Oct. 13, 1953 F. A. ROSS 2,655,102

INTAGLIO PRINTING PRESS

Filed Feb. 15, 1951 5 Sheets-Sheet 1

Fig. 1.

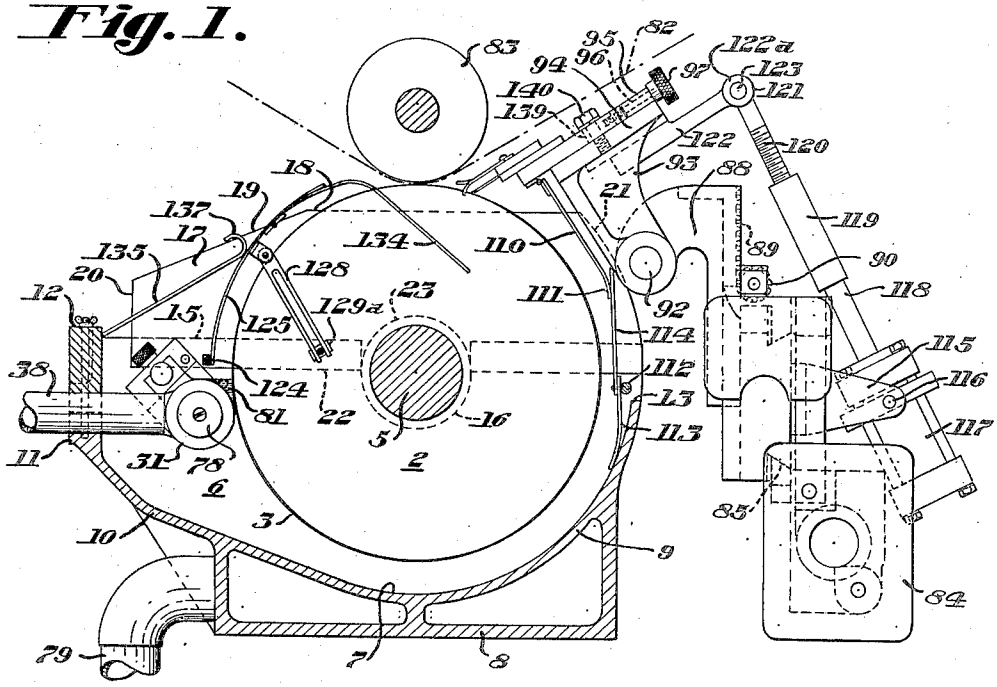
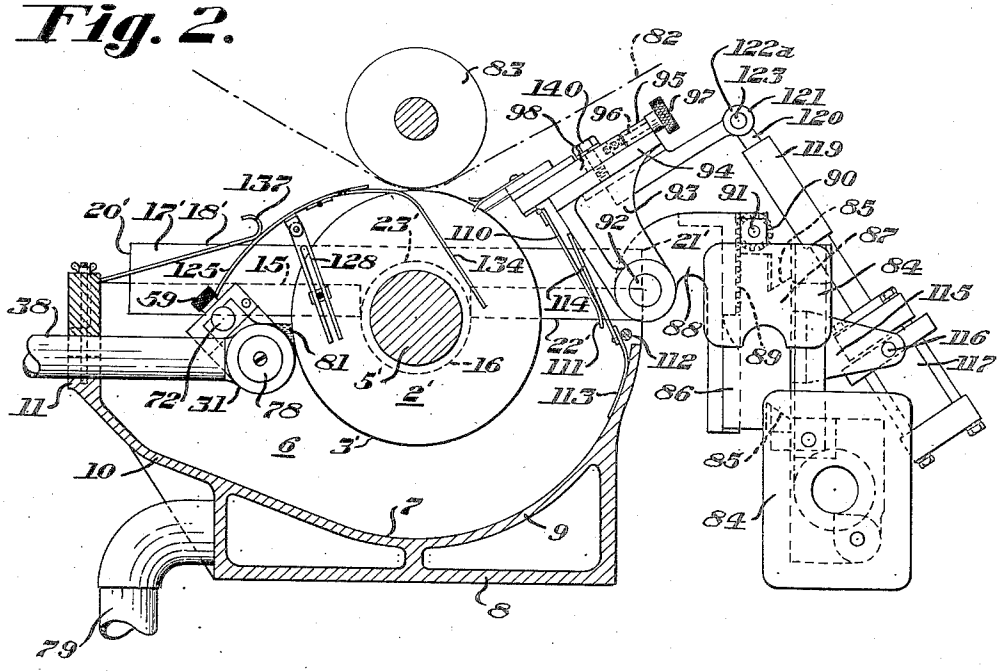


Fig. 2.



INVENTOR
FRANK A. ROSS
By his attorneys
Hoopes, Leonard & Glenn

Oct. 13, 1953 F. A. ROSS 2,655,102

INTAGLIO PRINTING PRESS

Filed Feb. 15, 1951 5 Sheets-Sheet 2

Fig. 3.

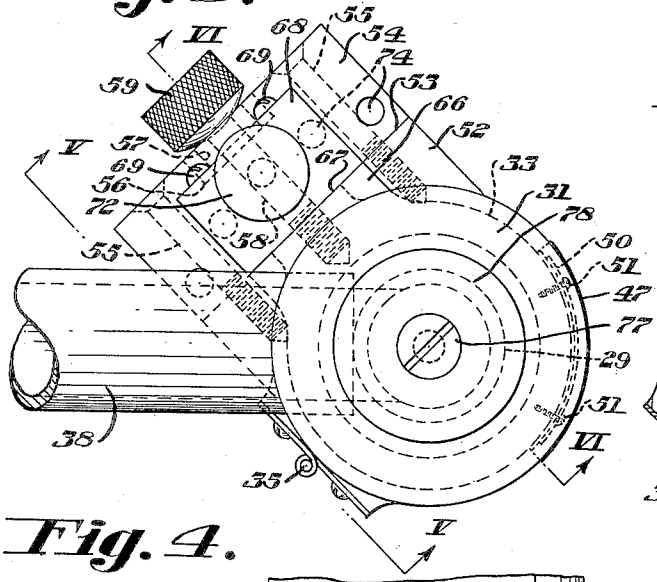


Fig. 7.

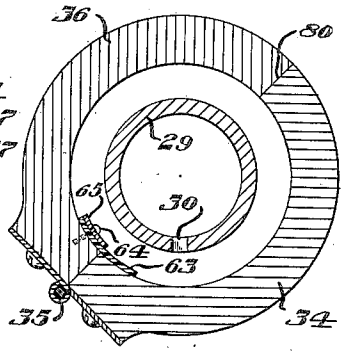


Fig. 4.

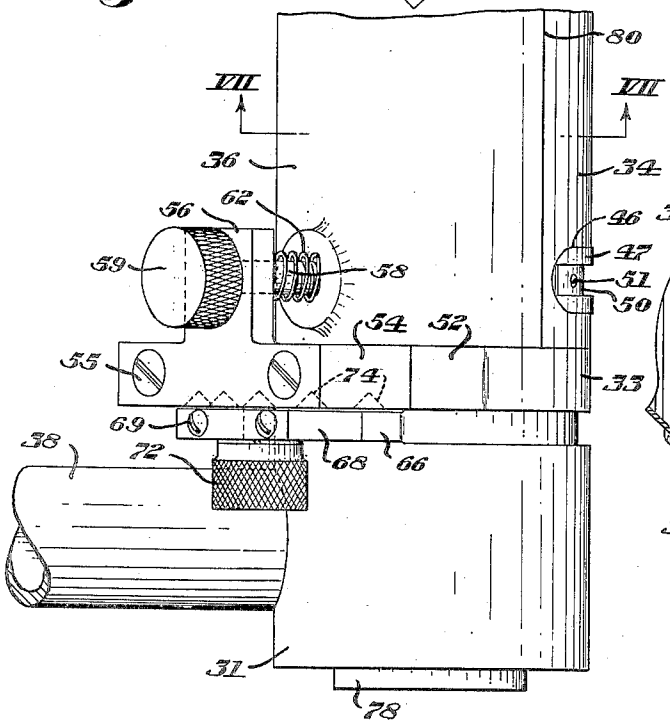
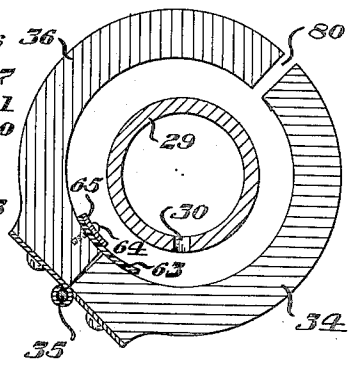


Fig. 8.



INVENTOR
FRANK A. ROSS
By his Attorneys
Hooper, Leonard & Glenn

Oct. 13, 1953 F. A. ROSS 2,655,102

INTAGLIO PRINTING PRESS

Filed Feb. 15, 1951 5 Sheets-Sheet 3

Fig. 5.

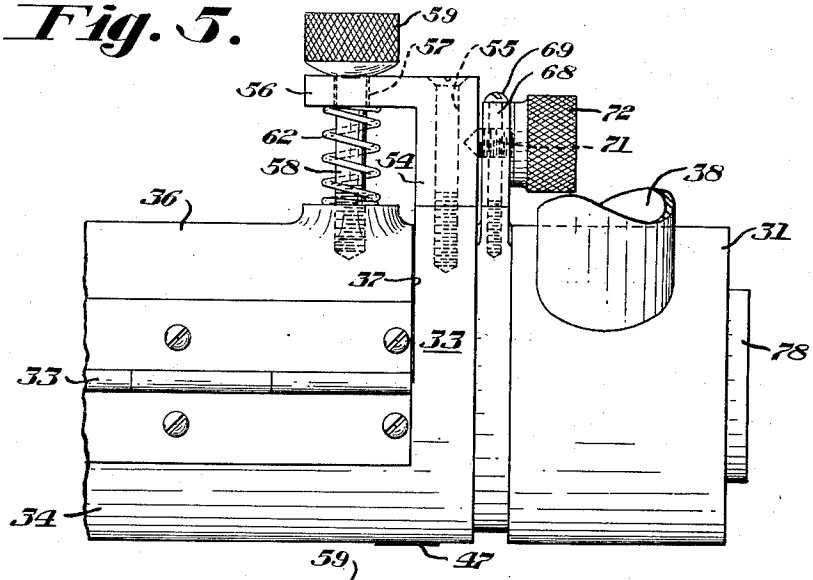
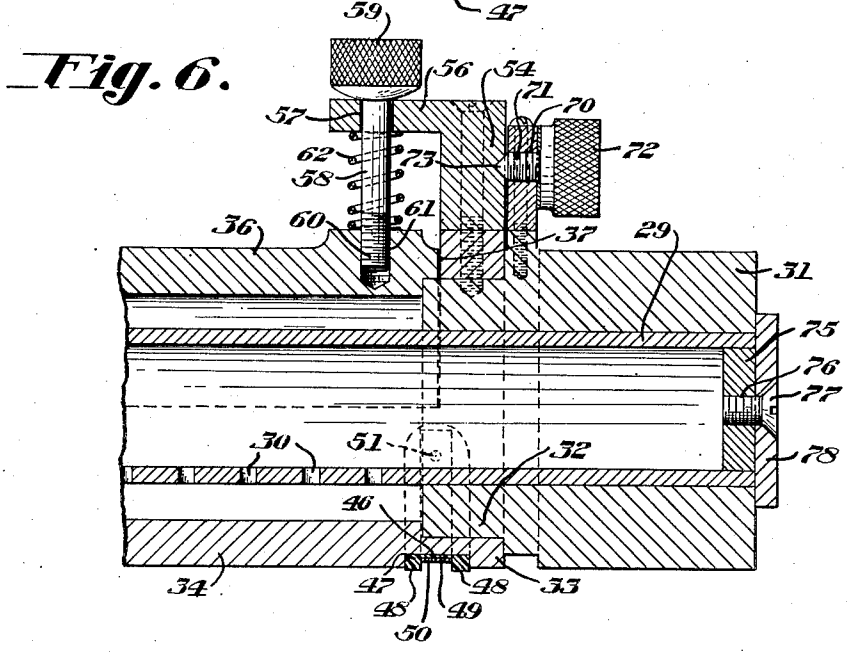


Fig. 6.



INVENTOR

FRANK A. ROSS

By his attorneys

Hoopes, Leonard & Glenn

Oct. 13, 1953 F. A. ROSS 2,655,102

INTAGLIO PRINTING PRESS

Filed Feb. 15, 1951 5 Sheets-Sheet 4

Fig. 9.

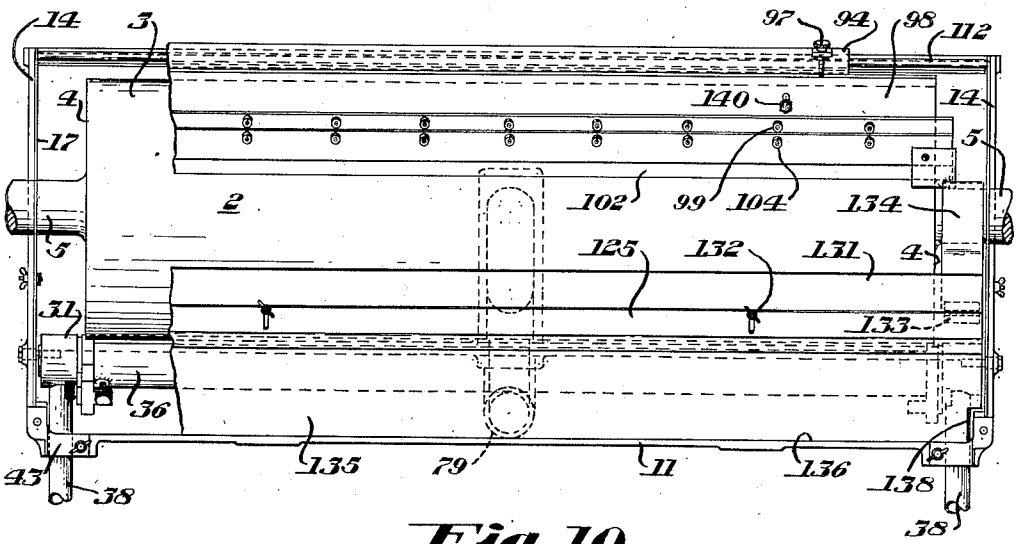
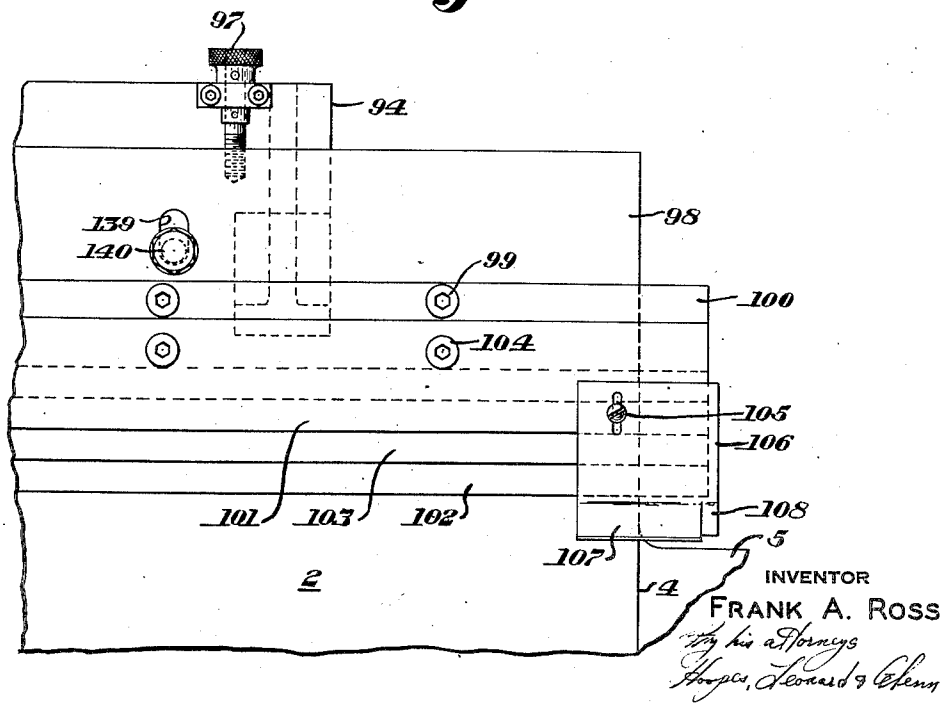


Fig. 10.



INVENTOR
FRANK A. ROSS
by his attorneys
Hayes, Leonard & Esperm

Oct. 13, 1953 F. A. ROSS 2,655,102

INTAGLIO PRINTING PRESS

Filed Feb. 15, 1951 5 Sheets-Sheet 5

Fig. 12.

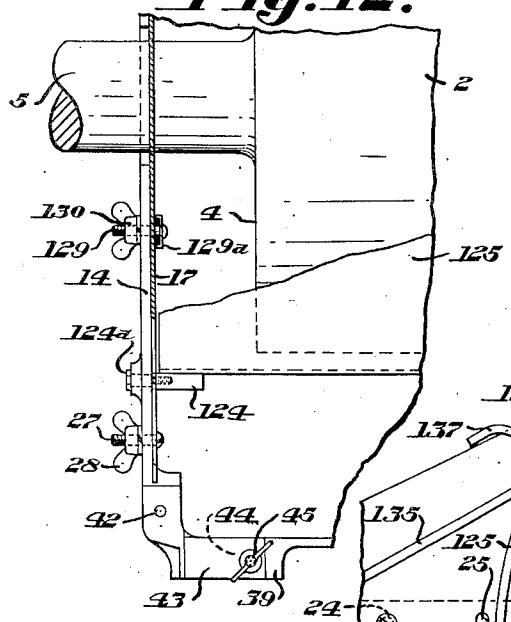


Fig. 14.

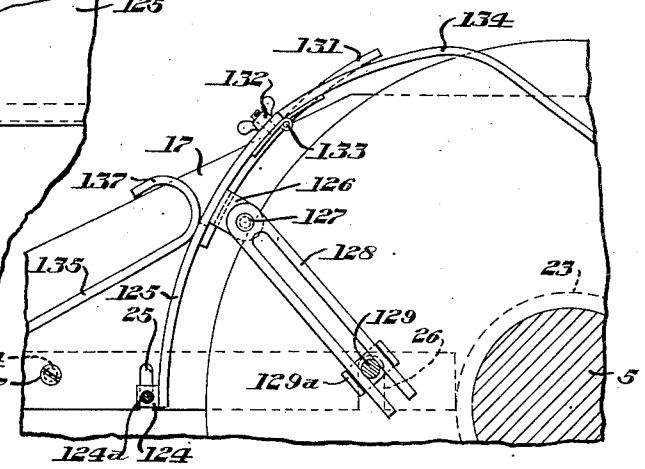


Fig. 13.

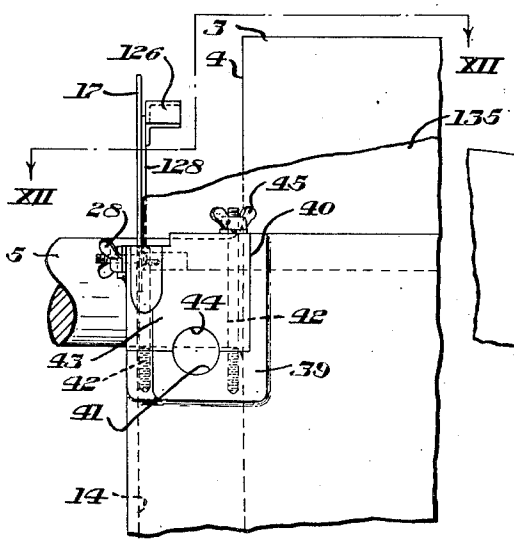
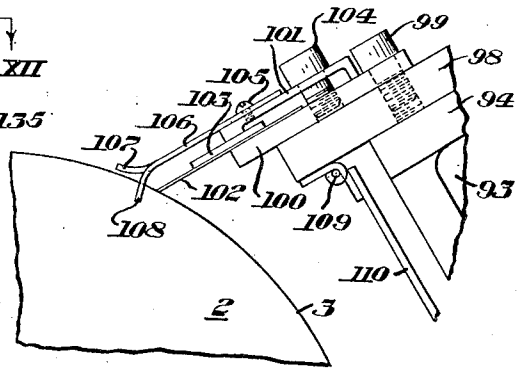


Fig. 11.



INVENTOR
FRANK A. ROSS
By his Attorneys
Hooper, Leonard & Glenn

Patented Oct. 13, 1953

2,655,102

UNITED STATES PATENT OFFICE

2,655,102

INTAGLIO PRINTING PRESS

Frank A. Ross, Ross Township, Allegheny County, Pa., assignor to Miller Printing Machinery Co., Pittsburgh, Pa., a corporation of Pennsylvania

Application February 15, 1951, Serial No. 211,074

16 Claims. (Cl. 101—157)

1

This invention relates to an intaglio printing press and especially to inking means for such a press. It has to do with means for applying ink to a rotatable intaglio printing cylinder and to an improved ink fountain structure.

The art of intaglio printing is old and well developed. The printing cylinder contains depressions to receive ink which is applied to the cylindrical surface of the printing cylinder and doctor means, ordinarily in the form of a blade oscillating parallel to the axis of the printing cylinder, bear against the cylindrical surface of the printing cylinder to remove excess ink and insure that at the printing point the cylinder carries a proper application of ink. When intaglio printing was done at relatively slow speeds the problems involved in applying and doctoring the ink were not especially difficult. However, printing speeds have increased to a multiple of the printing speeds in the days of the early development of the intaglio printing art so that now problems are encountered which previously did not exist. Those problems have not heretofore been solved with complete success.

High speed intaglio printing demands the delivery to the printing cylinder of a quantity of ink far greater than the quantity previously employed when printing was done at relatively low speeds. This poses difficult problems in even distribution of the ink along the printing cylinder and proper spreading of the ink between the point of application and the point of doctoring. Other problems are concerned with loss of ink from the printing cylinder through centrifugal force and the catching and returning of that ink. Still further problems have to do with the delivery of the ink to the point of application to the intaglio printing cylinder in the required quantity in uniform increments along the length of the printing cylinder.

Additional difficulties arise by reason of changing of the printing cylinder to replace a cylinder of one diameter with a cylinder of another diameter which requires shifting of the position of the ink applying means, the doctoring means and the means for maintaining the material being printed on in engagement with the cylinder.

I have devised an intaglio printing press which I believe for the first time successfully solves the various problems above referred to. In devising my novel press I have utilized a number of features which I believe to be basically new and have combined those features in a novel manner to accomplish results which, so far as I am aware, have not heretofore been considered obtainable.

2

My intaglio printing press comprises a rotatable intaglio printing cylinder arranged with its axis substantially horizontal together with means cooperating with the surface of the printing cylinder to apply ink thereto, means for maintaining in contact with the cylindrical surface of the printing cylinder material moving at a linear speed substantially equal to the linear speed of movement of the cylindrical surface of the printing cylinder so that the printing cylinder prints on the material and doctor means cooperating with the cylindrical surface of the printing cylinder to remove therefrom excess ink and insure retention thereby of a proper application of ink for printing.

I have found that the means cooperating with the surface of the printing cylinder to apply ink thereto should be disposed below the substantially horizontal plane containing the axis of the printing cylinder and at the side of the printing cylinder at which the cylindrical surface thereof moves downwardly; said means desirably forms with the cylindrical surface of the printing cylinder a receptacle for a pool of ink. The cylindrical surface of the printing cylinder, forming in effect a wall of said receptacle, moves downwardly in contact with the ink in the receptacle and is thereby properly and uniformly inked.

I have also found that when the ink applying means is disposed below the substantially horizontal plane containing the axis of the printing cylinder and at the side of the printing cylinder at which the cylindrical surface thereof moves downwardly the means for maintaining in contact with the cylindrical surface of the printing cylinder the material to be printed on should be disposed substantially directly above the axis of the printing cylinder. This means that any point on the cylindrical surface of the printing cylinder moves through a central angle of between 180° and 270° between the time it is inked and the time the ink is applied to the material being printed on. That is desirable to insure uniform spreading and application of the ink.

When the ink applying means and the means for maintaining in contact with the printing cylinder the material being printed on are disposed as above explained the doctor means preferably cooperates with the cylindrical surface of the printing cylinder within a central angle of 90° ahead of the position of contact therewith of the material being printed on. Generally that angle should be materially less than 90° and for best operation under most circum-

stances I prefer that the doctor means cooperate with the cylindrical surface of the printing cylinder within a central angle of 45° ahead of the position of contact therewith of the material being printed on.

I employ means for feeding or delivering ink to the receptacle for a pool of ink formed by the cylindrical surface of the printing cylinder and the means cooperating therewith referred to above to insure that a proper pool of ink is maintained in the receptacle at all times. Preferably a pool of ink of predetermined volume is maintained by continuously overflowing ink from the receptacle. The ink overflowing from the receptacle is recirculated.

I find it desirable to dispose the means cooperating with the surface of the printing cylinder to form a receptacle for a pool of ink at a side of the printing cylinder above the bottom thereof and within a central angle of 270° ahead of the position of contact with the printing cylinder of the material being printed on. The doctor means should cooperate with the cylindrical surface of the printing cylinder within a central angle of 90° and preferably within a central angle of 45° ahead of the position of contact with the cylindrical surface of the printing cylinder of the material being printed on.

I provide for generally horizontal movement of the means cooperating with the surface of the printing cylinder to apply ink thereto toward and away from the printing cylinder so as to provide for replacement of the printing cylinder by a printing cylinder of different diameter. The means cooperating with the surface of the printing cylinder to apply ink thereto may be carried by elongated supporting means entering the casing from without and projecting inwardly of the inner wall of the casing. The supporting means may be adjustably movable toward and away from the printing cylinder so that printing cylinders of different selected diameters may be employed. The elongated supporting means may comprise conduit means serving not only to support the means cooperating with the surface of the printing cylinder but also to deliver ink. In a preferred construction the ink fountain may have openings in its side through which conduits may pass, the conduits being adjustably movable within the openings. The conduits may carry the means cooperating with the surface of the printing cylinder to apply ink thereto and one or both thereof may deliver ink to form the pool of ink in contact with the cylindrical surface of the printing cylinder. The conduits may communicate with the means cooperating with the surface of the printing cylinder to apply ink thereto at or adjacent the ends thereof.

Ink collecting in the bottom of the ink fountain may be pumped into and through the conduit or conduits referred to. The overflowing ink is recirculated as above mentioned.

I provide cover means covering the upwardly open receptacle for a pool of ink formed by the printing cylinder and the means cooperating therewith referred to above. I also provide cover means largely covering the cylindrical surface of the printing cylinder and having portions disposed opposite the ends of the cylinder. The cover means preferably comprises a portion movably connected with the casing in which the printing cylinder is mounted and a portion disposed axially beyond an end of the printing cylinder hingedly connected with the first mentioned portion to permit the second mentioned portion to be moved relatively to the first mentioned portion to clear other parts of the press when the cover means is moved between operative and inoperative positions. The cover means preferably comprises a portion pivotally connected with the casing and a portion disposed axially beyond an end of the printing cylinder hingedly connected with the first mentioned portion and when the cover means is in operative position underlying a part of the ink applying means projecting beyond that end of the cylinder. Such a hinge connection permits the second mentioned portion of the cover means to be depressed relatively to the first mentioned portion to clear that part of the ink applying means when the cover means is swung between operative and inoperative positions. Means are preferably provided resiliently urging the second mentioned portion upwardly to predetermined operative position.

I preferably provide means extending between a movable portion of the cover means and the casing to maintain the movable portion of the cover means in desired adjusted positions relatively to the casing. I may employ adjustable fastening arms connected with the cover means adjacent the respective ends thereof and means fastening the arms in desired adjusted positions relatively to the casing.

I also provide means intercepting ink moving longitudinally of the doctor means past the ends thereof to maintain the ink in the casing together with guard means preventing the intercepted ink from falling onto the shaft or trunnions of the printing cylinder. Desirably cover means are provided for the printing cylinder and means are carried by the cover means opposite the end faces of the printing cylinder lying between the intercepting means and the journals of the printing cylinder deflecting ink from the intercepting means to prevent such ink from falling on the printing cylinder shaft means.

The cover means preferably comprises cover means for the printing cylinder extending generally upwardly and about a portion of the printing cylinder from a position generally above the ink receptacle and additional cover means for the ink receptacle closing against the first mentioned cover means.

The means cooperating with the printing cylinder to apply ink thereto preferably include an elongated hollow member disposed generally parallel to the axis of the cylinder and having passage means from the interior to the exterior thereof through which ink may pass. Ink may be introduced into the interior of the elongated hollow member and may pass therefrom through said passage means into the receptacle for a pool of ink formed between the elongated hollow member and the printing cylinder. Means may be provided for varying the effective cross-sectional area of the passage means.

The elongated hollow member may have opposed portions fastened together at one side and slightly spaced apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof, the opposed portions of the elongated hollow member being relatively adjustably movable to vary the width of the slit. The opposed portions of the elongated hollow member may be hinged together at one side and means may be provided for relatively hingedly moving the portions to vary the width of the slit.

The means cooperating with the printing cylinder to apply ink thereto may include in addition to an elongated hollow member such as is above referred to a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into position to pass outwardly through the passage means of the first mentioned elongated hollow member. The passage means of the second elongated hollow member are preferably disposed to direct ink passing therethrough generally away from the passage means of the first mentioned elongated hollow member. Thus ink from within the inner elongated hollow member passes first into the space within the outer elongated hollow member but outside the inner elongated hollow member and thence passes out of the outer elongated hollow member through the slit therein into the ink holding receptacle in contact with the intaglio printing cylinder. This construction brings about a smooth even uniform flow of ink into the receptacle. Ink is preferably introduced into the receptacle at a rate slightly in excess of the rate at which it is withdrawn through application to the intaglio printing cylinder, the excess ink overflowing the receptacle. In this way the maintenance of a continuous uniform depth or head of ink in the receptacle is assured.

The inner elongated hollow member preferably has a series of spaced apart passages disposed generally throughout the length of the inner elongated hollow member through which ink fed into the interior thereof may pass to the exterior thereof into the space within the outer elongated hollow member but outside the inner elongated hollow member. Since those passages are directed generally away from the slit in the outer elongated hollow member the ink has an opportunity to flow freely while within the annular space outside the inner elongated hollow member and inside the outer elongated hollow member to promote a rapid yet smooth and uniform flow of ink free from eddy currents and surges such as would interfere with proper application of the ink to the printing cylinder.

The elongated hollow member which cooperates with the printing cylinder to form the ink receptacle is preferably turnable in its support to vary the angle of discharge of ink through the passage means of the elongated hollow member into the ink receptacle. Generally the ink is discharged into the receptacle somewhat upwardly at an angle toward the printing cylinder which appears to give superior results. The angle may be adjusted as desired, normally being between 30° and 60° to the horizontal.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have shown a present preferred embodiment of the invention, in which

Figure 1 is a largely diagrammatic view, partly in elevation and partly in transverse cross section, of a portion of an intaglio printing press showing the intaglio printing cylinder, the ink fountain for applying ink thereto and doctoring the ink and the means for maintaining in contact with the cylindrical surface of the printing cylinder material to be printed on thereby;

Figure 2 is a view similar to Figure 1 but showing an intaglio printing cylinder of smaller diameter than the intaglio printing cylinder shown in Figure 1 mounted in the ink fountain with the various elements of the ink fountain mechanism adjusted to cooperate with the intaglio printing cylinder of relatively small diameter;

Figure 3 is an enlarged fragmentary elevational view of a portion of the ink fountain mechanism shown in Figures 1 and 2;

Figure 4 is a fragmentary plan view of the portion of the ink fountain mechanism shown in Figure 3;

Figure 5 is a fragmentary view largely in inclined elevation but partly in cross section on the line V—V of Figure 3;

Figure 6 is a fragmentary cross sectional view on the line VI—VI of Figure 3;

Figure 7 is a cross sectional view on the line VII—VII of Figure 4;

Figure 8 is a view similar to Figure 7 but showing the opposed portions of the ink delivering member in a different adjusted position than in Figure 7;

Figure 9 is a plan view with portions broken away of the structure shown in Figure 1 but to reduced scale;

Figure 10 is an enlarged fragmentary plan view showing a portion of the structure of Figure 9;

Figure 11 is an enlarged fragmentary elevational view showing in end view a portion of the intaglio printing cylinder and the doctor blade and associated mechanism;

Figure 12 is a fragmentary plan view to enlarged scale of a portion of a structure shown in Figure 9 and partly in horizontal cross section of the line XII—XII of Figure 13;

Figure 13 is an elevational view of the structure shown in Figure 12; and

Figure 14 is an enlarged fragmentary view similar to Figure 1 showing a portion of the structure shown in Figure 1.

Referring now more particularly to the drawings, I provide an intaglio printing cylinder whose length is determined by the width of the press but whose diameter depends upon the particular job being printed. In Figure 1 I have shown an intaglio printing cylinder designated generally by reference numeral 2 which is of relatively great diameter largely filling the ink reservoir while in Figure 2 I have shown an intaglio printing cylinder designated generally by reference numeral 2′ which is considerably smaller in diameter than the cylinder 2. All figures of the drawings which show the intaglio printing cylinder other than Figure 2 show the cylinder 2 of relatively great diameter which appears in Figure 1. The purpose of Figure 2 is to illustrate how intaglio printing cylinders of different diameters may be employed in my intaglio printing press and how the cooperating mechanism may be adjusted in accordance with the diameter of the particular intaglio printing cylinder being employed at any time. Further description of the intaglio printing cylinder 2 applies also to the intaglio printing cylinder 2′ since the two cylinders are identical except in diameter.

The intaglio printing cylinder 2 is of cylindrical shape, having a cylindrical printing surface 3 and end surfaces 4 which are planar and perpendicular to the axis of the cylinder. Coaxial with the cylinder 2 and projecting from the ends thereof past the end surfaces 4 are trunnions or

shaft portions 5 of relatively small diameter but which are likewise of cylindrical shape. The shaft portions 5 project through the ends of the ink reservoir presently to be described and outside the ends of the ink reservoir are journaled in suitable bearings as well known in the art. Since the bearings for the shaft portions 5 do not constitute my invention and since they are disposed laterally outside the ink reservoir shown in the drawings I have not illustrated the bearings but have confined the structure shown in the drawings to that portion of the intaglio printing press wherein the features of my invention reside. The intaglio printing cylinder 2 is driven through one of its shaft portions 5; the drive may be conventional.

The ink fountain is designated generally by reference numeral 6 and comprises an ink reservoir 7 in which the intaglio printing cylinder 2 is disposed. The ink reservoir 7 comprises a base 8 surmounted by an upwardly concave portion 9 forming an elongated upwardly open shell whose length is substantially greater than the length of the intaglio printing cylinder 2 between the end surfaces 4 thereof and which is large enough transversely to receive the largest intaglio printing cylinder which is adapted to be used in the press with substantial clearance between the cylinder and the ink reservoir. At the front of the press the ink reservoir is somewhat extended in the horizontal direction as indicated at 10 and has a generally vertical front wall 11 whose upward extremity is at 12. The rear wall is of generally arcuate shape about the axis of the cylinder, its upper extremity being at 13.

The ink reservoir has permanently applied vertical planar ends 14 which extend upwardly from the bottom of the ink reservoir to a level somewhat above the axis of the intaglio printing cylinder. Reference numeral 15 indicates the level of the upper edges of the ends 14 of the ink reservoir. The ink reservoir may be fabricated or cast. Since the ends 14 project upwardly somewhat above the axis of the cylinder provision must be made for passage therethrough of the shaft portions 5. To this end each of the ends 14 has an upwardly open recess 16 therein through which one of the shaft portions 5 passes.

The ink reservoir has no supporting function in relation to the intaglio printing cylinder; the cylinder is supported entirely by its bearings which as above explained are disposed outside the ends of the ink reservoir. As shown in Figure 1 a little clearance is provided between each shaft portion 5 and the corresponding recess 16.

To more substantially confine the ink it is desirable to extend upwardly the ends of the ink reservoir when the press is operating. To this end I provide at each end of the ink reservoir and disposed immediately inside the corresponding end 14 an upwardly projecting end plate. In Figure 1 one of the end plates is designated 17 while in Figure 2 one of the end plates is designated 17'. The end plates are selected according to the diameter of the intaglio printing cylinder being used at the time. When a cylinder of relatively great diameter is being used end plates of relatively great height are employed while when a cylinder of less diameter is being used end plates of less height are employed, this being illustrated in Figures 1 and 2. The end plates 17 each have an upper edge 18, an inclined forward edge portion 19, a vertical front edge 20 and a curved rear edge 21. The bottom edge of each end plate 17 is shown at 22, there being a downwardly open upwardly extending recess 23 in the lower edge of the end plate to receive the upper half of the corresponding shaft portion 5. Each of the end plates 17' has a horizontal upper edge 18', a vertical front edge 20', a vertical rear edge 21' and a horizontal lower edge 22' having therein a recess 23' similar in shape and function to the recesses 23 of the end plates 17. Aside from the differences in height and shape of the end plates 17 and 17' they are identical and they are identically applied to the ink reservoir. The following description of the manner of application of the end plates 17 applies also to the end plates 17'.

Each end plate 17 has adjacent its lower edge upwardly extending downwardly open recesses 25 and 26, there being one each of the recesses 25 and 26 in each end plate 17. The recesses 25 and 26 are to enable the lower portion of the end plate to be fitted down over parts of the ink fountain which intersect the plane of the end plate as will presently be described. Also each end plate 17 has two holes 24 therethrough for the purpose of receiving bolts 27 passing through the ends 14 of the ink reservoir whereby the end plates 17 are clamped against the inner faces of the ends 14, the lower edge of each end plate 17 overlapping the upper edge of the corresponding end 14 to a limited extent as shown in Figure 1. As above stated, there are two holes 24 in each end plate 17. One of the holes 24 is shown in Figure 14, the other being disposed near the rear of the ink reservoir so that each end plate 17 is held in place by two bolts 27, each of which passes through a hole 24 and through the corresponding end 14. A nut 28 is applied to each of the bolts 27 to clamp the end plate 17 to the end 14.

I shall now describe the means for applying ink to the intaglio printing cylinder 2. I provide a tube 29 which as shown is cylindrical having a row of ports 30 therethrough disposed in a line parallel to the axis of the tube and spaced apart as shown in Figure 6. The tube 29 in use is normally oriented with the ports 30 at the bottom, although it may be otherwise oriented by turning it about its axis. Applied to each end of the tube 29 is a hub 31 which has a cylindrical bore snugly receiving the tube end as shown in Figure 6. Each hub 31 has a reduced inner end 32 receiving a collar 33 having a cylindrical bore fitting snugly over the reduced inner end 32. The two collars 33, each fitting over the reduced inner end 32 of one of the two hubs 31, are integral with a half tube 34 extending parallel to the tube 29 and of greater diameter. Hinged to the half tube 34 by a hinge 35 extending parallel to the axis of the tube 29 is another half tube 36 which lies between the portions of the collars 33 which project laterally from the half tube 34. One end face of the half tube 36 is shown at 37 in Figure 6. Thus the half tube 34 with the integral collars 33, the hubs 31 the reduced inner ends 32 of which are embraced by the collars 33, the tube 29 which in turn is embraced by the hubs 31 and the half tube 36 hinged to the half tube 34 by the hinge 35 are the principal elements forming an ink applicator adapted to be disposed adjacent the intaglio printing cylinder 2 to apply ink therethrough as will presently be described.

A pipe 38 extends into each hub 31 and communicates with the interior of the tube 29. The pipes 38 are parallel to each other and their axes both intersect the axis of the tube 29 at right angles. The pipes 38 serve a dual function: they provide for the delivery of ink to the ink appli-

cator and they also serve as the mounting means for the ink applicator.

The front wall 11 of the ink reservoir has adjacent each end a thickened portion 39 into which extends an upwardly open downward recess 40 having at its bottom a semicircular seat 41 for one of the pipes 38. Dowel pins 42 project upwardly from the bottom of the recess 40 at opposite sides of the seat 41. A cap member 43 having in its bottom a semicircular recess 44 complementary to the seat 41 is applied downwardly into the recess 40, having bores receiving the dowel pins 42. The recess 44 of each cap member 43 cooperates with the corresponding semicircular seat 41 to snugly embrace one of the pipes 38 seated in the seat 41. One of each pair of dowel pins 42 projects above the top of the corresponding cap member 43 and has a nut 45 applied thereto to hold the cap member in place. Thus each pipe 38 is clamped between one of the seats 41 and the corresponding cap member 43, the fit of each pipe within its seat 41 and the recess 44 of the corresponding cap member 43 being such that the joint is substantially ink tight.

The ink applicator above described and which comprises the tube 29, the hubs 31 and the half tubes 34 and 36 is carried by the two pipes 38 and the applicator is supported by the front wall of the ink reservoir by the clamping of the pipes 38 by the cap members 43. As will be seen by comparing Figures 1 and 2, the ink applicator is disposed farther inwardly of the front wall 11 of the ink reservoir when an intaglio printing cylinder of relatively small diameter is being used relatively to its position when an intaglio printing cylinder of relatively great diameter is being used. By loosening the nuts 45 the cap members 43 are loosened sufficiently to permit sliding of the pipes 38 within the seats 41 so that it is a simple matter to adjust the ink applicator to the desired position to cooperate with the intaglio printing cylinder being used at any particular time. After the ink applicator has been adjusted in proper position the nuts 45 are tightened to hold it in that position.

The half tube 34 is the portion of the applicator which lies immediately adjacent the intaglio printing cylinder. In operation of the press the half tube 34 lies very close to but for the most part out of direct contact with the intaglio printing cylinder. The half tube 34 has adjacent each end thereof a channel 46 extending circumferentially part way around the half tube 34. Disposed in each channel 46 is a strip 47 of soft or resilient material such as rubber, neoprene or the like, the strips as shown being of generally U shape in cross section with relatively heavy legs 48 and a relatively thin cross portion 49. Disposed in the channel of the strip 47 is a hold-down member 50 which may be of metal, plastic or any other suitable material, and screws 51 pass through the hold-down member 50 and the resilient U-shaped strip 47 and into the half tube 34 to fasten the strip 47 in place. Normally the legs 48 of the strip 47 project slightly outwardly beyond the surface of the half tube 34 so that when the applicator is positioned close to the intaglio printing cylinder the strips 47 may lightly engage the surface of the intaglio printing cylinder to inhibit damage thereto such as might occur if the half tube 34 directly engaged the intaglio printing cylinder. The strips 47 adjacent the opposite ends of the applicator also serve to form to some extent dams inhibiting flow of ink parallel to the axis of the intaglio printing cylinder out of the ink pool formed between the applicator and the cylinder and presently to be described.

Each of the collars 33 has a projection 52 which terminates in a flat face 53 against which is positioned a bracket 54, each bracket 54 being fastened to the corresponding projection 52 by screws 55. Each bracket 54 has an axially projecting arm 56 having therethrough a bore 57. Loosely mounted in each bore 57 is a screw 58 whose head 59 is disposed outside the arm 56 and whose shank 60 is screwed into a threaded bore 61 in the half tube 36. A compression coil spring 62 is disposed about each screw 58 and biased between the half tube 36 and the corresponding arm 56. The screws 58 may be turned to adjust the angular relationship between the half tube 34 which is stationarily mounted and the half tube 36 which is hinged to the stationarily mounted half tube 34 by the hinge 35. The springs 62 normally urge the half tube 36 toward the half tube 34 and maintain the head 59 of each screw 58 in contact with the outer face of the corresponding arm 56. Figure 7 shows the half tubes 34 and 36 closed tightly together in a non-operative position. Figure 8 shows the half tube 36 turned somewhat away from the half tube 34 about the axis of the pintle of the hinge 35, this being accomplished by turning the two screws 58 to draw the half tube 36 outwardly against the action of the springs 62. A sealing member 63 is fastened to the inside of the half tube 36 by screws 64 and a hold-down strip 65 and spans the crack adjacent the hinge 35 between the half tube 34 and the half tube 36 thus inhibiting the outflow of ink therethrough. It is not seriously detrimental if a small amount of ink passes out through the crack but actually I find that the sealing member 63 virtually prevents any outflow.

Each hub 31 has a projection 66 which terminates in a flat face 67 against which is positioned a bracket 68, each bracket 68 being fastened to the corresponding projection 66 by screws 69. Each bracket 68 has therethrough a threaded bore 70 in which operates a screw 71 having a head 72 disposed away from the corresponding bracket 54 and a point 73 projecting through the bore. Each bracket 54 has an arcuate series of bores 74 which are spaced apart in an arc described about the axis of the tube 29. When the screws 71 are turned in their bores 70 to retract their points 73 away from the brackets 54 the assembly consisting of the half tubes 34 and 36, the brackets 54 and the screws 58 may be turned through a desired angle about the axis of the tube 29. When that assembly has been turned to the desired position with each screw 71 aligned with a bore 74 the screws are turned up until their points 73 enter those bores whereby to retain the assembly in desired angular position. The brackets 68 with the screws 71 therein and the brackets 54 with the bores 74 therein form cooperatively indexing mechanism for rapidly adjusting the half tubes 34 and 36 to desired angular positions. The hubs 31 are by the pipes 38 held in fixed angular position and since the hubs are thus held against turning and the tube 29 is engaged only by the hubs there is no tendency of that tube to turn when the assembled half tubes 34 and 36 are turned on the hubs 31. Moreover, the tube 29 has welded in each end a plug 75 having a central threaded bore 76 into which is threaded a screw 77 passing through a central opening in a plate 78. Each plate 78 bears against an end of the tube 29 and the end of the corresponding hub 31, maintaining the parts of the applicator assembled and also fric-

tionally holding the tube 29 against turning relatively to the hubs 31. If desired the tube 29 may be turned relatively to the hubs 31 after loosening or removing the plates 78, but it is seldom, if ever, necessary to change the angular relationship of the tube 29 to the hubs 31.

There is provided an ink pump which is not shown in the drawings. The ink reservoir 7 has an outlet 79 leading to the ink pump. The pump circulates ink by withdrawing it from the ink reservoir through the outlet 79 and pumping it back into the applicator through one or both of the pipes 38. A continuous circulation of ink is thus maintained during operation of the press. The ink entering the pipe or pipes 38 passes into the tube 29 and fills that tube. The ink within the tube 29 passes out of that tube through the ports 30 and into the annular space outside the tube 29 but within the assembled half tubes 34 and 36 and fills that annular space, the pressure on the ink exerted by the pump moving the ink through the tube 29 and the ports 30 and thence about the tube 29 to the slot 80 between the half tubes 34 and 36. The slot 80 discharges the ink toward the intaglio printing cylinder and in a somewhat upward direction. The ports 30 discharge the ink from the tube 29 generally away from the slot 80 so that the ink has to flow generally around the tube 29 to reach the slot 80 resulting in a smooth even discharge of the ink from the slot 80. The ink discharged from the slot 80 forms a pool of ink between the outside of the applicator and the outside of the intaglio printing cylinder as shown in Figure 1, the ink in the pool being designated by reference number 81. As above explained the applicator is spaced slightly from the intaglio printing cylinder although the strips 47 preferably engage the cylinder adjacent the ends of the applicator. When the intaglio printing cylinder is turning at high speed in the counterclockwise direction viewing Figure 1 the pool of ink 81 is maintained largely or entirely against outflow past the strips 47 bridging the gap between the applicator and the cylinder only at the bottom of the pool. The pump is preferably operated at such speed that a small quantity of ink always overflows the applicator backwardly or toward the left viewing Figure 1 whence it drops into the ink reservoir. This insures a substantially constant head of ink in the pool. Yet when the press is in operation, even though the ends of the pool are somewhat open above the strips 47, ink does not flow outwardly at the ends of the pool. I believe this to be because of the effect on the ink of the rapidly rotating intaglio printing cylinder together with the viscosity of the ink and the slight damming effect of the strips 47.

The pool of ink 81 is at the side of the intaglio printing cylinder at which the cylindrical surface of the cylinder moves downwardly and is disposed below the substantially horizontal plane containing the axis of the intaglio printing cylinder.

Material designated by reference numeral 82 is brought into contact with the intaglio printing cylinder to be printed on, the material moving at a linear speed substantially equal to the linear speed of movement of the cylindrical surface of the intaglio printing cylinder so that the printing cylinder prints on the material. The material 82 may for example be a strip of paper advanced by paper feeding mechanism in the press as well known in the art and pressed against the cylindrical surface of the intaglio printing cylinder by a roller 83. I preferably dispose the roller 83 at the top portion of the cylinder, desirably with its axis in substantially the same vertical plane with the axis of the cylinder. Thus the ink from the pool 81 travels through an angular distance of at least about 180° and normally close to 270° between its application to the intaglio printing cylinder and its deposition by the intaglio printing cylinder upon the material 82 which is being printed on.

Extending transversely of the press frame between opposed portions 84 thereof are guides 85 guidingly supporting a slide 86 having a dovetail extension 87 cooperating with the guides 85. The slide 86 is during operation of the press moved back and forth transversely of the press by suitable mechanism connected with the press drive which may be of conventional construction. Carried by the slide 86 and guided thereon for generally vertical movement are brackets 88 spaced apart transversely of the press. Each bracket 88 has a rack 89 with which meshes a pinion 90 keyed to a transverse shaft 91. By turning of the shaft 91 the respective brackets 88 are moved in unison while being guided vertically upon the slide 86.

Mounted in the brackets 88 is a shaft 92. Mounted on the shaft 92 for pivotal movement about the axis thereof are two support members 93. A plate 94 spans the space between and lies atop the support members 93 and is fastened thereto so that the plate 94 and the two support members 93 form in effect a saddle mounted for turning movement about the axis of the shaft 92.

The plate 94 carries on its upwardly facing surface adjacent the edge thereof remote from the intaglio printing cylinder two laterally spaced sleeves 95 in each of which operates a screw 96 having a knurled head 97. Each screw 96 is freely turnable in its sleeve 95. The screws 96 respectively threadedly engage a slide 98 carried upon the plate 94 and carried for movement thereon axially of the screws 96. Turning of the screws 96 adjusts the slide 98 upon the plate 94 toward and away from the intaglio printing cylinder. The slide 98 has therethrough elongated openings 139 through which pass screws 140 screwed into the plate 94. When the slide is positioned as desired the screws 140 are screwed down to engage the upper surface of the slide 98 and fasten the slide in place on the plate 94.

Fastened to the slide 98 by screws 99 is a doctor blade carrier 100 to which is clamped by a clamping member 101 the doctor blade 102 adapted to bear against the intaglio printing cylinder as well known in the art. Lying atop the doctor blade 102 is a plate 103, the clamping member 101, which is fastened to the carrier 100 by screws 104, pressing the plate 103 against the doctor blade 102 and thereby in turn pressing the doctor blade 102 against the carrier 100 to maintain the assembly. Substantial angular adjustments of the doctor blade 102 may be effected by loosening the screws 104 and adjusting the doctor blade at the desired angle and then tightening the screws 104 to clamp the doctor blade in position against the holder 100. Minute angular adjustments of the doctor blade may be effected by relative turning of the screws 96, i. e., by turning one of those screws through perhaps a portion of a turn while the other remains stationary.

The doctor blade cooperates with the cylindrical surface of the intaglio printing cylinder

within a central angle of 90° ahead of the position of contact therewith of the material 82. The doctor blade desirably cooperates with the cylindrical surface of the intaglio printing cylinder within a central angle of 45° ahead of the position of contact therewith of the material 82 as in the structures shown in the drawings.

The clamping member 101 has connected therewith by screws 105 guard members 106, one adjacent each end of the intaglio printing cylinder, each of the guard members 106 having a portion 107 positioned so that in any axial position of the doctor blade it overlaps the edge of the intaglio printing cylinder and a portion 108 which overlaps the end edge of the doctor blade. The doctor blade is longer than the intaglio printing cylinder and while the doctor blade oscillates parallel to the axis of the intaglio printing cylinder each end edge of the doctor blade always projects beyond the corresponding end face of the intaglio printing cylinder. The portions 107 of the guard members 106 intercept ink flying outwardly from the end edges of the intaglio printing cylinder and the portions 108 of the guard members 106 intercept ink moving off of the end edges of the doctor blade.

Hinged to the slide 98 by a spring hinge 109 is a guard member 110 which extends across the ink reservoir with its lower portion lying therewithin. The transverse dimension of the guard member 110 is such that its end edges fall just short of engaging the end plates of the ink reservoir when the doctor blade with its associated mechanism oscillates during the operation of the press. The spring hinge 109 urges the guard member 110 to turn in the counterclockwise direction about the axis of the pintle of the hinge, viewing Figure 11. The guard member 110 may be made of stiff material such as sheet metal or plastic and has its lower edge portion slightly inwardly curved as shown at 111 (Figures 1 and 2).

Extending within the ink reservoir generally parallel to the axis of the intaglio printing cylinder and journaled in the ends of the ink reservoir is a shaft 112. Fastened to the shaft 112 is a flexible guard member 113 and a stiff guard member 114. The flexible guard member 113 extends generally downwardly from the shaft 112 and lies against the inside of the rear wall of the ink reservoir. It may be made of rubber, neoprene or other suitable flexible material. The guard member 114 projects generally upwardly and lies behind the guard member 110 which is pressed by the spring hinge 109 into engagement therewith. The upper edge of the guard member 114 engages the support members 93. As will be seen by comparing Figures 1 and 2, the guard members 110, 113 and 114 effectively prevent ink from being thrown out at the rear of the ink reservoir regardless of the position of the doctor blade. As the doctor blade with its associated mechanism oscillates back and forth during operation of the press the guard member 110 oscillates relatively to the guard member 114 since the guard member 110 is connected with the doctor blade through the slide 98 while the guard member 114 is pivoted to the ink reservoir and does not move back and forth with the doctor blade.

The slide 86 carries brackets 115 to which is pivoted at 116 a cylinder 117 in which operates a piston with which is connected a piston rod 118 adjustably connectd through a turnbuckle 119 with a threaded rod 120 carrying an eye 121 at its upper end. Connected with the plate 94 is a projecting bracket 122 carrying a clevis 122a through which passes a pin 123 which also passes through the eye 121, which eye lies between the arms of the clevis 122a. Fluid under pressure normally resiliently presses the piston in the cylinder 117 generally upwardly to urge the doctor blade with predetermined force against the surface of the intaglio printing cylinder. The position of the doctor blade, which depends upon the diameter of the intaglio printing cylinder, is compensated for by adjusting the turnbuckle 119 as is clear by comparing Figures 1 and 2.

I provide a guard member 125 which is of generally arcuate shape and has connected therewith adjacent each of its lower corners a block 124. A trunnion screw 124a passes through each end 14 of the ink reservoir and threads into the corresponding block 124 whereby to mount the guard member 125 to the ink reservoir for turning movement about the axes of the trunnion screws 124a. The recesses 25 of the end plates 17 receive the trunnion screws 124a when the end plates 17 are applied. Connected with the guard member 125 adjacent each end thereof is a bracket 126 to which is pivoted at 127 a bifurcated arm 128 straddling a stud 129 in the corresponding end of the ink reservoir. Each stud 129 carries a clamp 129a which lies against the face of the arm 128 remote from the adjacent end plate 17. A nut 130 is threaded onto each stud 129 and when turned up against the end 14 of the ink reservoir draws the clamp 129a against the arm 128 and thereby clamps the arm to the corresponding end of the ink reservoir. Thus the guard member 125 is maintained in desired adjusted position relatively to the intaglio printing cylinder, different adjustments of the mechanism for clamping the guard member 125 in place being shown in Figures 1 and 2.

A guard member 131 which is also of generally arcuate shape is slidably connected with the guard member 125 and adapted to be maintained in desired adjusted positions relatively thereto by clamps 132. The guard member 131 may be extended or retracted as desired and fastened in place upon the guard member 125 by tightening the clamps 132.

Pivoted to the guard member 125 by spring hinges 133 are guard members 134, one disposed opposite and close to each end face of the intaglio printing cylinder. The spring hinges 133 maintain the guard members 134 in the positions shown in Figures 1 and 2 but permit the guard members 134 to turn in the clockwise direction about the pintles of the hinges, viewing Figure 14, when the guard member 125 is swung to the left or in the counterclockwise direction about the axis of the shaft 124 to enable the guard members 134 to clear the portions of the roller 83 which project beyond the ends of the intaglio printing cylinder. The guards 134 extend above and somewhat beyond the shaft portions 5 and intercept ink dripping from the guard members 106 to prevent that ink from falling onto the shaft portions 5.

A guard member 135 is adapted to close the front of the ink reservoir, having its forward lower edge supported against the inside of the front of the ink reservoir as shown at 136 in Figure 9 and having its rear upper edge lying against the exterior of the arcuate guard member 125 and being reversely turned as shown at 137 to provide a gripping portion whereby the

guard member 135 may be easily removed and replaced. The front corners of the guard member 135 are cut away as shown at 138 to enable the guard member to properly fit to the ink reservoir (Figure 9).

While I have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed relatively hingedly movable portions providing passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof, relative hinged movement of said portions varying the effective cross-sectional area of said passage means.

2. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed portions fastened together at one side and slightly spaced apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof, the opposed portions of the elongated hollow member being relatively adjustably movable to vary the width of the slit.

3. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed sections hinged together at one side and slightly spaced apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof, and means for relatively hingedly moving said sections to vary the width of the slit.

4. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into position to pass outwardly through the passage means of the first mentioned elongated hollow member.

5. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylnder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into the space within the first mentioned elongated hollow member but outside the second elongated hollow member, the passage means of the second elongated hollow member being disposed to direct ink passing therethrough generally away from the passage means of the first mentioned elongated hollow member.

6. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, means for varying the effective cross-sectional area of said passage means, and a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into the space within the first mentioned elongated hollow member but outside the second elongated hollow member.

7. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed portions fastened together at one side and slightly spaced apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the opposed portions of the elongated hollow member being relatively adjustably movable to vary the width of the slit, and a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into the space within the first mentioned elongated hollow member but outside the second elongated hollow member, the passage means of the second elongated hollow member being disposed to direct ink passing therethrough generally away from the slit of the first mentioned elongated hollow member.

8. Inking means for an intaglio printing press comprising an elongated hollow member adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed portions fastened together at one side and slightly spaced

apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the opposed portions of the elongated hollow member being relatively adjustably movable to vary the width of the slit, and a second elongated hollow member disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having a series of spaced apart passages disposed generally throughout the length of the second elongated hollow member extending from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into the space within the first mentioned elongated hollow member but outside the second elongated hollow member.

9. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having opposed portions fastened together at one side and slightly spaced apart at the opposite side to provide a slit through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and means connected with the supporting means and with one of the opposed portions of the elongated hollow member to move said portion relatively to the other portion to vary the width of the slit.

10. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the elongated hollow member being turnable in the supporting means without altering the effective cross-sectional area of said passage means to vary the angle of discharge of ink through the passage means into said receptacle.

11. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the elongated hollow member being turnable in the supporting means to vary the angle of discharge of ink through the passage means into said receptacle, and means carried by the supporting means for fastening the elongated hollow member in adjusted angular position.

12. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the elongated hollow member being turnable in the supporting means to vary the angle of discharge of ink through the passage means into said receptacle, and fastening means on the supporting means and the elongated hollow member for fastening the elongated hollow member in predetermined angular positions.

13. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and means connected with the supporting means and with the elongated hollow member operable to vary the effective cross-sectional area of said passage means.

14. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and screw means extending between the supporting means and the elongated hollow member turnable to vary the effective cross-sectional area of said passage means.

15. Inking means for an intaglio printing press comprising supporting means, an elongated hollow member carried by the supporting means adapted to be disposed adjacent the cylindrical surface of an intaglio printing cylinder generally parallel to the axis of the cylinder to form with said surface a receptacle for a pool of ink, said elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, the elongated hollow member being turnable in the supporting means to vary the angle of discharge of ink through the passage means into said receptacle, and means connected with the supporting means and with the elongated hollow member operable to vary the effective cross-sectional area of said passage means.

16. Inking means for an intaglio printing press having a rotatable intaglio printing cylinder mounted in a casing comprising conduit means entering the casing from without and projecting inwardly of the inner wall of the casing and means carried by the conduit means cooperating with the surface of the printing cylinder to form a receptacle for a pool of ink, said last mentioned means including an elongated hollow member adapted to be disposed generally parallel to the axis of the cylinder and having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof and into said receptacle, and a second elongated hollow mem-

ber disposed generally within the first mentioned elongated hollow member into which ink is adapted to be fed, the second elongated hollow member having passage means from the interior to the exterior thereof through which ink fed into the interior thereof may pass to the exterior thereof into position to pass outwardly through the passage means of the first mentioned elongated hollow member, the conduit means conducting ink into the interior of the second elongated hollow member.

FRANK A. ROSS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 21,212	Weiss	Sept. 19, 1939
923,242	Briggs	June 1, 1909
1,312,481	Huenke	Aug. 5, 1919
1,840,069	Walker et al.	Jan. 5, 1932
2,106,029	Horton	Jan. 18, 1938
2,141,978	Greenhill	Dec. 27, 1938
2,151,960	Ericksson	Mar. 28, 1939
2,247,156	Gurwick	June 24, 1941
2,278,138	Paardecamp	Mar. 31, 1942
2,550,454	Crafts et al.	Apr. 24, 1951

FOREIGN PATENTS

Number	Country	Date
487,015	Great Britain	June 14, 1938
721,597	Germany	June 10, 1942