May 22, 1956 J. W. NEUMANN 2,746,387

ROTARY INTAGLIO PRINTING AND EMBOSSING PRESS

Filed Nov. 7, 1950 6 Sheets-Sheet 1

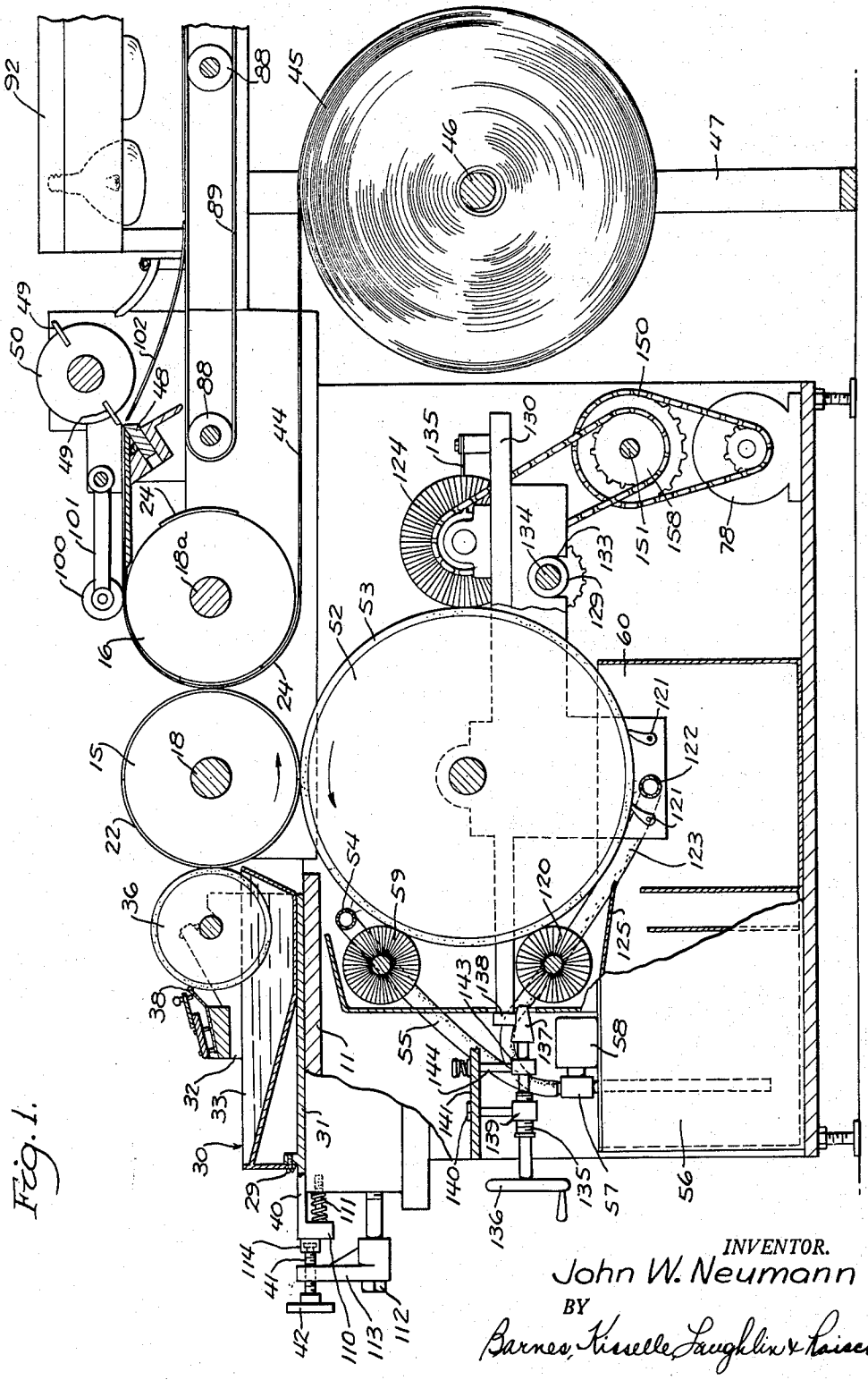


Fig. 1.

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Filed Nov. 7, 1950 6 Sheets-Sheet 2

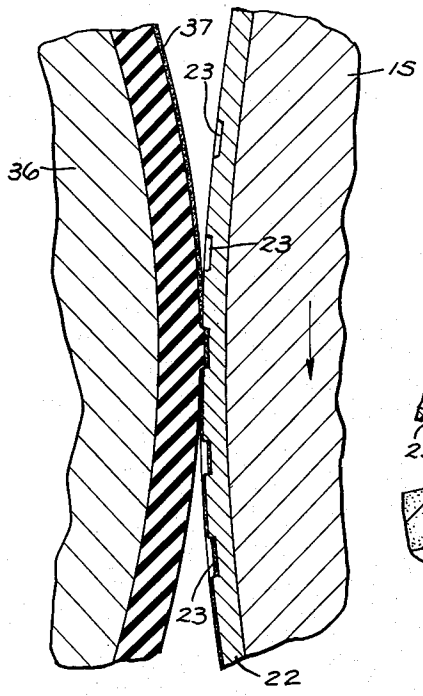


Fig. 2.

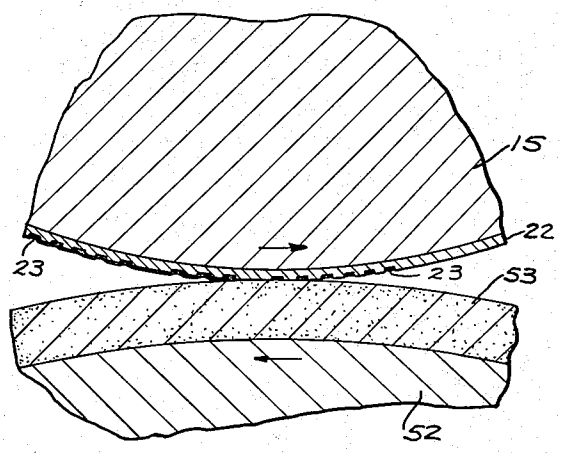


Fig. 3.

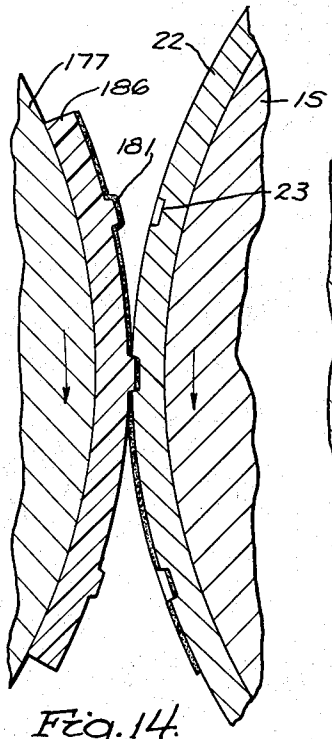


Fig. 14.

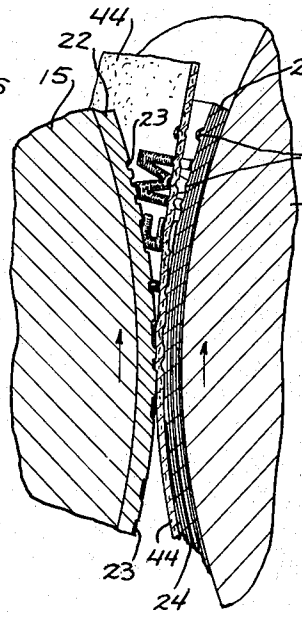


Fig. 4.

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Filed Nov. 7, 1950 6 Sheets-Sheet 3

Fig. 5.

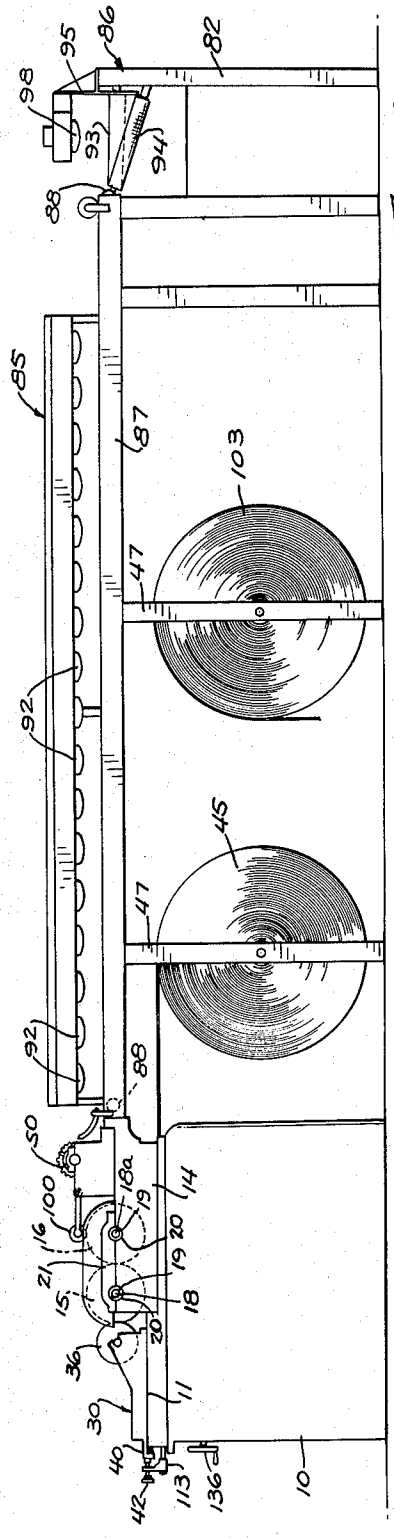
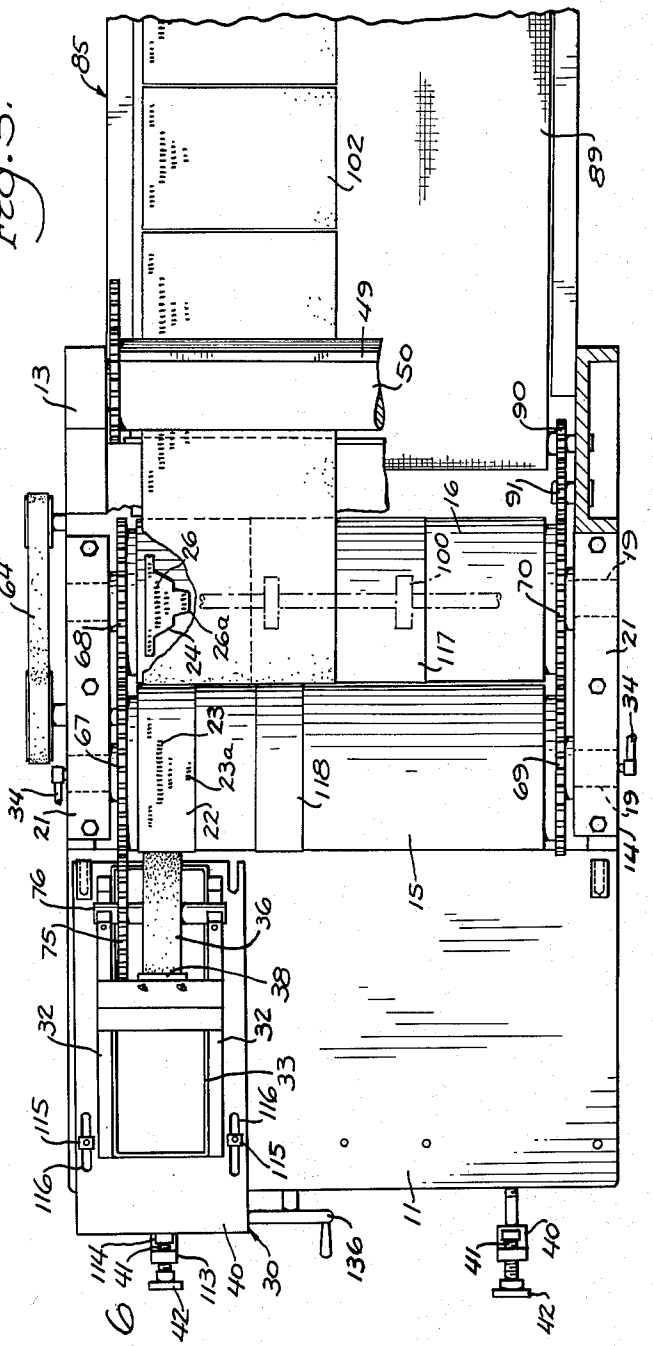


Fig. 6



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May 22, 1956 J. W. NEUMANN 2,746,387

ROTARY INTAGLIO PRINTING AND EMBOSSING PRESS

Filed Nov. 7, 1950 6 Sheets-Sheet 4

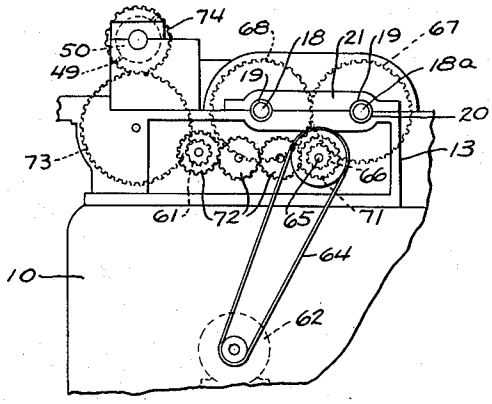


Fig. 7.

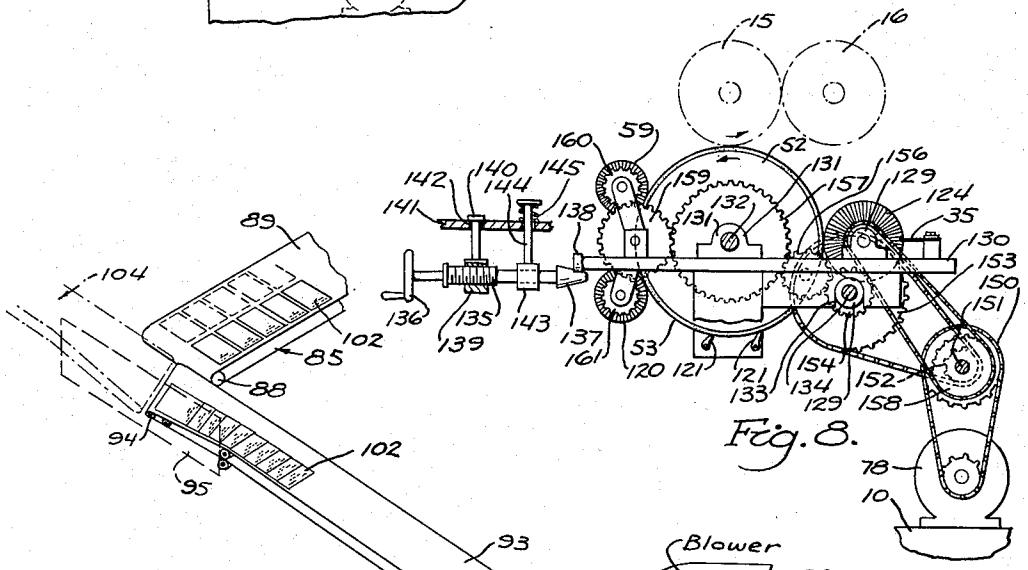


Fig. 8.

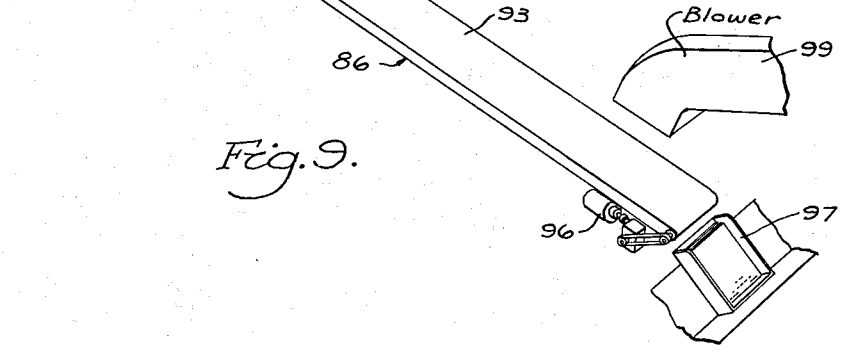


Fig. 9.

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May 22, 1956 J. W. NEUMANN 2,746,387

ROTARY INTAGLIO PRINTING AND EMBOSSING PRESS

Filed Nov. 7, 1950 6 Sheets-Sheet 5

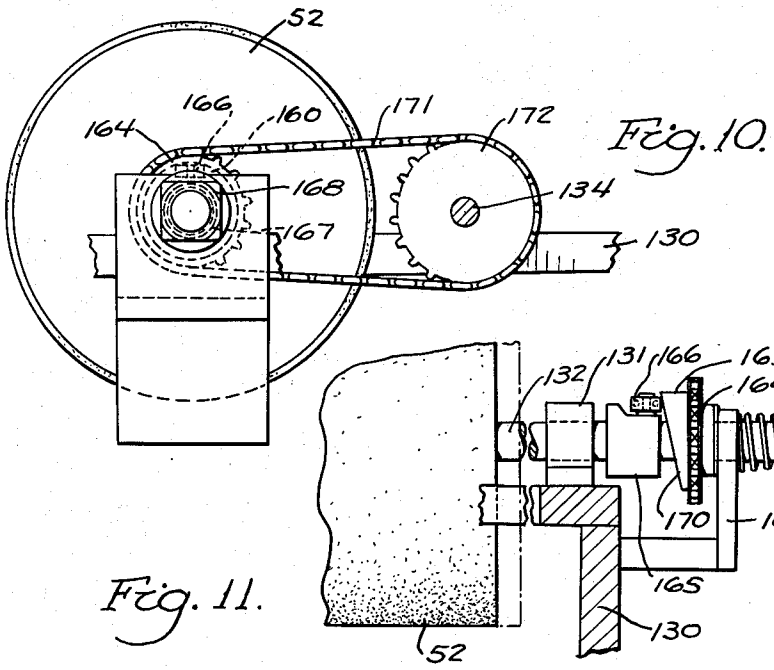


Fig. 10.

Fig. 11.

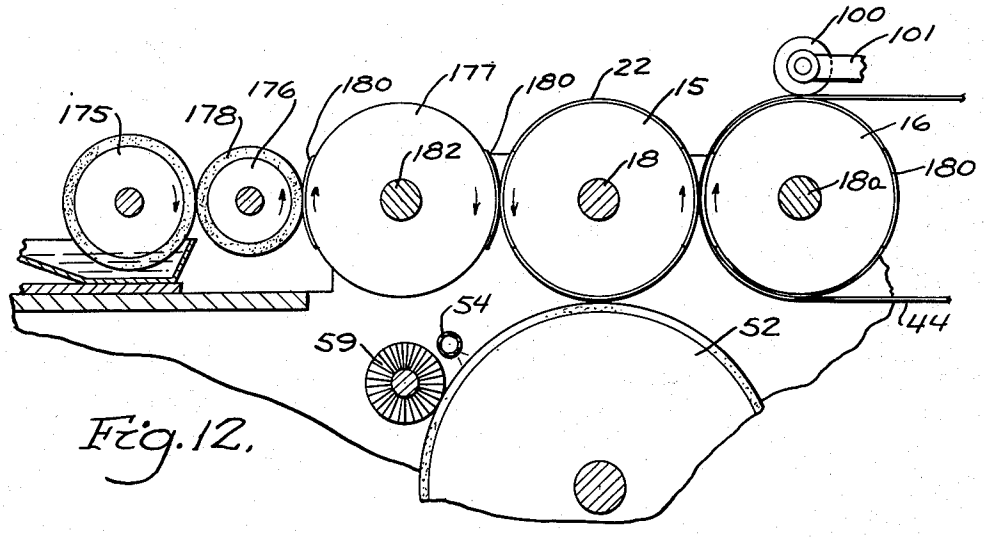


Fig. 12.

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ROTARY INTAGLIO PRINTING AND EMBOSSING PRESS

Filed Nov. 7, 1950 6 Sheets-Sheet 6

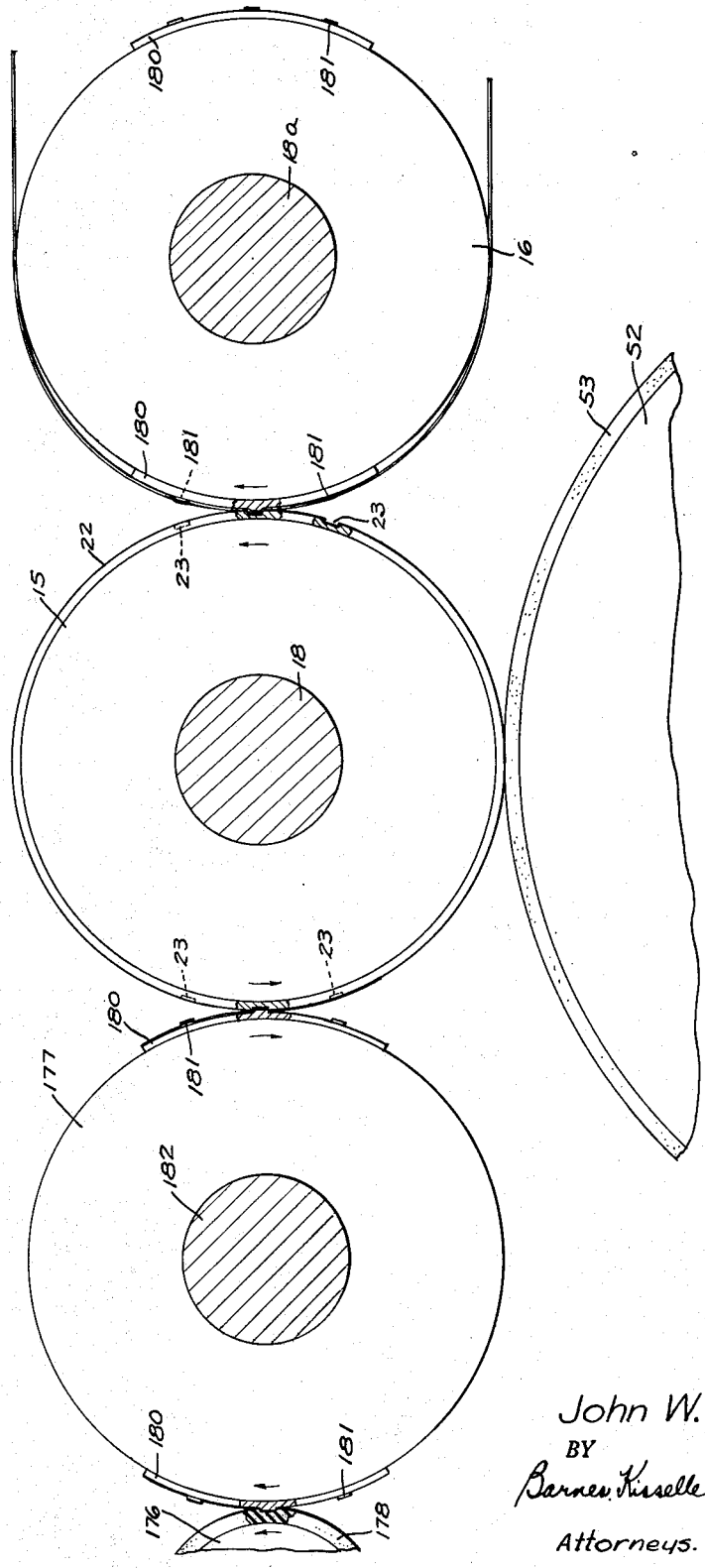


Fig. 13.

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2,746,387

ROTARY INTAGLIO PRINTING AND EMBOSSING PRESS

John W. Neumann, Detroit, Mich., assignor to Rotographic, Inc., Ferndale, Mich., a corporation of Michigan

Application November 7, 1950, Serial No. 194,478

11 Claims. (Cl. 101—155)

This invention relates to intaglio or gravure printing apparatus and more particularly to a rotary printing and embossing press for producing reproductions of the type commonly known as steel die stamping, steel die engraving, or copper plate engraving.

It is an object of this invention to produce a rotary printing press which is capable of producing engraved reproductions of the finest quality and with an unlimited size capacity at a very high rate of production.

It is also an object of this invention to produce an automatic rotary press which simultaneously prints and embosses.

More specifically, the invention contemplates a rotary printing press wherein an engraved metal die is mounted on the surface of one roller and arranged to engage the surface of another roller with substantially line contact pressure so that when a web of paper is fed between the two rollers the ink from within the engraving cuts on the die is applied to the paper. The second roller has secured thereto a male die which registers with the engraving cuts on the female die to permit printing and embossing in one operation. The arrangement also includes a novel inking mechanism for applying the desired amount of ink to the engraved die and a novel mechanism for wiping the ink from the unengraved surface portions of the die.

In the drawings:

Fig. 1 is a longitudinal vertical sectional view through the rotary press of this invention.

Fig. 2 is a fragmentary enlarged sectional view of the ink and printing rollers taken in a plane perpendicular to their axes of rotation and looking from the side of the press opposite the drive.

Fig. 3 is a fragmentary enlarged sectional view of the printing and wiping rollers taken in a plane perpendicular to their axes of rotation.

Fig. 4 is a fragmentary enlarged perspective view in section of the die and counterrollers showing the manner in which a web of paper fed therebetween is simultaneously printed and embossed.

Fig. 5 is a side elevation of the press on the side opposite the drive and shows the conveyor arrangement therefor.

Fig. 6 is a top elevation of the press and a portion of the conveyor.

Fig. 7 is a diagrammatic view showing the drive arrangement for the die and counterrollers and for the rotary knife.

Fig. 8 is a view showing the drive arrangement, cleaning mechanism, and adjusting means for the wiping roller.

Fig. 9 is a diagrammatic perspective view of the conveyor arrangement.

Figs. 10 and 11 are fragmentary views taken at right angles to each other showing the oscillating mechanism for the wiping roller.

Fig. 12 is a fragmentary longitudinal vertical sectional view of a combined printing and embossing press of modified construction.

Fig. 13 is a fragmentary enlarged sectional view of the

inking, printing, embossing and wiping roller arrangement of press shown in Fig. 12 taken in a plane perpendicular to the axes of the rollers.

Fig. 14 is an enlarged detail of the transfer and printing rollers of the machine illustrated in Figs. 12 and 13.

In Figs. 1 through 11 there is illustrated one form of construction of the press of this invention which comprises an upright hollow base 10, the upper end of which is closed at the rear portion by a bed plate 11. At the upper end of base 10 and spaced forwardly of plate 11 there is mounted a pair of parallel side frames 13 and 14. A printing roller 15 and a counterroller 16 are journalled at one end on frame 13 and at the other end on frame 14. Rollers 15 and 16 are fixed upon shafts 18 and 18*a*, respectively, the opposite ends of which are fitted with bearings 19. Side frames 13 and 14 are provided with spaced bearing sockets 20 for receiving bearings 19 at the ends of shafts 18. A split bearing cap 21 is arranged to be secured to the upper face of side frames 13 and 14 for fixedly holding bearings 19 within the bearing sockets 20 and thereby retaining rollers 15 and 16 spaced apart a fixed distance.

On the surface of printing roller 15 there is secured by suitable means a cylindrical die plate 22 which extends circumferentially around roller 15 and which is engraved on its surface as at 23 with the legend or representation to be printed.

A counter 24 is secured to the surface of roller 16 to correspond in position with the engraving on die 22. The number of counters 24 corresponds with the number of separately engraved areas on die plate 22. In the embodiment illustrated die plate 22 is engraved at two diametrically opposed areas and therefore two diametrically positioned counters 24 are employed. Counters 24 may be formed of a variety of materials such as paper, plastic materials such as resins, and fabric or paper impregnated with resins or the like. In the form of machine illustrated in Figs. 1 through 11 each counter 24 is of the laminated type comprising a plurality of strips of paper 25 which are built up one upon the other with adhesive until the desired thickness of the counter is obtained. If it is desired to use the press for embossing as well as printing, then the counter 24 is built up to a thickness such that, when the two rollers are rotated, the laminations 25 are compressed by the die plate 22 and the engraving cuts 23 produce corresponding projections 26 on the surface of counter 24 which register and interfit with the engraving cuts on die plate 22. The legend to be printed therefore appears in intaglio on die plate 22 and in relief on counter 24. It will be appreciated, of course, that if it is not desired to emboss the printed matter, then counter 24 simply comprises a substantially flat pad which is contacted by the surface of die plate 22 when the two rollers are rotated. In such a case, the engraving cuts on die plate 22 are of less depth than when it is desired to emboss the printed matter.

As will be explained more fully hereinafter, rollers 15 and 16 are both gear driven at the same number of revolutions. In order to insure the same surface speed for both rollers, which I have found to be absolutely essential, it is preferred to space the bearing sockets 20 apart a fixed distance equal exactly to the diameter of roller 15 as increased by two thicknesses of die plate 22 which will be an accurate total diameter equal to the pitch diameter of the gears 67 and 69. Then by building up the counter 24, as by the paper laminations 25, the same surface speed of the unengraved surface of die plate 22 and the surface of counter 24 is insured, since the diameter of roller 16 increased by the thickness of the two counters 24 will be exactly equal to the diameter of the roller 15 increased by two controlled thicknesses of die plate 22.

For supplying ink to die plate 22, there is provided an

ink fountain 30 having a substantially flat base 31 and upright side walls 32 at each side thereof. Base 31 is fashioned to receive a receptacle 33 for ink which may be secured to base 31 as by a screw 29. A roller 36 is journalled at each end in the side walls 32 and dips on its lower side into the ink within receptacle 33. Roller 36 is provided with a continuous layer of rubber 37 on the cylindrical surface thereof. A doctor blade 38 is arranged to engage the surface of roller 36 and thereby control the thickness of the film of ink on the surface of roller 36.

Ink fountain 30 is positioned on plate 11 such that roller 36 contacts the surface of the cylindrical die plate 22. I have found that, in addition to controlling the depth of the engraving cuts 23 and the doctor blade 38, the amount of ink applied to die plate 22 can be increased or decreased by varying the contact pressure between roller 36 and die plate 22. Base 31 is accordingly formed with a rigid extension 40 which overhangs the rear edge of plate 11 and which terminates in a depending boss 110 (Fig. 1). A compression spring 111 acts between boss 110 and plate 11 to bias the ink fountain in a direction away from roller 15. A headed bolt 112 at the rear end of base 10 loosely supports an arm 113 which is threaded to receive an adjusting screw 41. Screw 41 has a turning knob 42 at one end and a swivel block 114 at its other end. Arm 113 is arranged to be rotated on bolt 112 to an upright position wherein block 114 engages against boss 110. The base 31 can therefore be urged in a direction opposed to the force of spring 111 to vary the pressure with which roller 36 bears against die plate 22 by simply turning knob 42. The action of spring 111 is also such that when arm 113 is struck with a sharp blow to disengage block 114 from boss 110, base 31 springs back away from roller 15 and contact between roller 36 and die plate 22 is immediately broken. A pair of T-bolts 115 on plate 11 which extend upwardly through elongated slots 116 on base 31 is provided for guiding and firmly clamping base 31 on plate 11 after the proper pressure adjustment between roller 36 and die plate 22 is obtained.

Referring to Fig. 2, it will be observed that, when rollers 36 and 15 are rotated in the contacting position, a film of ink is applied to the surface of die plate 22 as well as within the engraving cuts 23. The quantity of ink deposited within the engraving cuts 23 determines the depth of color applied to the paper being printed. The quantity of ink within cuts 23 is also important from the standpoint of the quality of the reproduction produced, since an excess of ink causes spurting and feathered edges on the legend printed. The importance of regulating the pressure between roller 36 and die plate 22 will be readily appreciated, since this pressure and the adjustment of doctor blade 38 determine the amount of ink deposited within the engraving cuts 23.

The paper to be printed is fed as a web 44 between rollers 15 and 16 from a spool of paper 45 which is supported at its center upon a shaft 46 fixed at its ends upon upright supports 47. The web of paper 44 travels upwardly between rollers 15 and 16, over the top of roller 16, under guide rollers 100, and through a cutting mechanism comprising a stationary blade 48 and a pair of rotating blades 49 which are mounted on a rotating support 50. The speed of the rotating cutting mechanism is controlled relative to the rate of travel of the paper web such that the paper is cut to the desired sheet size, as will be more fully explained hereinafter. The paper web 44 is drawn through the machine by the rollers 15 and 16 and, since counters 24 do not extend continuously around roller 16, rollers 15 and 16 are each provided with circumferential pads 118 and 117 between which a portion of the web 44 is gripped at all times. The thickness of pad 118 is such that the effective diameter of roller 15 is exactly the same at die plate 22 and pad 118.

The ink which it is desired to transfer from die plate 22 to the paper web 44 is that ink which is deposited within the engraving cuts 23, and suitable means are therefore provided for wiping the unengraved surface portions of die plate 22 free of ink. In order to produce work of the highest quality, I have found that the wiping mechanism must be capable of wiping the surface die 22 absolutely clean and dry without removing, to any extent, any of the ink contained within the engraving cuts 23. A wiping mechanism which will produce these results is absolutely necessary in order to obtain sharply defined characters in deep, solid colors.

A preferred form of wiping arrangement which I have found to produce the desired results is illustrated in Fig. 1 and comprises a large roller 52 which is supported on base 10 below printing roller 15. Roller 52 is formed throughout or provided with at least a surface layer 53 of non-absorbent, heat resistant material, such as hard rubber, hard fiber, suitable plastics, etc., which provides a relatively smooth surface on the roller. The material of surface layer 53 must be capable of resisting the heat generated by the frictional engagement of roller 52 and die plate 22. At the same time, it must be a material which does not absorb ink and ink solvents so that it may be thoroughly cleaned. I have found that a wiper roller made of a thermo-plastic material manufactured and sold by United States Rubber Co. under the name "Enrup" works excellently. Roller 52 is supported on base 10 such that the surface of layer 53 just contacts and wipes over the surface of die plate 22. Rollers 15 and 52 are driven by suitable means, hereinafter more fully described, such that the surfaces of die plate 22 and roller 52 move in opposite directions at the point of contact so as to produce a very effective wiping action over the surface of die plate 22. In addition to moving in a direction opposite to surface of die plate 22, I have found that satisfactory results are obtained only when the surface of wiper roller 52 travels at a higher velocity than the surface of die plate 22. The surface of the wiper roller must travel at a rate such that it removes ink from the point of contact with plate 22 at a faster rate than the ink is presented by rotation of die plate 22. In other words, wiper roller 52 must remove the ink from plate 22 faster than it accumulates between the contacting surfaces of the die plate and wiping roller so that there will be no pool of ink at this point which can accumulate in the die cuts 23. I have found that when the surface speed of wiper 52 is about 1½ times the surface speed of die plate 22, a satisfactory wiping action is obtained.

The wiping action of roller 52 on die plate 22 generates considerable heat due to friction, and roller 15 is therefore formed as a hollow cylinder and water cooled as by pipes 34 swivelly connected with the cylinder at each end, one of the pipes being a water inlet and connected with a water tap (not shown) and the other pipe being a water outlet from the roller.

For the purpose of removing the ink picked up by surface layer 53, there is provided a spray nozzle 54 (Fig. 1) which is connected by a conduit 55 with a tank 56 containing a suitable solvent for the ink. A pump 57, driven by a motor 58, is connected with the conduit 55 to produce the desired flow of solvent to the spray nozzle 54. A rotary brush 59 is positioned beneath spray nozzle 54 and rotated such as to scrub the surface of the outer layer 53 on roller 52. Beneath brush 59 there is arranged a second rotating brush 120 and at the bottom of roller 52 is arranged a pair of spaced apart doctor blades 121. A nozzle 122 connected with pump 57 by a conduit 123 is arranged to spray the surface of roller 52 with clean solvent between doctor blades 121. A third rotary brush 124 buffs the surface of the wiping roller just before the roller wipes over die plate 22. A doctor blade 35 engages brush 124 and is arranged to remove from the brush foreign particles picked up from the surface of roller 52. A baffle plate 125 is positioned beneath brushes 50 and 120 to catch the ink contaminated solvent dripping

from the surface of the wiping roller and discharge it into a settling tank 60.

It will be noted that the surface of the roller 52 is sprayed with solvent issuing from nozzle 54 just after it wipes over die plate 22. The surface carrying the solvent and ink mixture is then thoroughly scrubbed by brush 59 which removes the greater portion of the ink and solvent. The surface of the wiper roller then advances to brush 120 where it is scrubbed again after which it is wiped by the first of two spaced doctor blades 121. Then it is sprayed with fresh solvent by nozzle 122 and wiped absolutely clean by the second doctor blade 121. Thereafter the surface of the wiping roller is buffed by brush 124 so that, as it again comes into contact with die plate 22, it is thoroughly clean and absolutely dry.

For supporting roller 52 on base 10 there is provided a generally rectangular frame 130 (Fig. 8) upon which roller 52 is mounted by means of pillow blocks 131 in which the ends of the shaft 132 on which roller 52 is fixed are journalled. Adjacent one end the sides of frame 130 are formed with downwardly opening slots 133, the upper ends of which form sockets for bearings 129 arranged on a shaft 134. Shaft 134 is journalled at each end in the side walls of base 10. The arrangement is such that frame 130 is free to pivot or rock around shaft 134 to thereby raise and lower roller 52. For controlling the raising and lowering of roller 52, an adjusting screw 135 is provided (Fig. 1). Screw 135 extends outwardly beyond base 10 at one end and is provided with a handwheel 136. At its other end screw 135 is fitted with a cone-shaped member 137 on the surface of which a pair of anti-friction rollers 138 is arranged to ride. Rollers 138 are mounted at the end of frame 130 remote from shaft 134. A threaded collar 139 engages a threaded portion of screw 135. Collar 139 is fixed at the lower end of a headed bolt 140 which is suspended from a bracket 141 on base 10. Bolt 140 passes freely through a hole 142 on bracket 141 so that the bolt is permitted to tilt to some extent on bracket 141. Screw 135 is also slidably supported by a second collar 143 fixed at the lower end of a bolt 144 which extends upwardly through bracket 141. A compression spring 145 acts between bracket 141 and the upper enlarged end of bolt 144 to provide a somewhat resilient support for frame 130.

It will be observed that by turning handwheel 136 frame 130 can be pivoted about shaft 134 and in this way the pressure with which roller 52 is brought to bear against die plate 22 can be adjusted. It will also be noted that, even though roller 52 should become worn to an out of round shape, the resilient support afforded by spring 145 will maintain roller 52 in contact with die plate 22.

Referring to Fig. 7, the drive mechanism for rollers 15, 16 and 36 comprises a variable speed motor 62 which is mounted at the lower end of base 10. Motor 62 is connected by a pulley and belt arrangement 64 with a shaft 65 journalled in side frame 13. A driving gear 66 is fixed on shaft 65 and is arranged to mesh with a large gear 67 which is keyed to the shaft 18 which supports roller 15. Gear 67 meshes with a similar gear 68 on the shaft 18*a* which supports roller 16 so that the two rollers are rotated in opposite directions and at the same speed. The opposite ends of shafts 18 and 18*a* are also provided with intermeshing gears 69 and 70 of the same size. There is also fixed to shaft 65 a second gear 71 which drives a plurality of idling gears 72, the last of which is supported on a shaft to which a smaller gear 61 is also secured. Gear 61 is of the same size as gear 66 and drives a large gear 73 of the same size as gears 67 and 68. Gear 73 meshes with a smaller gear 74 fixed to the rotating support 50 on which the knife blades 49 are mounted. By controlling the sizes of the gears in the above described gear train, it will be observed that the speed of the rotating knives can be controlled relative to the rate at which rollers 15 and 16 are rotated and, consequently, the speed of travel of the paper web 44.

Gear 67 at one end of roller 15 (Fig. 6) intermeshes with a gear 75 keyed to the shaft 76 on which the inking roller 36 is fixed. Gears 67 and 75 are designed such that rollers 15 and 36 have the same peripheral speed.

The driving mechanism for wiping roller 52 (Fig. 8) comprises a motor 78 on base 10 which has a chain drive with a sprocket 150 keyed to a shaft 151 which is journalled at one end of frame 10. Shaft 151 also supports a second smaller sprocket 152 which has a chain drive with a large sprocket 153 mounted on shaft 134. A smaller gear 154 is also keyed to shaft 134, and this latter gear meshes with an idler gear 156 which, in turn, meshes with a large gear 157 fixed on shaft 132. The speed of motor 78 and the gear and chain drive just described are selected such that the surface speed of roller 52 is greater than the surface speed of roller 15, preferably at least 1½ times as great. Gear 157 meshes with an idler gear 159 which, in turn, meshes with gears 160 and 161 which serve to rotate brushes 59 and 120, respectively. Brush 124 is chain driven from a sprocket 158 keyed to shaft 151.

I have found that when roller 52 is oscillated along its axis as well as rotated, an improved wiping action on plate 22 is obtained and, at the same time, the roller is more thoroughly cleaned and dried by the devices previously described which act upon the surface of roller 52. The mechanism for oscillating roller 52 along its axis of rotation is illustrated in Figs. 10 and 11. Shaft 132, which supports roller 52 and is journalled in pillow blocks 131, is extended outwardly at one end beyond pillow blocks 131 and rotatably supports a cam member 163 fixed to a sprocket 164. A collar 165 is keyed to shaft 132 and supports a roller bearing 166 which is urged into engagement with cam 163 by a compression spring 167 arranged between a nut 168 at the outer end of shaft 132 and a supporting bracket 169 on frame 130. Spring 167 is sufficiently strong to pull shaft 132 and roller 52 towards the right, as viewed in Fig. 11, so that roller bearing 166 rides at all times along the inclined face 170 of cam 163. Sprocket 164 is connected as by a chain 171 with a larger sprocket 172 keyed to the driven shaft 134. Shaft 134 rotates in the same direction as shaft 132, and it will be appreciated that in the arrangement illustrated roller 52 oscillates back and forth along its axis several times during each revolution of the roller, since cam 163 rotates at a speed greater than collar 165. The rate at which roller 52 oscillates can, of course, be controlled by suitably selecting sprockets 164 and 172; the extent of oscillation is of course relatively small and insufficient to cause a separation of the drive at 156, 157 and 159.

It will be noted that the whole wipe assembly can be removed from the press by simply disconnecting the chain drives on shaft 151 and lifting frame 130 off shaft 134. This feature is especially desirable from the standpoint of servicing the press.

The conveyor arrangement for the press comprises a longitudinal conveyor 85 and a transversely positioned conveyor 86. Conveyor 85 comprises a structural frame member 87 supported on legs 47. Frame 87 is provided with a plurality of transversely extending rollers 88 around which is arranged an endless belt 89. The endmost roller 88 toward roller 16 is positioned below rotary cutter 50 and is driven by a gear 90 which meshes with an idler gear 91 which, in turn, interengages with gear 70 at one end of roller 16. A bank of lights 92 or other suitable heating apparatus is supported on frame 87 over belt 89 to dry the ink on the paper sheets carried by the belt.

Conveyor 86 is positioned transversely of conveyor 85 at the discharge end thereof and comprises a frame member 82 on which are supported a plurality of rollers which support an endless belt 93. The rollers 94 at the end of conveyor 86 adjacent the discharge end of conveyor 85 are inclined downwardly and away from belt 89 so that, as the printed sheets of paper reach the end of conveyor 85, they fall into an inclined position on belt 93. An up-

right guide plate 95 is positioned along the inclined portion of belt 93 and forms a stop for aligning the paper sheets on belt 93 as they fall off the end of belt 89.

A suitable drive mechanism 96 is provided for driving belt 93 at a controlled variable speed. If the printed matter is simply letterheads, it will be observed that belt 93 can be driven at a much slower rate of speed than belt 89, the speed of belt 93 being adjusted so that the sheets overlap one another with only the printed matter at one end of the sheet exposed. At the discharge end of belt 93 a suitable receptacle 97 is arranged for receiving the printed sheets. Lights 98 may be arranged over belt 93 to facilitate complete drying of the ink and an air blower 99 may be arranged adjacent the discharge end of the belt to cool the printed sheets.

The operation of my rotary press is believed to be obvious from the above description. Paper is fed from roller 45 as a web 44 upwardly between rollers 15 and 16 and is directed over the top of roller 16 towards the rotary cutter 50. At the same time, the ink fountain roll 36 serves to apply a film of ink of controlled thickness to the surface of and the engraving cuts 23 in die 22.

As viewed in Fig. 1 roller 15 rotates in a counterclockwise direction, and therefore the inked surface of die 22 is wiped by roller 52 before it comes into contact with the paper being printed. Roller 52 is also rotated in a counterclockwise direction and the outer surface 53 thereof therefore wipes over the surface of die 22 to remove the ink from the surface of the die at a rate faster than the ink is presented to the surface of the wiper roll by the die thereby preventing an accumulation of ink at the line of contact between wiper surface 53 and die 22. The wiper surface 53 is then presented to the cleaning devices arranged around roller 52. The surface 53 is sprayed with solvent from nozzle 54, is scrubbed by brush 59 and then again by brush 120. The ink and solvent are then wiped off the scrubbed surface by the first doctor blade 121 and the surface is then again sprayed with fresh solvent and wiped clean by the second doctor blade 121. Finally, the cleaned surface of the wiper is buffed by brush 124 so that the surface presented to the die 22 is absolutely clean and bone dry.

Rollers 15 and 16 are synchronized in their rotation such that the engraved portion 23 of die 22 registers with the projections 26 on counter 24. Therefore, as the paper web 44 travels upwardly between the two rollers, it is embossed between the counter 24 and the die 22 and the ink within the engraving cuts 23 is deposited on the embossed portions of the paper to present very sharply defined characters. It will be appreciated that in color work the depth of shade may be controlled by increasing or decreasing the amount of ink applied to the engraved die. As was previously explained, the amount of ink picked up by die 22 can be controlled by adjusting the pressure between roller 36 and die 22 as by turning screw 41, by adjusting the doctor blade 38 and also by the depth of the engraving cuts 23.

After paper web 44 is printed and embossed between rollers 15 and 16, it continues around the top of roller 16 and travels toward rotary cutter 50. A hold-down roller 100, supported by a pivoted arm 101, aids in holding the paper in a position aligned with cutter 50. The paper is fed between knives 48 and 49 immediately after being printed and is thereby cut to the desired size, after which the sheets 102 drop on to the endless belt 89 of conveyor 85 which carries the sheets beneath the bank of lights 92 to substantially completely dry the ink. As the sheets reach the end of conveyor 85 they drop, one at a time, on to the inclined portion of the slower moving belt 93 of conveyor 86. The speed with which belt 93 is driven is controlled such that the sheets assume an overlapping position (Fig. 9) and the ink thereon is completely dried by the time the sheets are discharged off the end of conveyor 86 into receptacle 97.

One of the desirable features of the ink fountain arrangement 30 resides in the fact that it enables stopping operation of the machine or changing from one color to another without requiring a subsequent manual cleaning of ink from the surface of die plate 22 or wiping roller 52. When it is desired to stop the machine, arm 113 is struck a sharp blow in a direction transversely of the machine to disengage swivel block 114 from boss 110 and, at the same time, T-bolt 115 is loosened. Spring 111 slides base 31 to the left as viewed in Fig. 1 and inking roll 36 moves out of contact with die plate 22. As soon as swivel block 114 is disengaged from boss 110 and bolt 115 is loosened, the main switches (not shown) for motors 62 and 78 are actuated to stop the rotation of roller 15, 16 and 52. However, the lapse of time between these operations, even though they are performed in rapid succession, is sufficient to permit complete wiping of die plate 22 and complete cleaning of wiping surface 53. The machine is therefore completely cleaned when the operation thereof is stopped in this manner.

It will be appreciated that the size of copy that may be printed is controlled by the length of rollers 15 and 16. Consequently, if the particular sheets being printed are shorter than the length of rollers 15 and 16, then an additional die and counter may be secured to rollers 15 and 16 adjacent the opposite end thereof and an additional ink fountain and wiping roller are provided so as to print and emboss a web of paper from a second spool 103. When two webs of paper are fed through the press in this manner, a second conveyor 104 may be arranged at the end of conveyor 85 to extend in a direction opposite the conveyor 86.

It will also be noted that since the embossing and printing is performed by the substantially line contact pressure as distinguished from planar surface pressure as with presses of the flat bed type, large copy can be printed and embossed on a relatively small press.

The press arrangement described herein may also be employed for simultaneously printing and blank embossing by simply providing an inking roller of a width sufficient to ink only the portion of the engraved legend to be printed. The remainder of the engraved legend is thereby blank embossed. In Fig. 6, for instance, the portion 23*a* of the engraved legend 23 lies in a plane beyond the end of roller 36 and will therefore not be inked by the roller. The portion of the paper web which passes between the portion 23*a* of legend 23 and the portion 26*a* of the relief legend 26 on counter 24 will be blank embossed while the remainder of the legend will be printed and embossed.

As was previously mentioned, rollers 15 and 16 are spaced apart a fixed distance. This fixed spacing of the rollers insures the same surface speed of web 44, die 22 and counter 24 and enables controlling the pressure therebetween by varying the thickness of the laminated counter 24. The fixed spacing of rollers 15 and 16 is of special advantage for another reason. While the press is being operated with one set of rollers and dies, another set of rollers may be set up in a fixture having journals spaced apart to correspond with the spacing of bearing sockets 20. The die and counter on the rollers positioned in the auxiliary fixture can be set for the work to be printed and, after the run on the press is completed, the rollers in the press may be replaced with the rollers from the fixture in a minimum of time. This operation is facilitated by the split bearing caps 21. The time the press is down for setting up a new piece of work is therefore reduced to a minimum.

In Figs. 12 through 14 there is illustrated another form of printing press embodying the present invention. The machine illustrated in Figs. 12 and 13 differs in its construction from that shown in Figs. 1 through 11 primarily in that the ink is applied to the die 22 from the fountain roller 175 and inking roller 176 by an intermediate transfer roller 177. Roller 176 has a layer of relatively soft rubber 178 on the outer surface thereof. Roller 15 has

mounted on the outer surface thereof one or more die plates 22 as in the previous embodiment described. Rollers 177 and 16 are each provided with similar counters or male die members 180 having projections 181 which register with the engraved cuts 23 on the surface of plate 22. The shaft 182 which supports roller 177 and the shaft 18*a* which supports roller 16 are spaced apart a distance equal to exactly twice the diameter of roller 15 increased by two thicknesses of die plate 22, and shaft 18 which supports roller 15 is located exactly midway between the other two shafts. These three shafts are preferably journalled at their ends in fixed sockets on the frame of the machine provided with split bearing caps (not shown) as in the previous embodiment described. Rollers 15, 16 and 177 are interconnected by suitable gears (not shown) such that they will be rotated at exactly the same speed in the direction of the arrows in Fig. 12. Likewise, as in the previous embodiment described, inking roller 176 is geared to rotate at the same peripheral speed as roller 177.

When the machine is set in operation, roller 176 is adjusted to bear with the desired amount of pressure against the die member 180 on roller 177 to apply a film of ink over the surface of the die of the desired thickness. The surface layer 178 of roller 176 is relatively soft so that the ink is applied to the base surface as well as the projections 181 of die 180. As the roller 177 rotates, die 180 moves into registry with die 22 on roller 15, the projections 181 interfitting with the engraved cuts 23 on die 22. It will be noted that the projections 181 do not extend to the bottom of cuts 23. Sufficient clearance is allowed at this point to permit the retention of a film of ink of desired thickness between these members. The male die member 180 thereby applies a film of ink to the engraved and unengraved surface portions of die plate 22. As roller 15 rotates, die plate 22 rotates into contact with wiper 52 and the ink on the unengraved surface portions of die plate 22 is thereby removed. The wiped plate then rotates into registry with die 180 on roller 16 and the web of paper 44 is thereby simultaneously printed and embossed.

The male die members 180 on rollers 16 and 177 may be similar in form to the laminated paper counters 24 on the machine illustrated in Figs. 1 through 11. A more permanent counter may, however, be formed quite readily by pressure molding the same, using the die plate 22 as the mold. The material used for pressure molding the counters or male die members 180 may be selected from a wide variety of materials such as thermo-setting resins, thermo-plastic resins, thermo plastics such as nylon, and fabric or paper impregnated with resins or plastics. One material which I have found works very satisfactorily is a crepe paper impregnated with a thermo-setting phenolic resin and sold under the name "Phenopreg" by Fabricon Products, Inc. The resin-impregnated paper is formed into a pad of suitable thickness, applied to rollers 16 and 177, and heated. The rollers are then rotated so that the resin-impregnated paper is compressed by the die plate 22 into the shape of die 180 with the projections 181, in which form the resin hardens because of the combined heat and pressure. In order to obtain the necessary clearance between die members 180 and engraved die plates 22, a shim of the desired thickness may be interposed between the pad of resin-impregnated paper and rollers 177 and 16. Thereafter the formed die members are removed from the rollers, stripped of the shims, and adhered to the rollers 177 and 16 without the shims.

Although the two-roller machine illustrated in Figs. 1 through 11 is entirely satisfactory from the standpoint of operation and quality of work produced thereon, the three-roller machine illustrated in Figs. 12 through 14 has several advantages thereover. In the three-roller machine the inking roller 176 applies ink only to the die members 180 on roller 177 whereas in the two-roller machine the ink is applied as a continuous band around the surface of die plate 22. This difference in construction represents a savings in the amount of ink used and also enables the use of an inking roller of fixed width for inking die plates of various widths. Furthermore, since the distortion of the rubber surface on the inking roller is not relied upon for filling the engraving cuts on the printing roller, less pressure between the inking roller and the die roller is required and the inking roller is therefore subjected to less wear and tear and may be formed of a less expensive material. I have found, in addition, that the film of ink applied to the engraved die may be controlled more easily by employing the male die member 180 as the means for applying the ink to the engraving cuts in the printing die.

The engraved legend on the die plate is referred to herein as being formed in intaglio and the legend projecting from the surface of the counters or male die is referred to as being formed in relief.

I claim:

1. A rotary engraving press comprising a support, a cylindrical roller on said support, a die plate on said roller having a legend which includes solid lines engraved in the surface thereof, a second cylindrical roller on said support juxtaposed to said first roller and mounted on an axis parallel to the axis of the first roller, a counter on said second roller having said legend in relief on the surface thereof, the legend on said counter being arranged to register with the legend on said die plate when the rollers are rotated in opposite directions, means for feeding a web of paper between said rollers, said second roller being arranged to support said paper web in contact with the surfaces of said die plate and counter as the web passes through the plane of the axes of said rollers, means for rotating said rollers in opposite directions and at the same surface speed of said plate and counter, means for applying a heavy film of ink to said legend and the surface of said first roller of such thickness to substantially fill the engraved cuts in said legend, a cylindrical wiping roller mounted on said support in juxtaposition to said first roller on an axis parallel to the axis of said first roller, said wiping roller being positioned to contact the surface of said die plate on said first roller as said last mentioned surface travels from said inking means toward said second roller, and means for rotating said wiping roller at a surface speed greater than that of the surface of the die plate and in a direction such that the contacting surfaces of said wiping roller and die plate move in opposite directions.

2. The combination set forth in claim 1 wherein said wiping roller has the cylindrical surface thereof formed of a non-metallic material which is relatively hard and non-absorbent to liquids.

3. The combination set forth in claim 1 including a frame pivotally mounted on said support and on which said wiping roller is mounted and resilient means biasing said frame in a direction toward said first roller.

4. The combination set forth in claim 3 including a shaft for supporting said wiping roller on said frame, a cam member and a cam follower member on said shaft, one of said members being fixed to rotate with the shaft and means for positively rotating the other member relative to the shaft whereby to oscillate said wiping roller axially.

5. The combination set forth in claim 3 including means for cleaning said wiping roller comprising means positioned for directing a stream of solvent to a portion of the surface of said roller substantially immediately after said portion of said surface moves out of contact with said die plate, means spaced circumferentially in the direction of rotation from said solvent applying means for scrubbing the surface portion of said wiping roller to which solvent is previously applied by said solvent applying means, means spaced still further circumferentially in the direction of rotation for removing the

solvent and ink from the scrubbed surface of the wiping roller, means spaced still further circumferentially in the direction of rotation directing an additional stream of solvent to the surface of the wiping roller and rotary means positioned still further in the direction of rotation for buffing and drying the surface of the wiping roller.

6. The combination set forth in claim 1 including cleaning means for said wiping roller comprising means for applying a solvent to the surface of said wiping roller substantially immediately after it wipes over the surface of said die plate, means spaced circumferentially of said solvent-applying means in the direction of rotation of said wiping roller for scrubbing the surface of said wiping roller after the solvent has been applied thereto, means positioned circumferentially further in the direction of rotation of said wiping roller for removing the ink and solvent from the scrubbed surface of said wiping roller, and rotary means positioned still further circumferentially in the direction of rotation of said wiping roller for buffing the surface thereof to dry the same before it again contacts the inked surface of said first roller.

7. The combination set forth in claim 6 wherein said means for removing ink and solvent from the surface of said wiping roller includes a blade arranged to wipe the surface of said wiping roller.

8. A rotary engraving press comprising a support, a cylindrical roller on said support, a die plate on said roller having a legend including solid lines engraved in the surface thereof, a second cylindrical roller on said support juxtaposed to said first roller and mounted on an axis parallel to the axis of the first roller, a counter on said second roller having a relief legend thereon which is arranged to register with the legend on said die-plate when said rollers are rotated, means for feeding a web of paper between said rollers, said second roller being arranged to support said paper web in contact with the surfaces of said die plate and counter as the web passes through the plane of the axes of said rollers, means for rotating said rollers in opposite directions and at the same surface speed, means for applying a heavy film of ink to said legend and the surface of said die plate on the first roller of such thickness to substantially completely fill the engraved cuts in said legend, a frame pivotally supported on said support on an axis parallel to the axis of said first roller, a wiping roller journalled on said frame in juxtaposition to said first roller for rotation on an axis parallel to said pivotal axis, means for rotating said wiping roller at a surface speed greater than that of said first roller, and means for resiliently biasing and pivotally adjusting said frame for positioning said wiping roller in contact with the surface of the die plate on said first roller.

9. A rotary printing and embossing press comprising a support, a cylindrical roller on said support, a die plate on said roller having a legend including solid lines engraved in the surface thereof, a pair of spaced apart cylindrical rollers mounted on said support adjacent said first roller and each having a counter thereon provided with said legend in relief on the surface thereof, said first roller and said pair of rollers being mounted in juxtaposition on parallel axes, means for rotating said first roller in one direction and said pair of rollers in the opposite direction and at a speed such that said surfaces having said legends travel at the same velocity, said axes being spaced and said engraved and relief legends being located on the surfaces of said rollers so that the engraved legend on said die plate registers and interfits with the relief legends on the surfaces of each counter on said pair of rollers during rotation of the rollers as the legends on two adjacently positioned rollers pass through the plane of the axes of said adjacently positioned rollers, means for applying a film of ink to the surface and the legend in relief on one of said counters and a wiping roller arranged to wipe the surface of said die plate to remove the ink deposited thereon by said last mentioned counter while leaving the ink in the cuts of the engraved legend.

10. The combination set forth in claim 9 including means for feeding a web of paper between said first roller and the other of said pair of rollers whereby the counter on one roller of said pair of rollers applies ink to the engraved legend on said first roller and said web of paper is simultaneously printed and embossed between the die plate on said first roller and the counter on the other roller of said pair of rollers.

11. The combination set forth in claim 9 wherein said counters are formed of a hardenable plastic material.

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