top plan view of the apparatus.

Fig. 3 is a vertical cross-sectional view of the apparatus taken along line 3—3 of Fig. 2.

Fig. 4 is a transverse cross-sectional view of the apparatus taken along line 4—4 of Fig. 3, placing the rolls in a common plane to illustrate the transfer of the carbon from the supply source to the paper.

Fig. 5 is a longitudinal cross-sectional view of a portion of the apparatus taken along line 5—5, of Fig. 2, showing the gear trains for driving the various rolls of the apparatus.

Fig. 6 is a cross-sectional view of the vibrator rolls taken along line 6—6 of Fig. 7.

Fig. 7 is an end elevational view of the mechanism for producing vibration of the vibrator rolls, taken along line 7—7 of Fig. 4.

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Fig. 8 is a horizontal cross-sectional view of the gear train for driving the vibrator rolls taken along line 8—8 of Figs. 4 and 7.

Fig. 9 is an elevational view of typical work produced upon the machine of this invention.

Fig. 10 is a side elevational view of a machine for handling a continuous web through a plurality of paper handling units, one of which is the carbon applying unit of this invention.

The carbon applying apparatus of this invention consists of a frame 10 upon which a pair of upwardly extending brackets 11 and 12 are secured upon opposite sides of the frame 10. A pair of paper sheet or web feeding rolls 13 and 14 is suitably bearinged in the brackets 11 and 12 and are arranged in parallel relation therebetween. A feed roll 15 is disposed in parallel relationship with the feed roll 14 within a support table 16 upon which the paper sheet or web rests in its passage to the feed rolls 13 and 14. A slot 17 is provided in the table 16 so that the surface of the roll 15 can be disposed slightly above the upper surface of the table 16. One end of the feed roll 15 is bearinged in an arm 18 extending from the bracket 11 while the opposite end of the feed roll is bearinged in a bar 19 secured to the bracket 12. The feed rolls 13 and 14 are also bearinged in the bar 19 at one end thereof.

Each of the feed rolls 13, 14 and 15 has a beveled gear 20 upon the shaft thereof disposed between the bar 19 and the bracket 12. A countershaft 21 is suitably bearinged in the bar 19 and is provided with beveled gears 22 adapted to engage the beveled gears 20 so that the feed rolls 13, 14 and 15 will be driven at synchronous speeds. The center beveled gear 20a drives the countershaft 21 and in turn is driven by the feed roll 14 through a gear train which will be hereinafter described.

The carbon applying unit 25 consists of a pair of frame members 23 and 24 retained in spaced parallel relationship by means of the bars 26. A shaft 27 supports the frame members 23 and 24 and is bearinged in the bracket members 11 and 12 and thereby provides a pivot for the carbon applying unit 25.

Carbon applying rolls 28 (Figure 4) are carried upon a shaft 29 suitably bearinged in the frame members 23 and 24, as for example, by means of the ball bearings 30. The carbon applying rolls 28 are adjustable axially upon the shaft 29 so that they can be disposed at any selected position with respect to a paper sheet or web passing thereover. It will be understood that any number of such rolls 28 may be provided, depending upon

the number of rows of regularly recurrent carbon areas to be applied to any particular job. The rolls 28 may be secured to the shaft 29 by means of suitable set screws 31. An electric heating unit 32 is disposed within the shaft 29 for heating the carbon applying rolls 28 and thus maintain the carbon in liquid form for application upon a paper web. The heating unit may be supported upon the frame members 23 and 24 by means of suitable brackets 33.

A carbon receiving roll 34 is suitably bearinged in the frame members 23 and 24 and is disposed adjacent the lower end of the frame members for engaging carbon supplying discs 35 supported upon a liquid carbon supply container 36. The carbon supplying discs are adapted to lightly engage the roll 34 for supplying carbon thereto. The roll 34 engages a transfer roll 37 that is suitably bearinged in the frame members 23 and 24. The transfer roll 37 in turn engages a pair of vibrating rolls 38 and 39, and they in turn engage the transfer rolls 40 and 41, respectively, which in their turn engage the carbon applying rolls 28 for supplying liquid carbon thereto. The rolls 37 to 41 inclusive are all suitably bearinged in the frame members 23 and 24 in parallel alignment with one another so that their entire surfaces engage for transferring carbon from the carbon receiving roll 34 to the carbon applying rolls 28. Electric heating elements 42 and 43 are disposed within the vibrator rolls 38 and 39 to heat the same and maintain the carbon in liquid form during its transfer from the transfer roll 37 to the transfer rolls 40 and 41.

The carbon supplying discs 35 are carried upon a shaft 44 supported upon the carbon supply container 36. The carbon supplying discs 35 are adjustable axially upon the shaft 44 to position the discs in alignment with cooperating carbon applying rolls 28 as shown in Fig. 4. The discs 35 may be secured to the shaft 44 by means of set screws 45.

The carbon supply container is adapted to be heated by means of an electric strip heater 46 positioned within the walls of the container 36 for maintaining the temperature of the carbon therein sufficiently high to hold it in liquid form. The supply container 36 may be supported by means of a cart 47 having wheels 48 adapted to run upon tracks 49 for moving and guiding the cart and supply container with respect to the carbon receiving roll 34 of the carbon applying unit 25. One of the wheels for the cart 47 may consist of a spur gear 50 adapted to ride upon the rack 51. A screw 52 extends through the supporting leg 53 for the gear 50 and is adapted to frictionally engage the gear to prevent its rotation and thus prevent movement of the cart 47 with respect to the carbon applying unit 25.

An impression roller 55 is supported upon the brackets 11 and 12 by means of upwardly extending ears 56 and 57, respectively (Figure 2), and is disposed above the carbon applying rolls 28 so that a paper sheet or web can be fed therebetween. Pressure rollers 58 and 59 are disposed above the feed rollers 14 and 13, respectively for applying pressure upon a paper sheet or web passing across the feed rollers 14 and 13. The pressure rollers 58 and 59 are carried upon arms 60 and 61, respectively that are pivoted to brackets 62 and 63, respectively, by means of pivot pins 64 and 65. The brackets 62 and 63 are clamped upon supporting brackets 66 and 67 that are secured to the bracket members 11 and 12 extending upwardly from the frame 10. The arms 60 and 61

maintain the rollers 58 and 59 in close adjacent relationship to the feed rollers 14 and 13, being adjusted by means of screws 68 and 69. Springs 70 and 71 retain the arms 60 and 61 in engagement with the screws 68 and 69 to maintain a predetermined adjusted relationship between the rollers 58 and 59 and the feed rollers 14 and 13, respectively.

Paper sheets 75 of a paper web are adapted to be fed from the table 16 to the feed roller 14 by means of the feed roll 15. This feeding mechanism consists of a bell crank lever 72 pivoted upon the pivot pin 73 and having two arms 76 and 77 extending angularly from the arm 78 of the bell crank lever 72. The arm 78 carries a roller 79 that engages the surface of an actuating cam 80 carried upon a driven shaft 81, the drive for the shaft 81 being hereinafter described. A spring 86 retains the roller 79 in engagement with the surface of the cam 80. The arm 76 of the bell crank lever 72 carries a roller 82 disposed above the feed roll 15 so that the paper sheet or web 75 can pass between the roll 82 and the feed roll 15. The arm 77 of the bell crank lever 72 is disposed beneath the feed roll 15 and carries a stop pin 83 that is adapted to stop the end of the sheet 75 for properly positioning the same for advancement to the feed roll 14 so that carbon spots can be applied to the under surface of the sheet or web 75 by means of the carbon rolls 28.

Rotation of the cam 80 causes the roller 79 to ride upon the valley 84 and the land 85 of the cam 80. As long as the roller 79 engages the valley 84 the roller 82 will be out of engagement with the paper sheet or web 75 passing between the roller 82 and the feed roll 15. The sheet or web 75 is moved forward into engagement with the stop pin 83 to prelocate the forward edge of the paper sheet or web 75 for advancement to the feed roll 15. When the land 85 engages the roller 79 on the arm 78 of the bell crank lever 72, the arms 76 and 77 will be moved downwardly as viewed in Fig. 3 so that the roller 82 will apply pressure upon the paper sheet or web 75 so that the feed roll 15 then advances the paper sheet or web 75 to the feed roll 14. It is, of course, understood that movement of the arm 77 removes the stop pin 83 from engagement with the edge of the paper sheet or web 75 so that the same can be advanced to the feed roll 14. This feed mechanism is synchronized with the operation of the elements of the machine in a manner hereinafter described.

As heretofore mentioned the carbon applying unit 25 is pivotally mounted upon the shaft 27. The carbon applying unit is pivotally mounted to permit movement of the carbon applying rolls 28 with respect to the impression roller 55. Simultaneously, with this movement the carbon receiving roll 34 is moved into and out of engagement with the carbon applying discs 35 so that the carbon is supplied to the receiving roll 34 only when the carbon applying rolls are in engagement with a paper sheet or web 75. By so actuating the carbon applying unit the carbon is used from the unit for application upon a paper sheet or web 75 as rapidly as supplied to the carbon receiving roll 34. Therefore the carbon applying unit 25 does not become loaded with excess carbon in the intervals between the applications of carbon to the sheet or web 75.

A driven cam 90 (Figure 3) is provided for actuating the carbon applying unit 25 for pivoting the same upon the shaft 27 at the proper intervals for applying carbon to spot areas upon

the paper web or sheet 75. The cam 90 is secured to a driven shaft 91 and is synchronized with the other mechanism of the machine in a manner hereinafter described. The cam 90 is provided with a pair of annular grooves 87 and 88 (Figure 2) adapted to receive cam segments 89. Screws 92 secure the cam segments 89 within the grooves 87 and 88. These segments 89 determine the interval of time that the carbon applying rolls 28 will be in engagement with the paper sheet or web 75. Either a single segment can be used for controlling the engagement time of the carbon applying rolls 28, or a plurality of segments can cooperate with one another to provide any time interval desired and thus control the length of the carbon spot applied to the sheet or web 75. As shown in Fig. 3 the cam segments 89 are separated from one another and therefore the carbon applying rolls are brought into engagement with the sheet or web 75 twice for each revolution of the cam 90.

The segments 89 provide the lands on the cam 90 for actuating a bell crank lever 93 which pivots at 94 to the frame 10 and having a roller 95 on one end thereof and an adjusting screw 96 on the opposite end thereof adapted to engage the frame member 24 of the carbon applying unit 25. The pivot 94 for the bell crank lever 93 is a shaft that extends between the frame members 11 and 12, the lever 93 being secured to the shaft 94 by a set screw 97. A lever 98 is secured upon the shaft 94 and retained from rotation by means of a set screw 99. The lever 98 is provided with an adjusting screw 100 similar to the adjusting screw 96 and is adapted to engage the frame member 23 of the carbon applying unit 25.

Rotation of the cam 90 causes the roller 95 to ride upon the lands provided by the cam segments 89 to rotate the carbon applying unit in a clockwise direction about the pivot 27 and thus place the carbon receiving roll 34 in engagement with the carbon applying discs 35 and place the carbon applying rolls 28 in engagement with the under side of the paper sheet or web 75 passing between the carbon applying rolls 28 and the impression roll 55. As long as the roll 95 engages the cam segment 89 the carbon will be transferred from the carbon applying rolls 28 to the paper web or sheet 75. When the roll 95 rides in a valley 101 provided by the surface of the cam 90 the carbon applying unit will be rotated to prevent engagement of the carbon applying rolls with the web or sheet 75 and prevent engagement of the carbon receiving roll with the carbon applying discs 35. The edges of the cam segments 89 are sharp to provide rapid engagement and disengagement of the carbon rolls 28 with the paper sheet or web 75 so that a sharp line of carbon is provided at the point of engagement and disengagement with the web 75 thereby improving the neatness and appearance of the finished product.

The shaft 27, which provides the pivot for the carbon applying unit 25 carries a stop member 102 that limits the degree of rotation of the carbon applying unit 25 (see Fig. 1). Adjustable stop members 103 and 104 are carried upon the bracket 12 between which the stop member 102 may reciprocate. The adjustment of the stop members 103 and 104 control the rotation of the carbon applying unit 25. A spring 105 urges the stop member 102 against the stop 103 to make a clean break between the carbon applying rolls 28 and the paper web or sheet 75 passing thereover.

The various elements of the machine heretofore described are synchronized in their operation by means of a system of chain and gear drives. The shaft 91 for the cam 90 carries a pulley 106 driven by a belt 107 from a suitable source of power such as an electric motor. An endless chain 109 engages a sprocket 108 carried upon the shaft 91 and a sprocket 110 carried upon the shaft 81 for the feed cam 80. Therefore, the cam 90 for actuating the carbon applying unit 25 and the cam 80 for feeding the paper sheets toward the carbon applying rolls 28 may be synchronized in their operation so that the cam 80 will operate the bell crank lever 72 to feed the paper web or sheet toward the carbon applying rolls 28 at the proper interval of time inadvance of the actuation of the carbon applying unit 25 by means of the cam segments 89 so that the sheet or web 75 will be in position above the carbon applying rolls 28 for applying carbon to the underneath side of the sheet at the proper spots on the sheet. Since the paper feeding cam 80 rotates once for each revolution of the carbon unit actuating cam 90 it will be readily apparent that the carbon spots will be applied upon the sheets passing over the carbon applying rolls at the same location on each sheet.

An endless chain 111 engages a second sprocket on the shaft 81 and engages a sprocket 112 on the shaft 44 that carries the carbon applying discs 35 whereby the discs are driven for rotation in the liquid carbon contained in the supply container 36. The shaft 81 also carries a spur gear 113 that drives a gear train consisting of the spur gears 114, 115, 116 and 117 for rotating the impression roller 55. The spur gear 116 is carried upon the shaft for the feed roll 14 and thus drives the beveled gear 20a (see Fig. 2) for driving the feed rolls 15 and 13 therefrom. The supporting shaft for the impression roller 55 has a second spur gear 118 thereon that drives a gear train consisting of the gears 119, 120, 121, 122, 123, 124 and 125 for driving the carbon applying rolls 28, the transfer rolls 40 and 41, the vibrator rolls 38 and 39, the transfer roll 37 and the carbon receiving roll 34. Thus it will be seen that all of the mechanism of the carbon applying unit 25 is driven in synchronism. The rotation of the carbon applying unit 25 about the pivot 27 is insufficient to separate the mesh between the spur gears 118 and 119 so that the drive connection is never lost.

The vibrator rolls 38 and 39 are adapted to be reciprocated axially by means of a crank arm 126 (Figure 6) that is pivotally mounted upon the ears 127 extending from the frame of the carbon applying unit 25. The crank arm is provided with pins 128 that engage annular grooves 129 in the vibrator rolls 38 and 39. A yoke 130 on the crank arm 126 engages an eccentric 131 (see Figs. 4 and 8) rotatably carried upon the shaft 132 for the carbon receiving roll 34. The eccentric 131 has a spur gear 133 integral therewith that meshes with a pinion 134 carried upon a stub shaft 135. The pinion 134 is integral with a spur gear 136 that meshes with a pinion 137 secured to the shaft 132 by means of a pin 138, whereby the eccentric 131 is slowly driven to oscillate the crank arm 126 and thus reciprocate the vibrator rolls axially. Reciprocation of the vibrator rolls 38 and 39 spreads the liquid carbon upon the transfer rolls 37, 40 and 41 so that the carbon is more evenly distributed upon the surface of the carbon applying rolls 28.

A typical workpiece having carbon spots applied thereto is shown in Fig. 9 wherein the car-

bon spots 139 and 140 have been applied to the sheet 75 in two different areas. The length of the carbon spots 138 and 140 is controlled by the length of the cam segments 89 as previously described. The transverse position of the carbon spots 139 and 140 upon the sheet 75 is regulated by axial adjustment of the carbon applying rollers 28 upon the shaft 29 that support the same. The width of the carbon spot is regulated by the width of the carbon applying roll. Thus it may be seen that the spots can be applied at any location upon a sheet and they may be of any width or length desired.

There may be times when a paper sheet 75 does not enter between the feed roll 14 and the pressure applying roll 58 in the proper manner and under such condition the carbon on the rollers 28 would smear the face of the impression roller 55 and spoil sheets subsequently treated. To prevent this from happening the shaft 96 is movable axially so that the bell crank lever 93 and the lever 98 can be moved out of engagement with the frame members 23 and 24 of the carbon applying unit and thus prevent actuation of the unit when the cam segments 89 engage the roller 95.

The shaft 94 is slidable in the frame 10 and is provided with a spring 141 around one end thereof retained between the frame 10 and the collar 142 so that the spring urges the shaft in a downward direction as viewed in Fig. 2. A collar 143 limits the movement of the shaft 94. A bell crank lever 144 is pivoted by a pin 145 upon the frame 10 and has the end 146 in engagement with the end of the shaft 94 and the opposite end connected to a rod 147. The rod 147 is connected to a bell crank lever 148 pivoted at 149 and having a handle 150 for operating the bell crank lever 148 and thus the bell crank lever 144 to move the shaft 94 upwardly as viewed in Fig. 2 when desired.

The machine that has been described thus far is particularly adaptable for use in applying carbon spots on individual sheets of paper. Each sheet of paper is fed against the stop pin 83 and is thus properly located for passage through the carbon applying unit of the machine. The carbon applying unit is capable of being used as one of the units in a series of paper handling units wherein a continuous web may be printed, perforated, creased, carbon applied thereon, folded, stacked, etc. The carbon apparatus of this invention performs one of a series of operations on a continuous web.

Fig. 10 shows a schematic machine for performing a series of operations upon a continuous web, one of which is the carbon applying operation performed by the machine of this invention. In this modification the frame 160 supports a plurality of paper handling units 161 and the carbon applying apparatus 162 of this invention. A continuous web 163 is fed or pulled through the paper handling unit 161 and the carbon applying apparatus 162, and as shown in this modification, the web passes over a roll 164 to a receiving roll 165. The carbon applying apparatus 162 is identical with the carbon apparatus previously described except that the continuous chain 109a for driving between the cam 90 and the cam 80 is somewhat longer to permit adjustment of the carbon applying unit 25a with respect to the cam 90 so that slight variations in location of the carbon spot on the continuous web can be adjusted. An idler pulley 166 is provided to retain tension upon the endless chain 109a. The carbon applying unit 25a is adjustable upon the frame 160 by means of an adjusting screw 167. An electric motor 168 drives a shaft 169 through a chain and spur gear 170 for driving the paper handling units 161 by means of the shafts 171 and the carbon applying apparatus 162 by means of the shaft 172. The operation of the carbon applying apparatus 162 is identical with the operation of the apparatus heretofore described.

This application is a division of our co-pending application, Serial No. 447,850, for Method and apparatus for applying carbon to sheets, filed June 20, 1942.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent is:

1. That method of applying liquid carbon to predetermined areas only of a strip of material comprising, translating the strip at a given speed, positively and continuously rotating a carbon transfer means adjacent the path of said strip so that its surface speed is equal to that of said strip, moving said transfer means into contact with said moving strip in timed relation to the spatial position thereof to apply carbon to the desired area, and suddenly withdrawing said transfer means when the predetermined area has been covered.

2. A method for applying coating to predeterminedly spaced recurring areas only of a moving strip, comprising, moving said strip linearly along a direction parallel with that determined by said recurring areas, positively and continuously rotating a coating transfer surface adjacent and in alignment with the line of recurring areas at a surface speed equal to that of said strip and in the same direction of motion as said strip, positively moving said surface into and out of contact with said strip in timed relation to the spatial movement thereof dependent upon the location, length, and spacing of said areas, and supplying coating material to the transfer surface only during time intervals whose sum is substantially equal to the total time said surface and strip are in coating contact.

3. That method of applying coating to aligned, regularly-recurring areas only of a strip, comprising; moving said strip at a given linear speed in a direction determined by the direction of said aligned areas, positively rotating a coating transfer surface adjacent, in the same direction, and in contact with said strip, at a surface speed substantially equal to that of said strip and positively and instantaneously moving said transfer surface out of contact with said strip in predetermined timed relation with the movement thereof, to form aligned coated areas interspersed with uncoated areas in the desired linearly-spaced relation and extent.

4. That process of applying carbon in spot areas to a strip of paper, comprising, moving said strip at a uniform rate parallel to the direction determined by successive spots in the same line, simultaneously positively rotating a carbon transfer element at a substantially like surface speed adjacent said strip, in the same direction as said strip and in a plane normal to said strip and containing said line, and intermittently shifting said transfer element into and out of contact with said strip, in timed relation to the movement thereof, to apply carbon to the desired areas of said strip.

JAMES A. LA HATTE.
ROBERT B. SMITH.