March 20, 1934. C. F. HEHLE ET AL 1,952,028

ROTARY PRINTING MACHINERY

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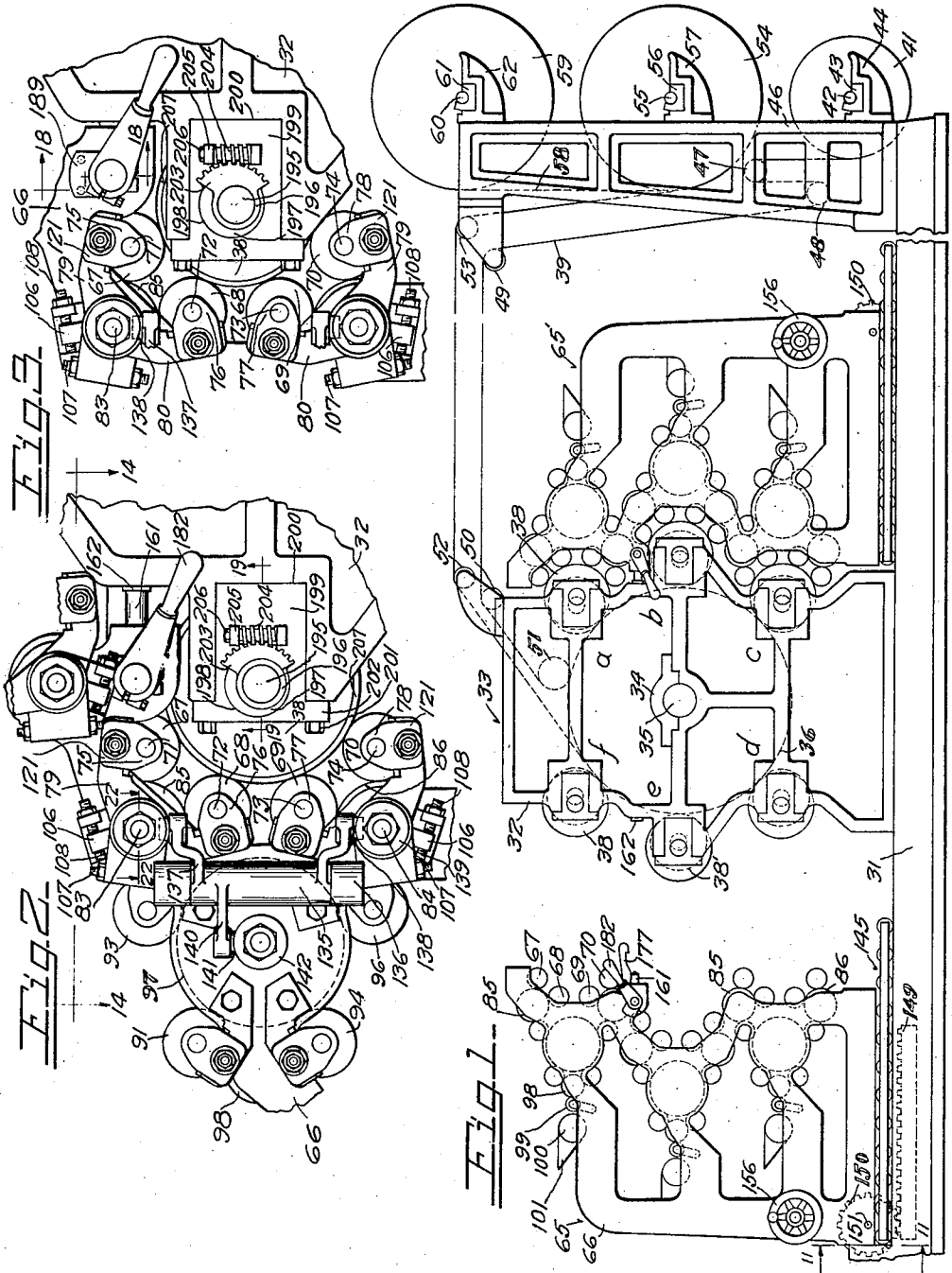


Fig. 3.

Fig. 2.

Fig. 1.

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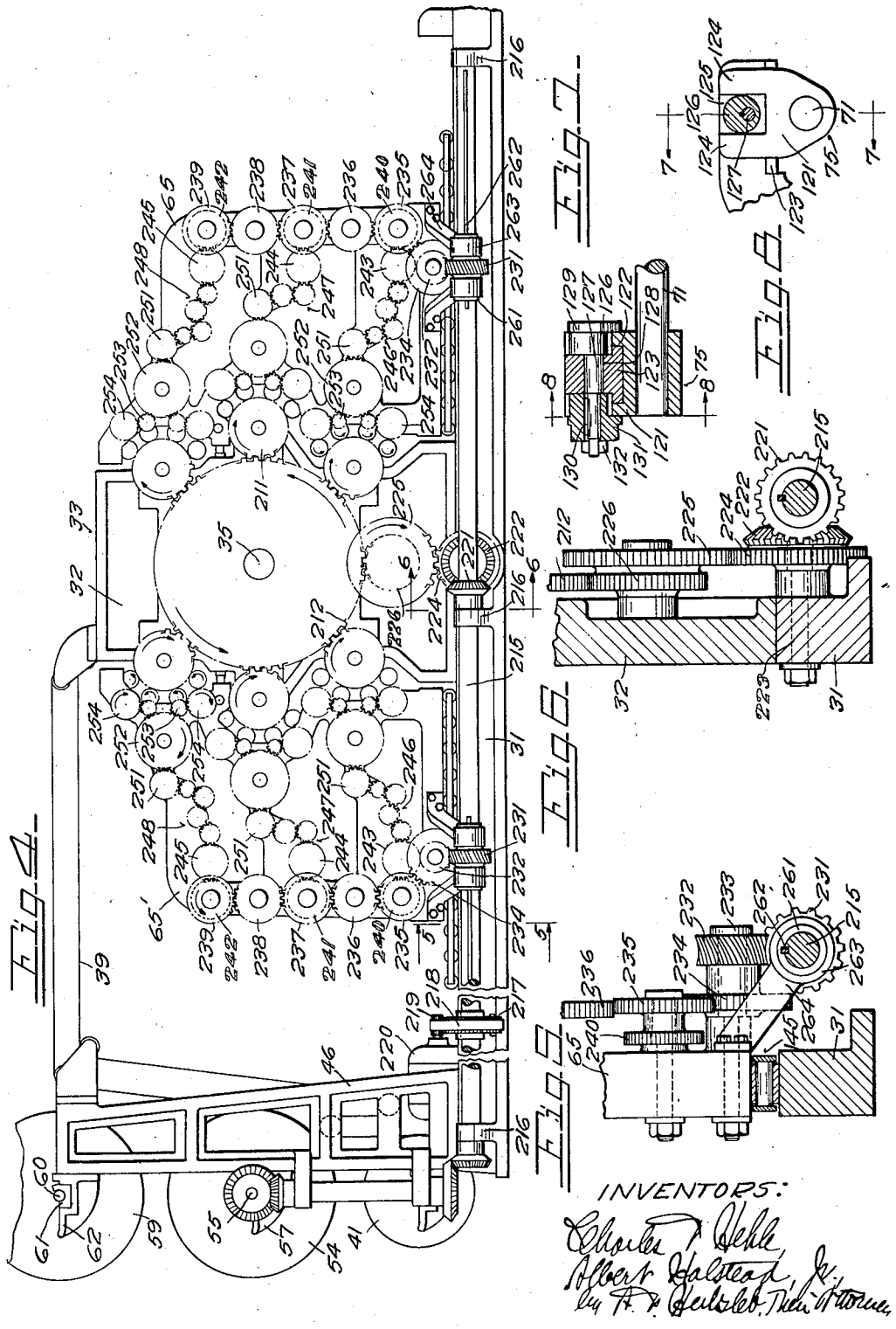
Albert Halstead Jr.,

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March 20, 1934. C. F. HEHLE ET AL 1,952,028

ROTARY PRINTING MACHINERY

Filed Nov. 21, 1931 4 Sheets-Sheet 2



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ROTARY PRINTING MACHINERY

Filed Nov. 21, 1931 4 Sheets-Sheet 3

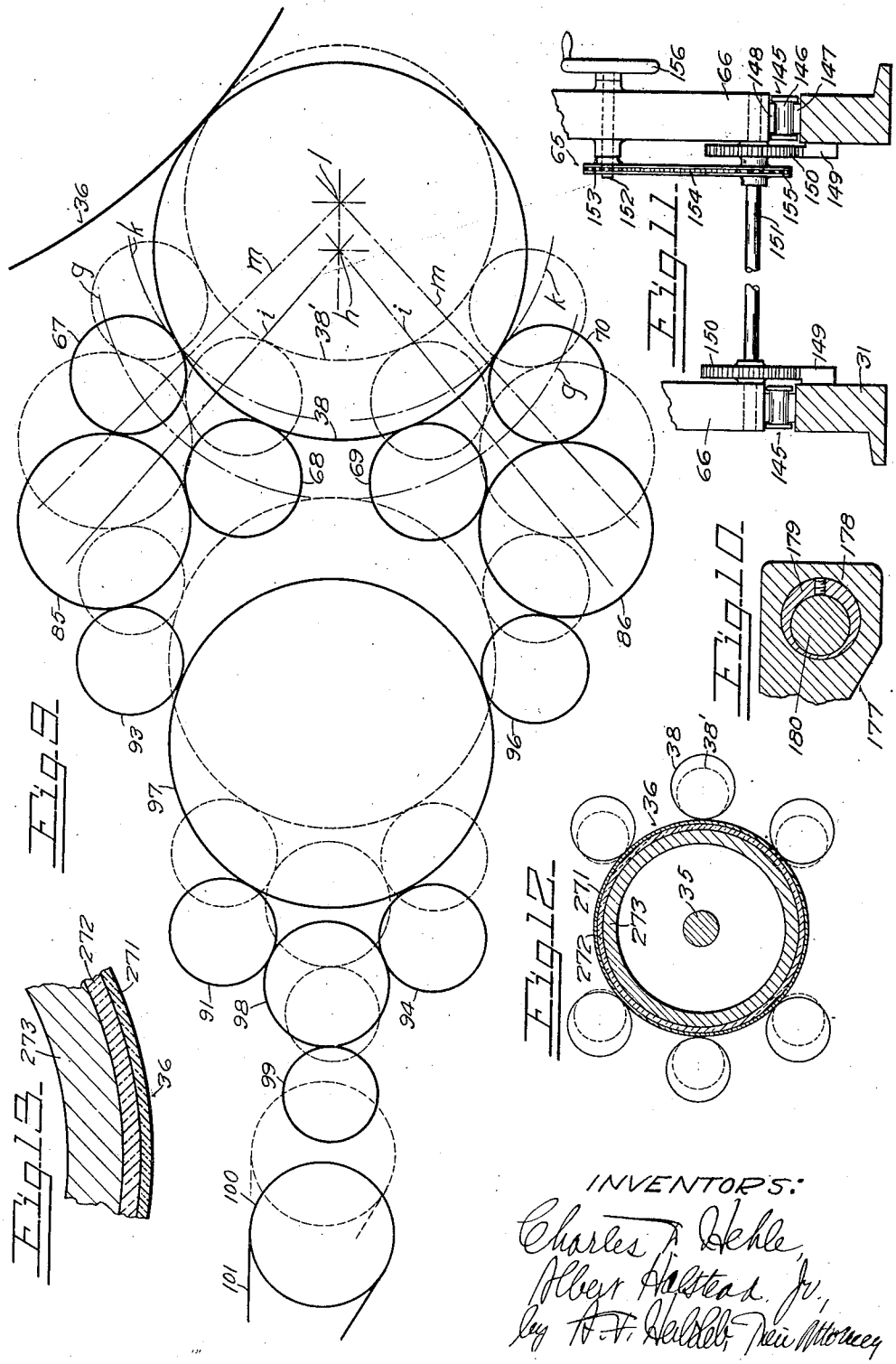


Fig. 9

Fig. 11

Fig. 10

Fig. 12

Fig. 13

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ROTARY PRINTING MACHINERY

Filed Nov. 21, 1931 4 Sheets-Sheet 4

Fig 14.

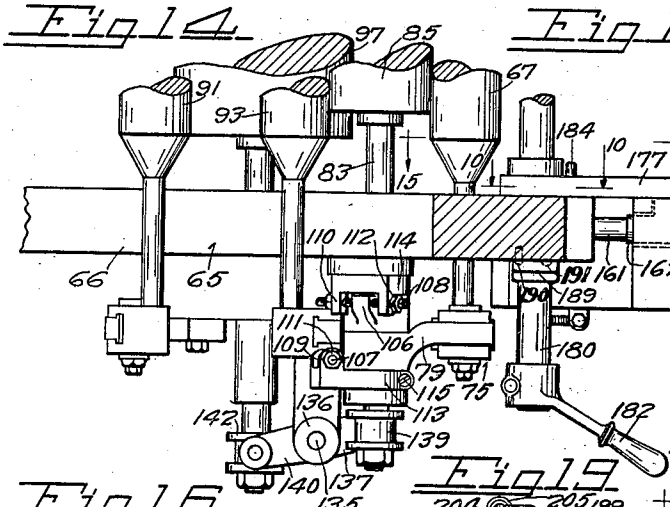


Fig 17.

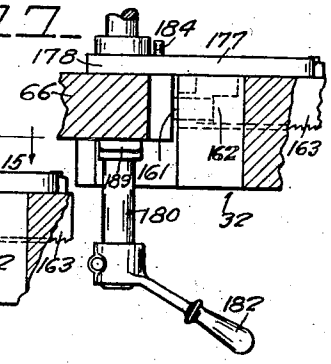


Fig 15.

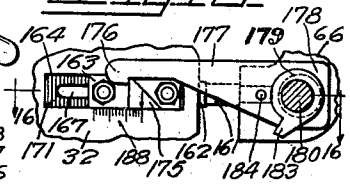


Fig 16.

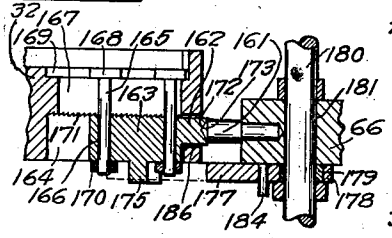


Fig 19.

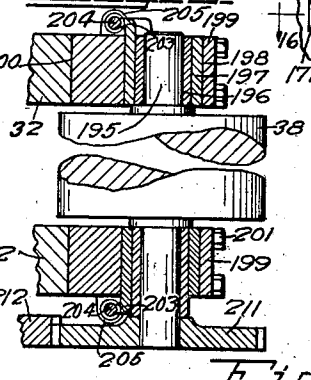


Fig 18.

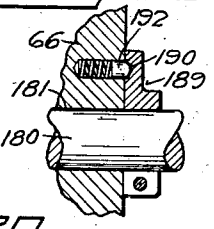


Fig 24.

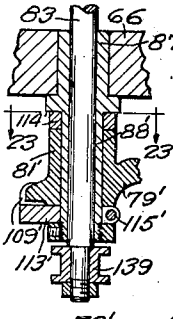


Fig 22.

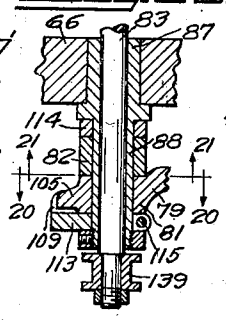


Fig 21.

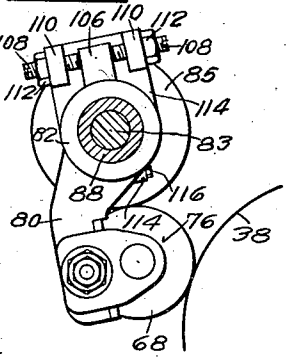


Fig 20.

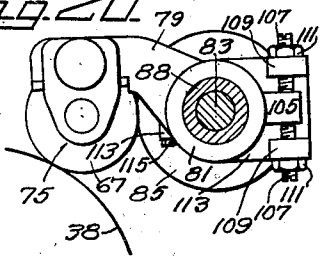
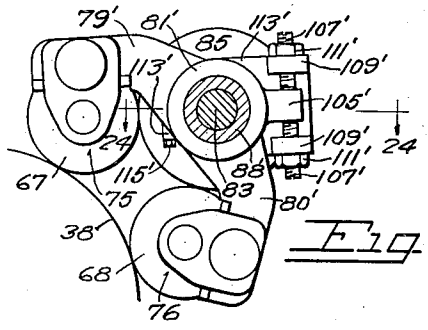


Fig 23.



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UNITED STATES PATENT OFFICE

1,952,028

ROTARY PRINTING MACHINERY

Charles F. Hehle and Albert Halstead, Jr., Milwaukee, Wis., assignors to Claybourn Process Corporation, Milwaukee, Wis., a corporation of Wisconsin

Application November 21, 1931, Serial No. 576,509

9 Claims. (Cl. 101—178)

Our invention relates to rotary printing machinery, and it is the object of our invention to provide rotary printing surfaces of different diameters arranged to cooperate with an impression cylinder of given diameter; further, to provide adjustable form inking rollers adjustable for having their contact lines contact the printing surfaces of different diameters adjustably related so as to arrange said contact lines on the arcs of cylinders of different diameters; further, to provide means for adjustably positioning the axes of rotation of the printing surfaces of different diameters toward and from the axis of rotation of the impression surface for causing printing impressions between said surfaces throughout the range of different diameters of said printing surfaces; and, further, to provide means for adjusting the inker mechanism toward and from the axes of rotation of the printing surfaces and impression surface, and fixing the inker mechanism in various adjusted positions complemental to the positions of the rotating printing surfaces of different diameters properly related to the rotary impression surface.

It is the object of our invention, further, to provide means for driving an impression cylinder and form inking rollers at the same circumferential speeds, and to interpose form cylinders of various diameters between the circumferences of said impression cylinder and form inking rollers, and to provide means for rotating the form cylinders of various diameters at different rates of speed for causing them to respectively rotate at the same circumferential speeds as the circumferential speeds of the impression cylinder and form inking rollers; and further, to provide sets of form cylinders of different diameters about an impression cylinder, and means for adjusting the form inking rollers of said respective sets of form cylinders individually about said form cylinders of various diameters, for causing surface contacts between said form inking rollers and the printing surfaces on said various form cylinders of said various sets of form cylinders throughout the various positional relations of said sets of form cylinders about the impression cylinder.

It is the object of our invention further to provide a circumferentially closed rotary impression surface so that rotary printing surfaces of different diameters may have printing relation throughout the circle of the circumferentially closed impression surface and regardless of the proportional relation between the diameters of the rotary printing surfaces and the diameter of the circumferentially closed impression surface; and, further, to provide a novel circumferentially closed impression surface and novel supporting means therefor whereby indenting of the impression surface is minimized, to maintain the rotary circumferentially closed impression surface in its true cylindrical plane, in order that proper printing impressions may be obtained regardless of the successive points around the circumference of the closed impression surface which may be impressed by the various parts of the circumferential printing surfaces of different diameters.

It is the object of our invention, further, to provide a closed impression surface, and a plurality of sets of printing surfaces of different diameters arranged thereabout, for printing various colors with printing surfaces of different circumferential lengths and diameters; and, further, to provide adjustable inker mechanism for said respective sets of printing surfaces of different diameters, including form rollers adjustable for inking contact with printing cylinders of different diameters.

It is the object of our invention, further, to provide a cylindrical impression part or shell having an outer layer of comparatively harder substance and an inner layer of comparatively softer substance, said substances being preferably resilient, whereby the principal resilient yielding to excess printing pressure is obtained in said inner layer.

Our invention is applicable primarily for continuous web printing of cellophane, glassine, tissue, wall and other paper and substances; for printing webs with form cylinders of different diameters in manner to permit the printed web to be cut into similarly printed sheets of different lengths; and for printing continuous printing matter along the web, and providing diversity in designs, patterns and sizes of printing configurations, by continuous printing surfaces of various circumferential lengths and diameters. In printing on products of this sort, particularly when they are thin and hard surfaced, it is desirable that the type or printing faces do not come into registry with the same portions of the impression cylinder on successive revolutions thereof. The reason for this is that continuous pressure on the same portions of the impression cylinder tend to make impressions therein corresponding to the elevations of the type or printing face. In other words, after a run of any length, inspection shows that the printing cylinders act as male dies and make corresponding female dies on the impression cylinder.

As good work can only be done where the sur-

face of the impression cylinder is substantially perfectly smooth, the problem of applicants is not found where printing heavy and resilient materials such as heavy, soft paper, cloth, etc., but is present to a marked degree where the product printed is very thin and hard surfaced. Furthermore, the tolerance in such cases is much less than is true in cases of heavy, softer materials, so that accuracy is much more important here than there.

In order to avoid this highly undesirable result, we have provided, as hereinafter described, a definite lack of relationship between the diameters of the printing cylinders and impression cylinder, so that they are disproportional one to the other, in order that a given portion of the printing surface does not strike the same portion of the impression cylinder on successive revolutions thereof.

In using various sizes of printing cylinders it is manifest that some of them may not be disproportional to the impression cylinder, and we therefore aim to have our impression cylinder sufficiently resilient and hard surfaced so as to afford a proper factor of safety in order that these sizes of printing cylinders may be used. However, we prefer to use disproportional cylinders whenever practicable.

This is particularly important where our machine is used for printing thin, hard surfaced materials such as those hereinafter enumerated. Because we have to combine extreme accuracy with ability to compensate for inequalities which are always present in the subjects to be printed, we have found that the hard outer surface that we use gives us the smooth printing surface requisite for fine work, but the resiliency that we have added enables us to compensate for inequalities in the product to be printed and also to prevent the making of impressions therein by repeated blows of the printing cylinders.

We have exemplified our invention as embodied in a multi-color web printing machine in which the printed web is rewound for subsequent further fabrication, treatment, and cutting into sheets or lengths, as may be desired. This exemplification is for illustration and is not to be considered a limitation. Our invention is, for instance, also applicable in rotary printing machines, printing in one or more colors, and disposing of the printed web in other manners.

In the drawings:

Fig. 1 is a diagrammatic view in side elevation, illustrating a six color rotary web printing machine, partly broken away, including our invention, and showing rewinding means for the printed web, and a pair of inker frames, one of which is in coactive relation with its form cylinders, and the other of which is spaced from its form cylinders, and showing form cylinders of one size in full lines and having the circles of form cylinders of smaller diameters and their arbors imposed thereon in dotted lines.

Fig. 2 is a side elevation of one of the inker sets in coactive relation with a form cylinder of larger diameter, partly broken away, the form cylinder including a cylindrical printing plate.

Fig. 3 is a similar view, partly broken away, showing the inker set in association with a form cylinder of smaller diameter.

Fig. 4 is a side elevation of the printing machine, taken from the gear side of the machine, and partly broken away.

Fig. 5 is a cross-section, taken on the line 5—5 of Fig. 4, showing a detail of the driving means for an inker frame.

Fig. 6 is a cross-section of a detail for the driving means of the printing couples, taken on the line 6—6 of Fig. 4, and partly broken away.

Fig. 7 is a detail view of one of the adjusting means for the form rollers, taken on the line 7—7 of Fig. 8, and partly broken away.

Fig. 8 is a cross-section of the same, taken on the line 8—8 of Fig. 7, and partly broken away.

Fig. 9 is an end elevational diagrammatic representation of a larger form cylinder in coactive relation with the impression surface of the impression cylinder, partly broken away, and the inking rollers for the larger form cylinder, in full lines, and the circle of a smaller form cylinder in coactive relation with the proximate arc of the cylindrical impression surface, and the inking rollers therefor, in dotted lines, viewed from the operator's side of the machine.

Fig. 10 is a cross-sectional detail view of the clamping means for the inker frame, taken on the line 10—10 of Fig. 14.

Fig. 11 is a cross-section, taken on the line 11—11 of Fig. 1, showing the means for adjusting the inker frames.

Fig. 12 is a cross-section of the impression cylinder and its impression and cushioning layers in association with cylindrical printing surfaces of different diameters diagrammatically represented, such cylindrical printing surfaces of greater diameter being shown in full lines and of less diameter in dotted lines.

Fig. 13 is an enlarged view showing a sector of the impression cylinder with its cushioning layers, partly broken away.

Fig. 14 is a cross-section, taken on the line 14—14 of Fig. 2, showing a portion of the inking rollers, and a stop and clamping means between the inker frame and the main frame when employing a form cylinder of larger diameter, and partly broken away.

Fig. 15 is a cross-section of the same, taken on the line 15—15 of Fig. 14, and partly broken away.

Fig. 16 is a cross-section of the same, taken on the line 16—16 of Fig. 15, and partly broken away.

Fig. 17 is a cross-section, taken on the line 14—14 of Fig. 2, showing the relation of the frames, the stop and clamping means when employing a form cylinder of smaller diameter, and partly broken away.

Fig. 18 is a cross-section, taken on the irregular line 18—18 of Fig. 3, showing the positioning means for the operating shaft of the clamping means, partly broken away.

Fig. 19 is a cross-sectional detail view of an exemplified adjusting means for adjusting a form cylinder of given diameter for minor adjustments of contact relation with its impression cylinder, taken on the line 19—19 of Fig. 2, and partly broken away.

Fig. 20 is a cross-sectional detail view showing the adjusting means for adjusting one of the form inking rollers of a pair of form inking rollers, taken on the line 20—20 of Fig. 22.

Fig. 21 is a cross-sectional detail view, showing the means for adjusting the other inking roller of a pair of form inking rollers, taken on the line 21—21 of Fig. 22.

Fig. 22 is an axial sectional detail view of the means for mounting the respective arms of a pair of separately adjustable form inking rollers, taken on the line 22—22 of Fig. 2.

Fig. 23 is a side elevational detail view, showing the adjusting and mounting means for a pair of form inking rollers combinedly adjustable, taken partly in section on the line 23—23 of Fig. 24; and,

Fig. 24 is an axial sectional detail view of the same, taken on the line 24—24 of Fig. 23.

The exemplified printing machine includes a base 31 having side frames 32 of a cylinder frame 33 at its respective sides. The side frames are suitably connected to form the main frame of the machine. Each of the side frames contains a bearing 34 for the arbor 35 of an impression cylinder 36, extending crosswise of the machine between the side frames.

Printing cylinders 38 have coactive relations with the impression cylinder for forming printing couples for printing a web 39 which passes about the impression cylinder between the impression cylinder and the respective printing or form cylinders. There may be one or more of these form cylinders, six of the same being represented respectively at the stations *a*, *b*, *c*, *d*, *e* and *f*. At each of these stations a different color or treatment may be applied to the web. Form cylinders are exemplified at these various stations. (Fig. 1.)

At each of these stations there may be cylindrical printing surfaces of various circumferential lengths or diameters, exemplified by form cylinders of different diameters, a larger one of which is represented in full lines by the form cylinder 38 and a smaller one of which is represented by dotted lines at 38'. Form cylinders of equal diameters are preferably simultaneously located at all the stations, although this is not essential.

It will be understood that the number and relative diameters of the form-cylinders or printing surfaces and the difference in steps of diameters at the respective stations is not limited, and that the diameters of form cylinders or printing surfaces at different stations may vary, and be for instance multiples of each other, or their circumferential lengths may be aliquot parts of each other.

The web is represented as received from a web roll 41, whose axle 42 is journaled in bearings 43, on brackets 44, at the respective sides of the printing machine, and shown mounted on stands 46 supported at the end of the base. (Figs. 1 and 4.) The web passes over guide rollers 47, 48, 49 and 50, and a guide roller 51 at the impression cylinder, for guiding the web to the impression surface of the impression cylinder, the web passing thence through the printing couples at the stations *a*, *b*, *c*, *d*, *e* and *f*, for being printed or treated at said respective stations, and being thence guided by guide rollers 52 and 53 about a rewind roll 54, whose axle 55 is journaled at its respective ends in bearings 56, on brackets 57, on the stands 46. The rewind roll is suitably driven.

A smut web 58 is received from a smut web roll 59, the respective ends of whose axles 60 are journaled in bearings 61 on brackets 62, extending from the stands 46. The smut web passes from its roll between the layers of the printed web 39 laid about the rewind roll 54 in rewinding the web.

Inking mechanisms are provided for the various form cylinders. The inking mechanisms for the respective form cylinders are substantially duplicates of each other and are provided with major adjustments for adjusting the form inking rollers for accommodating form cylinders of various diameters, and minor adjustments for adjusting the more minute contacts of said form inking rollers.

The sets of inking rollers at the opposite sides of the printing couples are mounted on inker stands 65, 65'. Each of the inker stands is exemplified as supporting three inker sets for coaction with three form cylinders at the respective sides of the impression cylinder. The respective inker stands comprise side frames 66 at the respective sides of the printing machine, which are rigidly connected together across the printing machine for forming rigid inker frames, in or from the respective side frames of which the shafts for the various inking rollers are journaled or supported.

The inker sets include form rollers 67, 68, and 69, 70, (Figs. 1, 2, 3 and 9) shown in pairs, the shafts 71, 72, and 73, 74, of which are, at the respective ends of the form rollers, journaled in bearings 75, 76 and 77, 78, respectively. The pairs of bearings 75, 76 and 77, 78 are respectively on arms 79, 80 at the respective ends of the form rollers.

The arms 79, 80, at the respective ends of each pair of form rollers are provided with bearings 81, 82. (Figs. 2, 3, 20–22.) The bearings for the arms of the respective pairs are pivoted about the axes of the shafts 83, 84, of reciprocating inking rollers 85, 86, of the set, said shafts of said reciprocating inking rollers being journaled in bearings 87 at their respective ends in the side frames of the inker frame. The pivot bearings of the respective arms are journaled on extensions 88 of said bearings 87.

Distributing inking rollers 91, 93, 94, 96, coact with a reciprocating inking roller 97. (Figs. 2 and 8.) The inking rollers 93 and 96 also coact respectively with the reciprocating rollers 85, 86. A feed inking roller 98 is mounted in the inker frame and coacts with the distributing inking rollers 91, 94. A ductor inking roller 99 is movable laterally between the feed roller 98 and a fountain roller 100 of a usual ink fountain 101, the frame of which may form a connecting member between the side frames of the inker frame.

The reciprocating rollers, the feed roller and the fountain roller are usually metal rollers, the balance of the inking rollers being softer composition rollers.

The major adjusting means for the form inking rollers exemplified comprise said arms 79, 80, pivoted about the axes of their coacting reciprocating rollers and means for adjusting said form rollers about the circumferences of said reciprocating rollers, so that the contact lines of the set of form inking rollers with the cylindrical printing surfaces of different diameters lie in arcs of corresponding different d'ameters.

Lugs 105, 106, on the respective arms 79, 80, of each pair of form inking rollers are contacted respectively by adjusting screws 107, 108, (Figs. 2, 3, 20, 21 and 22), threaded respectively in lugs 109, 110, and fixed in adjusted positions by clamp nuts 111, 112. The respective lugs 109, 110, are on split collars 113, 114, respectively clamped about the extension 88 of the bearing 87. These respective collars are clamped in place by clamp bolts 115, 116, spanning the split in said split collars and acting to clamp and unclamp said collars in adjusted positions about said bearing extension.

The supporting arms of the respective form inking rollers at the respective sides of the hori-

zontal plane in which the axis of the form cylinder is located are oppositely disposed, as exemplified in Figs. 2 and 3, for encompassing the form cylinder, the ends of the arms 79 projecting toward each other and the arms 80, being respectively projected downwardly and upwardly toward each other.

In adjusting said form inking rollers, the collars 113, 114, are unclamped and the arms 79, 80, at each end of said rollers are manually swung about their axes of oscillation for moving said collars and said arms into proximate locations for coaction with the form cylinder which they are to contact. The finer portions of such adjustments are made by manipulation of the adjusting screws 107, 108, for completing said major adjustment. Such major adjustment arranges the contact lines of the respective form inking rollers of the set of inking rollers on arcs of different diameters, causing approach and recession between the individual form inking rollers about the reciprocating roller so that said form inking rollers may make proper inking contact with cylindrical printing surfaces of various diameters, exemplified respectively by the full lines and the dotted lines in the diagrammatic representation in Fig. 1.

Thus referring to Fig. 9, the axes of the respective pairs of form inking rollers 67, 68 and 69, 70, lie in arcs *g* described from the axis *h* of the form cylinder of larger diameter as a center, said arcs *g* intersecting radial lines *i* between the axis of the form cylinder of larger diameter and the axes of the arms of the respective pairs of form inking rollers, and the contact lines of the rollers of the respective pairs of form inking rollers with the form cylinder of largest diameter are equidistant from said respective radial lines when said form inking rollers are adjusted for major inking relations with said form cylinder of larger diameter. When employing a form cylinder of smaller diameter, the axes of said form inking rollers lie in arcs *k* described from the axis *l* of a form cylinder of smaller diameter, the arcs *k* intersecting radial lines *m*, between the axis *l* and the axes of the respective supporting arms of the pairs of form inking rollers, said contact lines of said form inking rollers of said respective pairs being equidistant from said respective radial lines when adjusted for major inking relations with the form cylinders of smaller diameter.

It will be noted by comparison of Figs. 2, 3 and 9, and comparison of the positions of the dotted circles and full line circles representing positions of smaller and larger form cylinders in Fig. 1, arranged about the impression cylinder, that there is greater difference in horizontal linear distance between the axes of the form cylinders of different diameters at the stations *a*, *c*, *d* and *f*, than at the stations *b* and *e*, in different positions radially about the impression cylinder and adjustments of the form cylinders in parallel right lines. Form cylinders which are in the same vertical planes, as the form cylinders at the stations *a* and *c* and *d* and *f*, are adjusted similar distances.

The inker frames are adjusted in similar right lines, making different major adjustments of the form rollers in different vertical planes advisable. The major adjusting means described enable such different adjustments to be made.

The form inking rollers for a portion of the form cylinders may be adjusted in pairs, as exemplified for instance in the modification of adjusting means shown in Figs. 23 and 24, in which the arms 79', 80', of a pair of form inking rollers both project integrally from a single bearing 81', the arms moving together in their major adjustments about the axis of the coacting reciprocating roller, there being a single lug 105' projecting from said bearing, with which set screws 107' threaded in lugs 109' coact, the set screws being clamped in adjusted positions by jam nuts 111'. The lugs 109' are on a split collar 113' clamped about the extension 88' by a clamp screw 115' spanning the split in said split collar. A filler collar 114' locates the bearing 81' endwise. Similar adjusting means having oppositely extending arms are provided for the other pair of form rollers of said set of form rollers.

Minor adjustments are provided for more minute relative contacts of the form inking rollers, as by mounting each of the bearings 75, 76, 77, 78 at each end of the respective form inking rollers on a slide 121, having a T-slot guideway 122, received about the corresponding guide 123 on the adjustable arm. (Figs. 2, 3, 7 and 8.) This slide has cheeks 124, at its respective sides forming a slot 125. An eccentric 126 at each side of the guide 123 is located in said slots.

Rotation of the eccentrics adjusts the slide for adjusting the form inking roller toward and from its coacting reciprocating roller and toward and from its coacting form cylinder. The eccentrics are shown on a rock shaft 127 journaled in a bearing 128 in the guide. The shaft has a flange 129 at one end. One of the eccentrics 126 is shown integral with the shaft and the other eccentric is shown as having a key connection 130 with said shaft. This latter eccentric has a head 131 thereon by means of which to turn the shaft. A clamp nut 132 has threaded connection with the shaft and clamps the parts in adjusted positions. (See Figs. 7 and 8.)

The distributing rollers 91, 93, 94 and 96 are mounted on similar slides similarly adjusted with relation to the reciprocating roller 97 and for coaction of the rollers 93, 96, with the reciprocating rollers 85, 86, and coaction of the distributing rollers 91, 94, with the feed roller 98.

Reciprocation of the reciprocating rollers is accomplished by a rock shaft 135 journaled in bearings 136 of the inker frame, and suitably operated, and having thereon arms 137, provided with rollers 138, received in grooves of spools 139, on the shafts of the respective reciprocating inking rollers 85, 86, and an arm 140 having thereon a roller 141 received in the groove of a spool 142 on the shaft of the reciprocating inking roller 97.

The provision of cylindrical printing surfaces of various diameters between the impression cylinder and the form rollers changes the positions of the contact circles with which the form inking rollers must coact. For accommodating such changes we provide means for limiting the approach of the inker mechanism toward the axes of rotation of the form cylinders of various diameters, and for fixing the inker mechanisms in such various adjusted positions.

We accordingly mount the inker frames slidably on the base of the machine, (Figs. 1, 4, 5 and 11), as on roller frames 145 comprising rollers 146 between plates 147 on the base and 148 on the bottom of the inker frame, for ease of movement of the inker frame toward and from the impression frame of the machine, such means being provided at each side of the machine. At each side of the base and at each of the inker frames there is a rack 149, instanced as fixed to the base,

with which a gear 150 at each end of a cross-shaft 151, journaled in the side frames of the inker frame, meshes.

A shaft 152 is journaled in bearings in one of the side frames of the inker frame, and has a sprocket pinion 153 fixed thereon. A sprocket chain 154 is received over this sprocket pinion and a sprocket gear 155 fixed to the cross shaft 151. A hand wheel 156 is fixed to the shaft 152 for rotating the shaft and said cross-shaft in one or the other direction, for causing approach or recession of the inker frame with relation to the form cylinders with which it coacts.

At each side of the inker frame there is a stop 161 which coacts with a stop 162 on the main frame, adjustment being provided for such stops. (Figs. 14 to 18 inclusive.) Adjustment of the stop 162 is instanced. This stop is located on a stop block 163. This block is adjustable on the main frame toward and from the inker frame, as by being located in a guideway 164 in the main frame, along which it is movable. It is clamped in adjusted positions by means of bolts 165 located in holes 166 in the block and slidable endwise in said holes. The bolts are slidable laterally in a slot 167 in the main frame, their heads 168 being slidable in an enlargement 169 of said slot. Nuts 170 threaded to said bolts clamp the block to the frame. Teeth 171 between the block and the frame aid in holding the block in adjusted positions.

One of the stops is provided with a conical recess 172 and the other stop is provided with a conical end 173 received in said recess for centering the inker frame with relation to the main frame.

The block is provided with a lug 175 forming a keeper for a hook 176 on a hook arm 177. The hook arm has a bearing 178 about an eccentric 179 on a rock shaft 180 journaled in bearings 181 in the inker frame. The rock shaft has an operating handle 182 fixed thereto. It also has an arm 183 fixed thereto arranged to contact a pin 184 on the hook arm.

The relation of the high part of the eccentric to the arm 183 is such that when the rock shaft is rocked in one direction, the hook is moved into release position with relation to its keeper and the arm 183 is moved toward its coacting pin, so that when release of the hook has been effected, the arm engages the pin for raising the hook arm and arranging the hook out of range with the keeper, thereby releasing the inker frame so that the inker frame may be moved toward and from the main frame.

When the inker frame has been moved toward the main frame so that the stops 161, 162 coact, and the rock shaft is moved in the opposite direction, the arm 183 rocks in a direction away from the pin for permitting the hook arm to move so that its hook is again in clamping relation with its keeper. In the form shown, the hook arm drops by gravity into this position. Further rocking movement of the rock shaft moves its eccentric in the bearing of the hook arm for drawing the hook toward its keeper on the main frame and clamping the inker frame to the main frame.

The stop 162 is on a stem on the block. This stem is arranged to move endwise in a hole 186 in the main frame. The stop 161 is on a stem projecting from the inker frame. This stem is received in said hole for permitting closer approach of the inker frame toward the main frame during certain adjustments of the stop on the main frame, as when employing form cylinders of smaller diameters. A scale 188 between the block and main frame indicates the proper positions of the block for the form cylinders of various diameters. (Fig. 15.)

Both the stop and the keeper on the main frame are located on the block 163 so that both are adjusted simultaneously according to the diameters of the form cylinders or printing surfaces employed.

A locating plate 189 is fixed to the rock shaft and has indentations 190, 191, (Figs. 14 and 18), therein with which a spring-pressed plunger pin 192 coacts for locating the rock shaft in its clamping position and unclamping position respectively.

One or more of the stops and locking means may be provided at each side of the machine.

The cylindrical printing surfaces of various diameters may be suitably provided, as by providing a form cylinder or form cylinders which may be increased or decreased in diameter and have the printing surfaces or printing plates suitably secured thereto, or in other manner, but we have preferred to exemplify the various cylindrical printing surfaces of various diameters at the respective stations as located on form cylinders of different diameters arranged to be substituted for each other in the printing machine. The term form cylinders herein includes the printing surfaces thereon or secured thereto and the printing surfaces of various diameters.

A form cylinder is shown at 38, provided with axles 195, journaled in bearing bushings 196, mounted in eccentric sleeves 197, eccentrically journaled in bearing bores 198 in bearing blocks 199, at the respective ends of the form cylinder. (Figs. 2, 3 and 19.) The bearing blocks are received in recesses 200 in the respective side frames of the cylinder frame, and are preferably fitted in said recesses, and are fixed in place by bolts 201 passing through holes in flanges 202 of the bearing blocks and threaded into the side frames. The eccentric sleeve is provided with a segment gear 203 with which a worm 204 meshes, the worm being held endwise between and journaled in bearing lugs 205 extending from the bearing blocks. The worm is provided with a suitable head 206 for receiving a suitable wrench by means of which to rotate the same.

The printing surfaces 38 of various diameters may be directly on the form cylinders or be mounted on printing plates 207 (Figs. 2 and 3) suitably secured to the form cylinders. These printing plates may be in the form of closed cylinders, or may be in the form of sectors of a cylinder, or usual curved printing plates for single or multi-color printing adjustably secured in usual manner about the form cylinders, and may be continuous about the form cylinder or may be interrupted about the form cylinder, all as may be desired, or the character or configurations of the work may demand.

Any number of such form cylinders, printing surfaces and printing plates of various diameters may be employed in the printing machine, a larger one of the same being exemplified in full lines at 38 and a smaller one of the same being exemplified in dotted lines at 38'. (Figs. 1, 2 and 3.) Each of the form cylinders is provided with axles, bearing bushings, eccentric sleeves, block bearings and means thereon for adjusting the bearing sleeves, as a unit, the block bearings of the respective units being interchangeably in-

serted and positioned in the recesses 200 in the side frames of the cylinder frame, and fixed in place.

The axes of rotation of the form cylinders of various diameters and the axles thereof vary in distance relation to the axis of rotation of the impression cylinder, as illustrated, for instance, by comparison of such axles shown respectively in full lines and in dotted lines in Fig. 1, complemental respectively to the dotted line and full line form cylinders shown in said figure.

The form cylinders of various diameters are also provided with driving gears 211 of different diameters, the pitch lines of which gears correspond respectively to the cylindrical planes of the cylindrical printing surfaces and the usual bearers for said respective form cylinders. These respective gears are fixed to the arbors of the respective form cylinders, and mesh with the gear 212, fixed to the axle 35 of the impression cylinder.

We prefer to drive the inking rollers from a rotary member whose speed has definite relation to the speed of the impression cylinder, and to so arrange the drive that the surface speeds of the form inking rollers equal the surface speed of the impression cylinder, regardless of the diameters of the respective cylindrical printing surfaces or form cylinders which may be interposed between the impression cylinder and the form rollers.

Thus a shaft 215 extends lengthwise of the machine and is journaled in bearings 216 of the base. (Figs. 4 and 6.) It has a gear 217 fixed thereto, a silent chain 218 being received about said gear and a pinion 219 on the drive shaft of an electric motor 220. A bevel pinion 221 rotates with the shaft 215 and meshes with a bevel gear 222 on a stud shaft 223 in the main frame. A gear 224 rotates with this bevel gear and meshes with a gear 225 with which a gear 226 also rotates. The gear 212 on the arbor of the impression cylinder meshes with the gear 226.

At each of the inker frames there is a spiral gear 231 which rotates with the shaft 215 and meshes with a spiral gear 232 on a stud shaft 233 in the inker frame and having a gear 234 rotating therewith. (Figs. 4 and 5.) A gear 235 meshes with the gear 234 and in turn meshes with a series of intermeshing gears 236, 237, 238, 239. Gears 240, 241, 242, rotate with the respective gears 235, 237, 239, and mesh with gears 243, 244, 245, on shafts in the inker frame. The latter gears respectively mesh with sets of intermeshing gears 246, 247, 248, for the respective sets of inking rollers.

At each of said sets of inking rollers a gear 251 is meshed by one of said sets of last-named intermeshing gears. The gear 251 is fixed to the shaft of the feed inking roller 98 for rotating the latter. The gear 251 meshes with a gear 252 fixed to the shaft of the reciprocating inking roller 97. The gear 252 meshes with a pair of pinions 253, journaled on the inker frame and respectively meshing with a pair of gears 254, respectively fixed to the shafts of the reciprocating rollers 85, 86, for rotating the latter.

The gear 231 is fixed to or part of a sleeve 261 which has spline key and groove connection 262 with the lengthwise shaft 215, and is journaled in bearings 263 on brackets 264 fixed to the inker frame. (Figs. 4 and 5.) When the inker frame is moved back and forth toward and from the main frame, the gear 231 moves therewith for maintaining drive relation between the drive shaft 215 and the gearing on the inker frame throughout the positions of the inker frame, in order that idle distribution of the ink on the inking rollers may be obtained when the inker frame is moved from the cylinder frame, and inking relation between the rotating form inking rollers and the form cylinder or cylinders may be maintained when the inker frame is moved into inking position.

The cylindrical printing surfaces of various diameters have preferably been so prepared that all of their printing portions are in the same cylindrical plane, as by employment of the Claybourn plate correcting methods and devices shown and described in the Claybourn Patents No. 1,549,185, No. 1,549,186 and No. 1,549,187, dated August 11, 1925, respectively for Method of correcting printing plates and printing plates produced thereby, Means for compressing printing plates, and Means for correcting printing plates, and the Claybourn Patent No. 1,607,438, dated November 16, 1926, for Method of correcting printing plates, all issued by the United States Patent Office to Leslie W. Claybourn.

We have found that correcting the printing surfaces in a rotary printing press so that all of the printing portions thereof are in the same cylindrical plane enables us to employ an impression cylinder having an impression surface which is comparatively hard and which resists indentation by the printing lines while producing excellent printing impressions upon the surface of the web passing through the printing couples. By so relating the parts we have found that it is no longer essential that the same printing lines shall coact with the identical lines or portions on the impression surface, as has heretofore been usual and necessary in letterpress printing.

In our invention various printing lines or printing portions of the cylindrical printing surfaces of different diameters may coact and usually do coact with different coacting portions of the impression cylinder at each revolution of said cylinder.

We have further provided form cylinders, the printing surfaces on which need no longer be aliquot parts of the cylinder in which the cylindrical surface of the impression cylinder is located, but may be of any desired size relation thereto.

For enhancing the printing result, the printing cylinder is provided with an outer layer 271 of harder material and an inner layer 272 of softer material, backed by the body 273, usually of metal, of the impression cylinder. The layers are preferably closed shells, and are comparatively thin so as to be readily but not unduly responsive to the printing pressures in a rotary printing press of the character described, which is capable of high grade printing. The layer 272 is preferably of cushioning material, as for instance of comparatively softer vulcanized rubber, linoleum, cork or composition or other material, ranging as an example, in hardness from 35 to 65 points of the rubber gage, assuming a cylinder thirty-four inches in diameter, and be for instance of semi-hard material of the hardness of the rubber in ordinary casings or ordinary inner tubes of usual automobile tires, and be of suitable thickness, ranging for instance from one-fourth inch to one inch or more.

The outer layer 271 is preferably of harder material, but the materials may be similar to

the materials of which the inner layer 272 is composed. The outer layer may, for instance, be a composition and of hardness similar to a hard gutta percha or hard vulcanized rubber, and may, as an example, have a resistance of hardness of 75 to 95 points on the rubber gage, assuming a cylinder of thirty-four inch diameter.

The layers are preferably held to the body of the cylinder so as to rotate therewith and with each other, and may be constructed so as to be integral with or fixed to each other and to the cylinder, and when of rubber or rubber composition may be vulcanized to each other and to the body of the cylinder, or the same may be glued or cemented or otherwise held together and to said body. The layers are so held to the body of the cylinder as to resist centrifugal displacement at high speeds.

The layers 271, 272, are preferably yieldable, the inner layer preferably yielding more readily than the outer layer. The layers are preferably resilient, so that the various portions thereof will readily and instantly resume normal positions after having had a dislodging pressure applied thereto.

The outer layer may be of suitable thickness in a range, as an example, of one-sixteenth to one-half inch.

The outer layer is made preferably comparatively hard so as to obtain clear cut impressions of the printing lines upon the web passing between the impression cylinder and the form cylinders, and the yielding and resiliency of the layers and their comparative hardness permits yielding of the impression surface to excess pressure between it and the printing surface, and instant return to normal position, and permits yielding of the impression layers or buckling of the same between lines of impressions between the various printing cylinders, upon excess pressure of one or more of the form cylinders toward the axis of rotation of the impression cylinder, and instant return to normal cylindrical form of the impression cylinder.

Such latter action is in practice slight and almost infinitesimal, but is permitted in our improved device, and aids in the uniformity and clearness of the printing. It further prevents shifting between the contact lines between the form cylinder, the web and the impression cylinder, in high grade letter-press printing at high speeds, to avoid smutting in the printing and shifting between the printing line and the printed line during the printing.

These examples of materials and harnesses of the respective layers are given as examples and not as limitations, the desirable materials and hardnesses depending on the character and density of the printing and the material being printed.

The printing machine shown and described and its construction and its parts, and their structure and arrangement, is presented merely as exemplifications and not as limitations, as our invention is applicable in other relations.

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

1. In a rotary printing machine, the combination of a main frame, a rotary impression cylinder rotatable in said main frame, an inker stand, inking rollers on said inker stand including form inking rollers, driving means for said impression cylinder and said inking rollers rotating said impression cylinder and said form inking rollers at the same circumferential speeds, form cylinders of various diameters interposed between said form inking rollers and said impression cylinder, means rotating said respective form cylinders of various diameters at said same circumferential speeds, adjusting means adjusting the distance of said inker frame from said main frame, and means fixing the adjusted positions of said inker frame for locating said form inking rollers in contact range with said form cylinders of various diameters.

2. In a rotary printing machine, the combination of a main frame, a rotary impression cylinder rotatable in said main frame, an inker stand, inking rollers on said inker stand including form inking rollers, driving means for said impression cylinder and said inking rollers rotating said impression cylinder and said form inking rollers at the same circumferential speeds, form cylinders of various diameters interposed between said form inking rollers and said impression cylinder, means rotating said respective form cylinders of various diameters at said same circumferential speeds, adjusting means adjusting said inker frame toward and from said main frame, means fixing the adjusted positions of said inker frame for locating said form inking rollers in contact range with said form cylinders of various diameters, and major adjusting means for said form inking rollers adjusting the contact lines of said form inking rollers with said form cylinders into arcs complemental to the respective curvatures of said form cylinders of various diameters.

3. In a rotary printing machine, the combination of a main frame, a rotary impression cylinder rotatable in said main frame, an inker stand, inking rollers on said inker stand including form inking rollers, driving means for said impression cylinder and said inking rollers rotating said impression cylinder and said form inking rollers at the same circumferential speeds, form cylinders of various diameters interposed between said form inking rollers and said impression cylinder, means rotating said respective form cylinders of various diameters at said same circumferential speeds, adjusting means adjusting said inker frame toward said main frame and adjusting said form inking rollers into contact range with said form cylinders of various diameters, major adjusting means for said form inking rollers adjusting the contact lines of said form inking rollers with said form cylinders into arcs complemental to the respective curvatures of said form cylinders of various diameters, and minor adjusting means for minor inking contacts of said form inking rollers with said form cylinders of various diameters.

4. In a rotary printing machine, the combination of a rotary impression cylinder, a frame in which the same rotates, rotary printing surfaces of different diameters in said frame coacting with said rotary impression cylinder, an inker frame, form inking rollers thereon for inking contact with said rotary printing surfaces, adjusting means adjusting said inker frame toward and from said first-named frame for distance relation therebetween determining inking range between said form inking rollers and said rotary printing surfaces of different diameters, and adjustable stops and clamping means between said frames located at the proximate ends of said frames fixing the distance relations between said

frames according to said different diameters of said rotary printing surfaces.

5. In a rotary printing machine, the combination of a rotary impression cylinder, a frame in which the same rotates, rotary printing surfaces of different diameters coacting therewith, an inker frame, form inking rollers thereon for inking contact with said rotary printing surfaces, adjusting means adjusting said inker frame toward and from said first-named frame for distance relation therebetween determining inking range between said form inking rollers and said rotary printing surfaces of different diameters, and adjustable stops and clamping means between said frames fixing the distance relations between said frames according to said different diameters of said rotary printing surfaces, said stops and clamping means including connected members adjustable as a unit on one of said frames and coacting members on the other of said frames, and adjusting means relatively adjusting the same.

6. In a rotary printing machine, the combination of a rotary impression cylinder, a frame in which the same rotates, rotary printing surfaces of different diameters coacting therewith, an inker stand, form inking rollers thereon for inking contact with said rotary printing surfaces, adjusting means adjusting said inker stand toward and from said first-named stand for distance relation therebetween determining inking range between said form inking rollers and said rotary printing surfaces of different diameters, and adjustable stops and clamping means between said frames fixing the distance relations between said frames according to said different diameters of said rotary printing surfaces, said last-named means including a block on one of said frames comprising a stop and a retaining part, means for adjusting said block toward and from the other of said frames according to the different diameters of said rotary printing surfaces, a coacting stop and coacting retaining part on the other of said frames, and means for forcing approach between said retaining parts for clamping said stops and frames together.

7. In a rotary printing machine, the combination of a rotary impression cylinder, rotary printing surfaces of different diameters selectively coacting therewith, form rollers arranged in sets of pairs for inking contact with said respective rotary printing surfaces of different diameters, coacting inking rollers contacted by the form rollers of said respective pairs of form rollers for transferring ink thereto, and adjusting means for the pairs of form rollers including arms pivoted about the axes of rotation of their respective coacting inking rollers, means for adjusting said arms angularly about said axes of rotation, arms supporting said respective form rollers and pivoted about said axes of rotation, and minute adjusting means comprising parts on said respective arms for adjusting said form rollers about said last-named axes of rotation, for adjusting said form rollers of said respective pairs of form rollers equidistant from coincident radial planes of said respective rotary printing surfaces of different diameters and said respective coacting inking rollers.

8. In a rotary printing machine, the combination of a rotary impression cylinder, a gear rotating therewith, rotary form inking rollers, means rotating said form inking rollers and said rotary impression cylinder at similar surface speeds, rotary printing cylinders of different diameters interposed between said impression cylinder and said form inking rollers, axles therefor, gears of different diameters for said respective rotary printing cylinders of different diameters, bearing-bushings for said respective axles, eccentric sleeves for said respective bearing-bushings, block-bearings for the latter respectively, and adjusting means on said respective block-bearings for adjusting said eccentric sleeves, said respective rotary printing cylinders and said last-named gears of each diameter, and the axles, bearing-bushings, eccentric sleeves, block-bearings and adjusting means therefor, respectively constructed as a unit with the rotary printing cylinder of corresponding diameter, said block-bearings of said respective units arranged to be interchangeably mounted in operative relations with the said rotary impression cylinder, with said gears of different diameters of said respective units meshing with said first-named gear, for rotating said rotary printing cylinders of different diameters at similar surface speeds.

9. In a rotary printing machine, the combination of a rotary impression cylinder, sets of rotary printing surfaces of different diameters in different radial positions about said impression cylinder, an inker stand, sets of pairs of form inking rollers thereon for inking contact with said respective sets of printing surfaces, coacting inking rollers for pairs of said sets of form inking rollers contacted by said form inking rollers for transferring ink thereto, and adjusting means for said respective sets of form inking rollers pivoted about the axes of rotation of their coacting inking rollers for adjusting said form inking rollers of said respective sets whereby to arrange the contact lines thereof with said printing surfaces on different arcs coincident with the curvatures of said printing surfaces of different diameters, said adjusting means including coacting micrometer adjusting means pivoted about said axes, and means whereby to adjust the latter collectively about said axes, and adjusting means adjusting said inker stand along right lines toward and from said impression cylinder for inking range of said respective sets of form inking rollers with said respective sets of printing surfaces of different diameters.

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