

Nov. 10, 1959

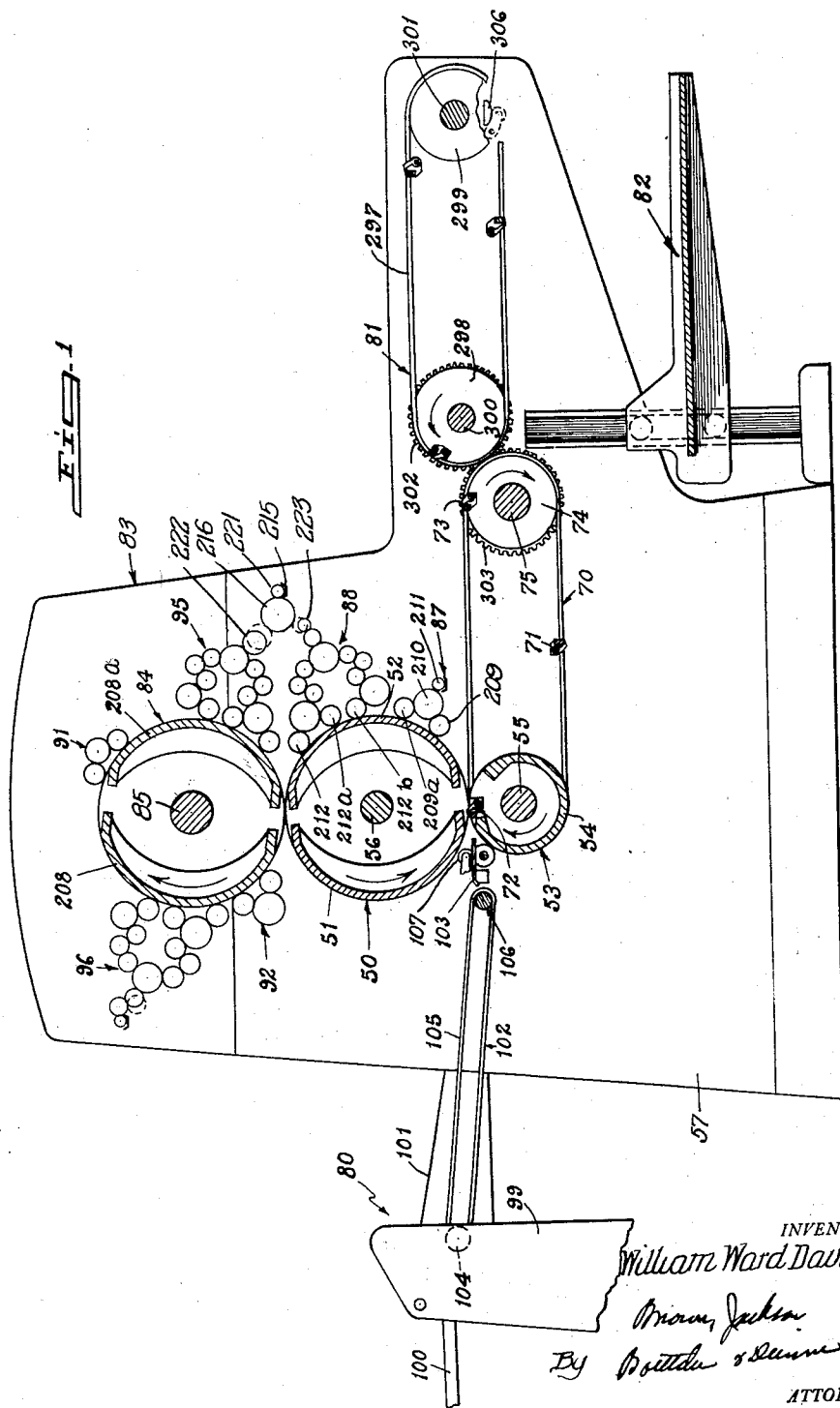
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

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30 Sheets-Sheet 1



Nov. 10, 1959

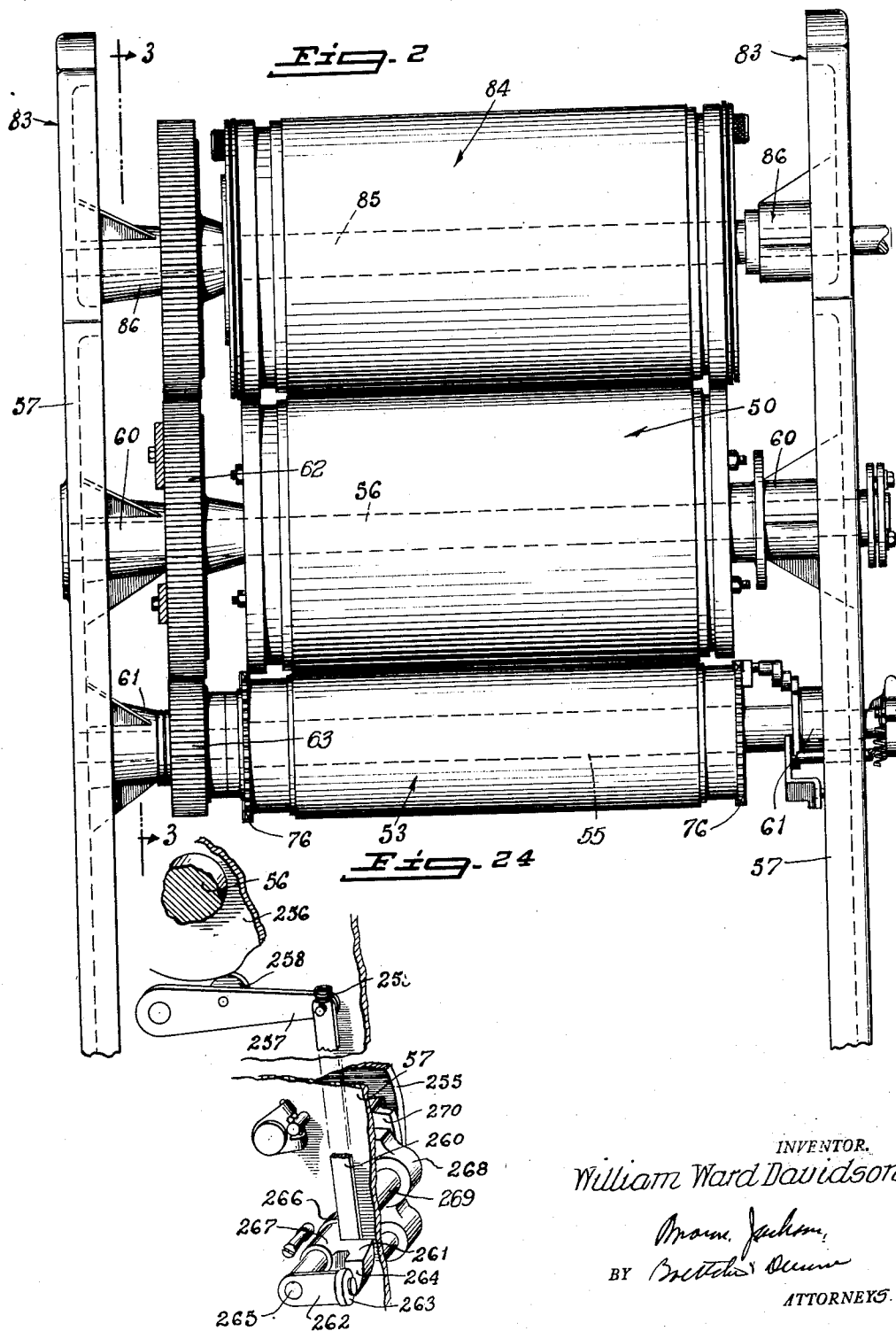
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 2



INVENTOR.
William Ward Davidson,
Mam. Jackson,
 BY *Bretcher & Quinn*
 ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

2,911,907

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Filed Oct. 28, 1955

30 Sheets-Sheet 4

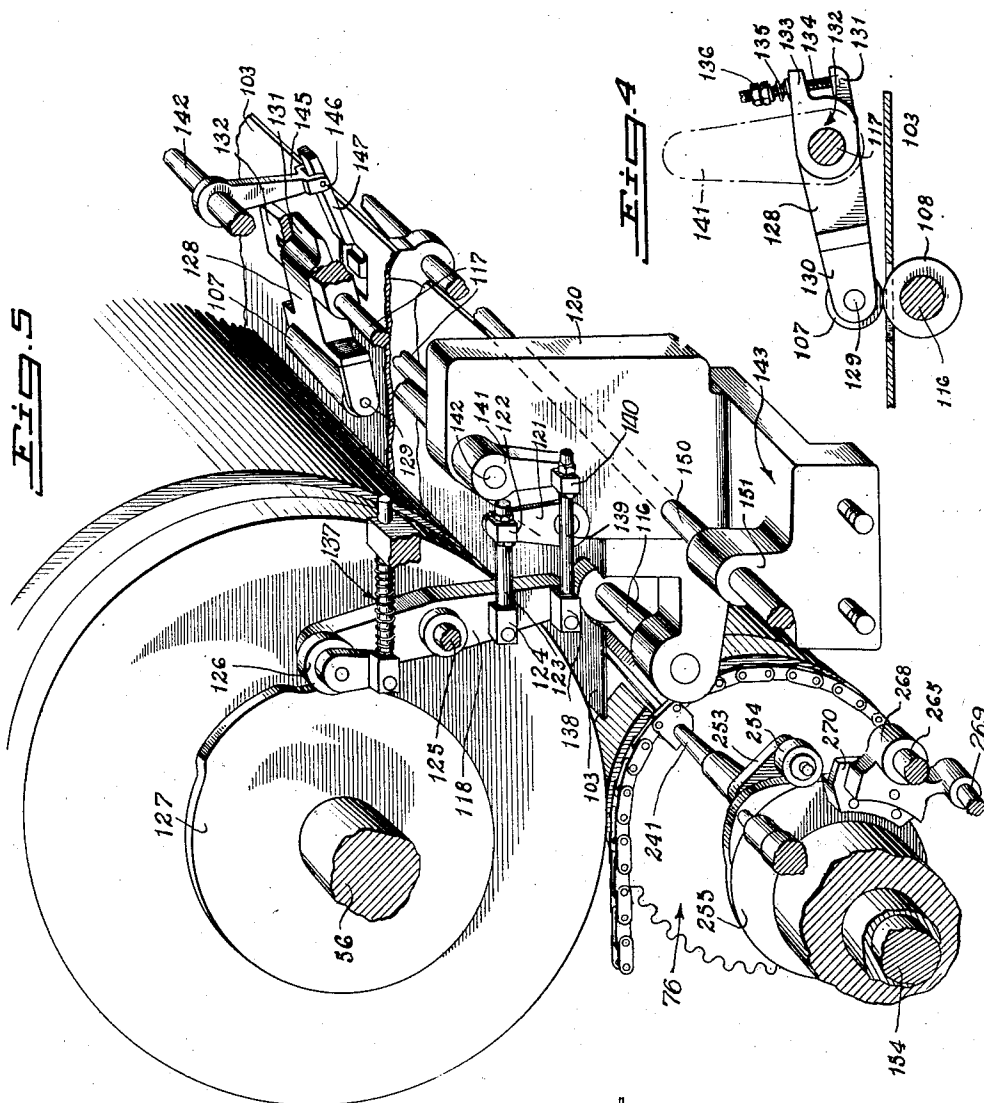


Fig. 5

Fig. 4

Fig. 7

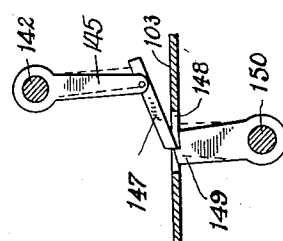
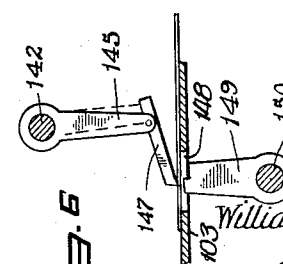


Fig. 6



INVENTOR.
William Ward Davidson,
BY *Maxon Jackson,*
Witcher & Quinn
ATTORNEYS

Nov. 10, 1959

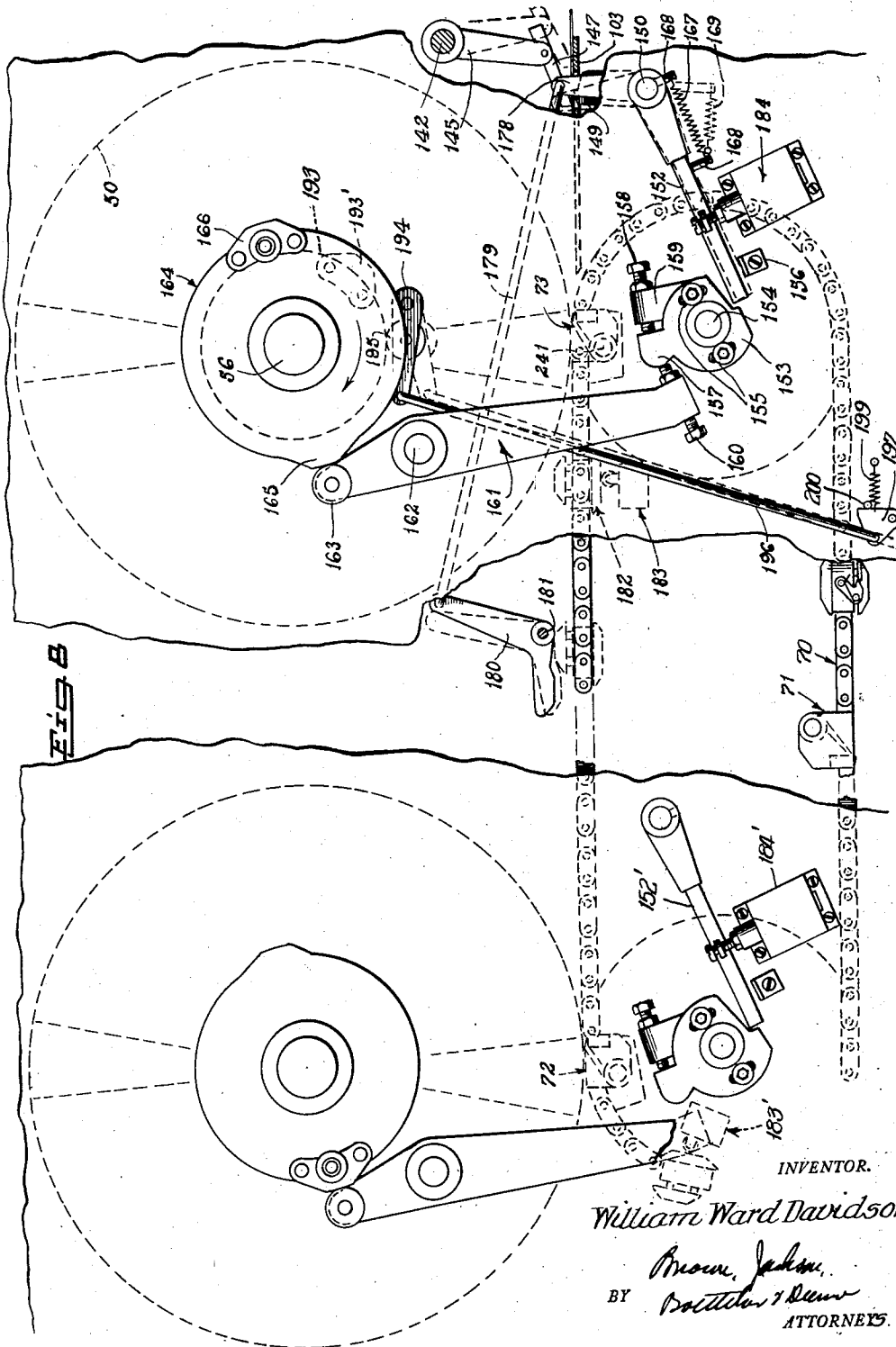
W. W. DAVIDSON

2,911,907

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30 Sheets-Sheet 5



Nov. 10, 1959

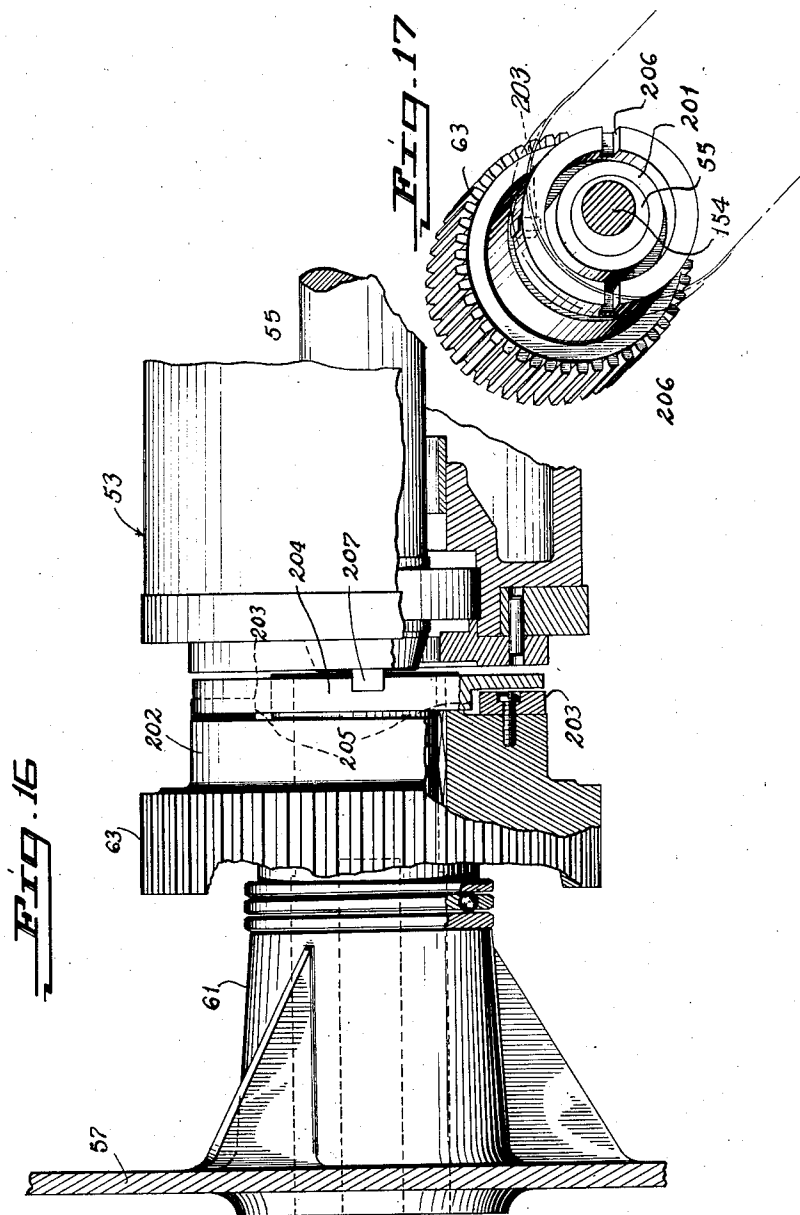
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 7



INVENTOR.
William Ward Davidson,
BY *Mason, Jackson,*
Witcher & Seaman
ATTORNEYS.

Nov. 10, 1959

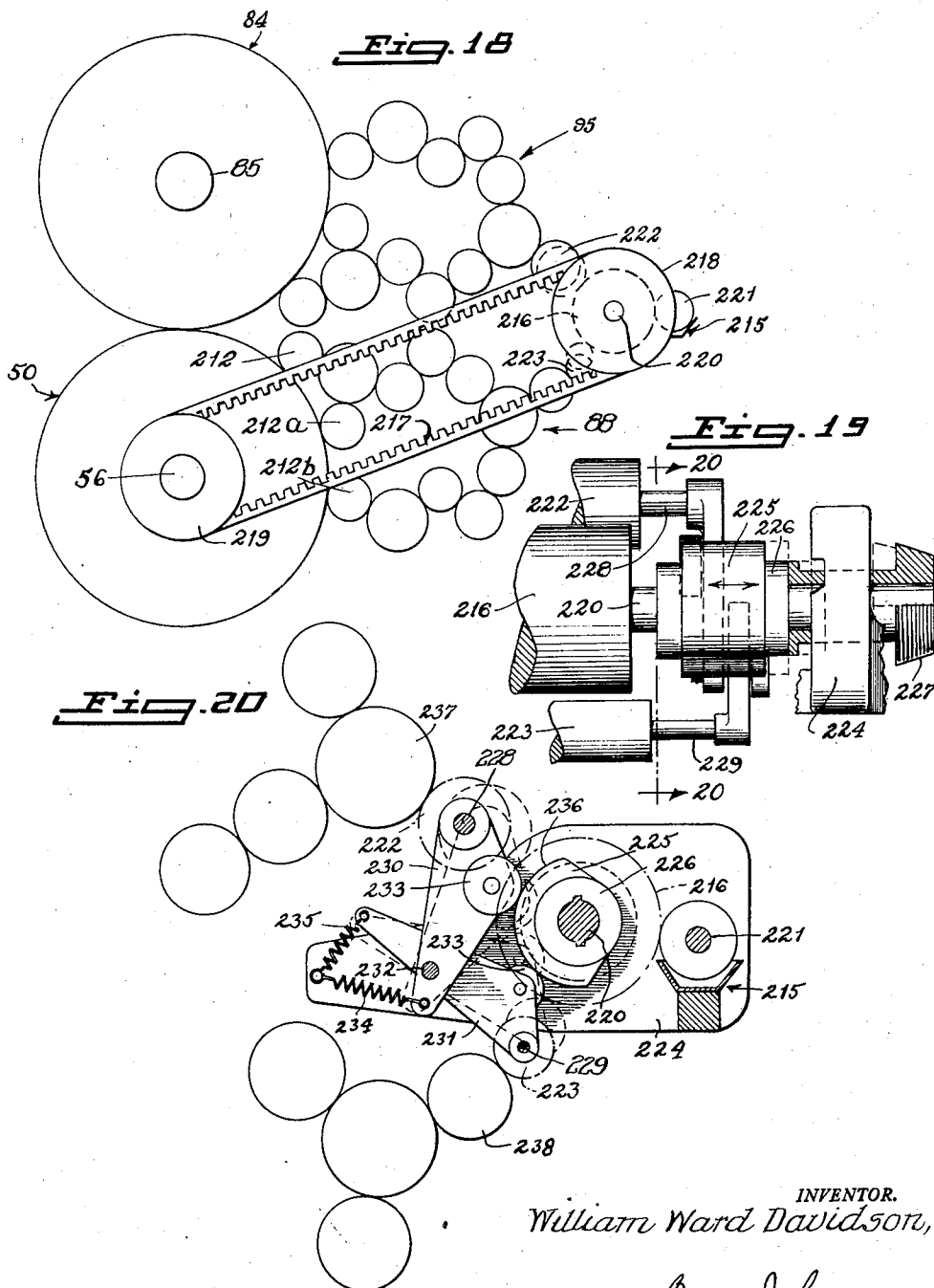
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 8



INVENTOR.
William Ward Davidson,

BY *Brown, Jackson,*
Reutter & Brown
ATTORNEYS

Nov. 10, 1959

W. W. DAVIDSON

2,911,907

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30 Sheets-Sheet 9

Fig. 23

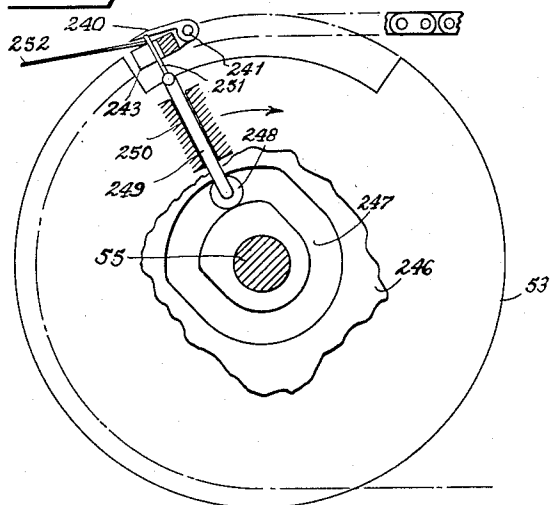


Fig. 21

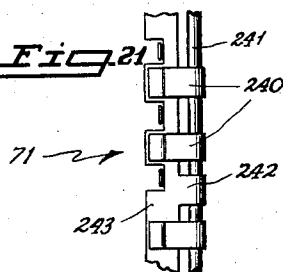
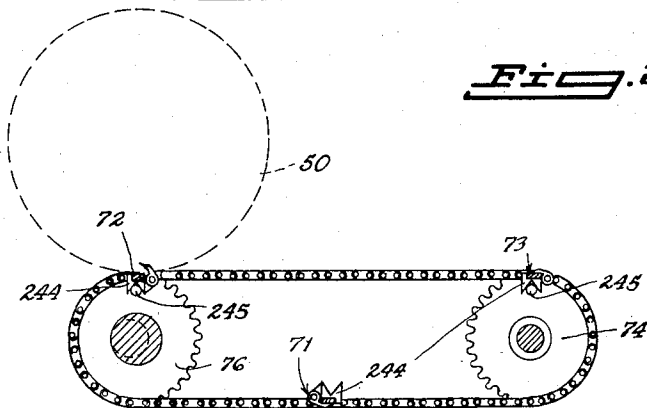


Fig. 22



INVENTOR.
William Ward Davidson,

BY *Norm. Jackson*
Boatman & Co.
ATTORNEYS.

Nov. 10, 1959

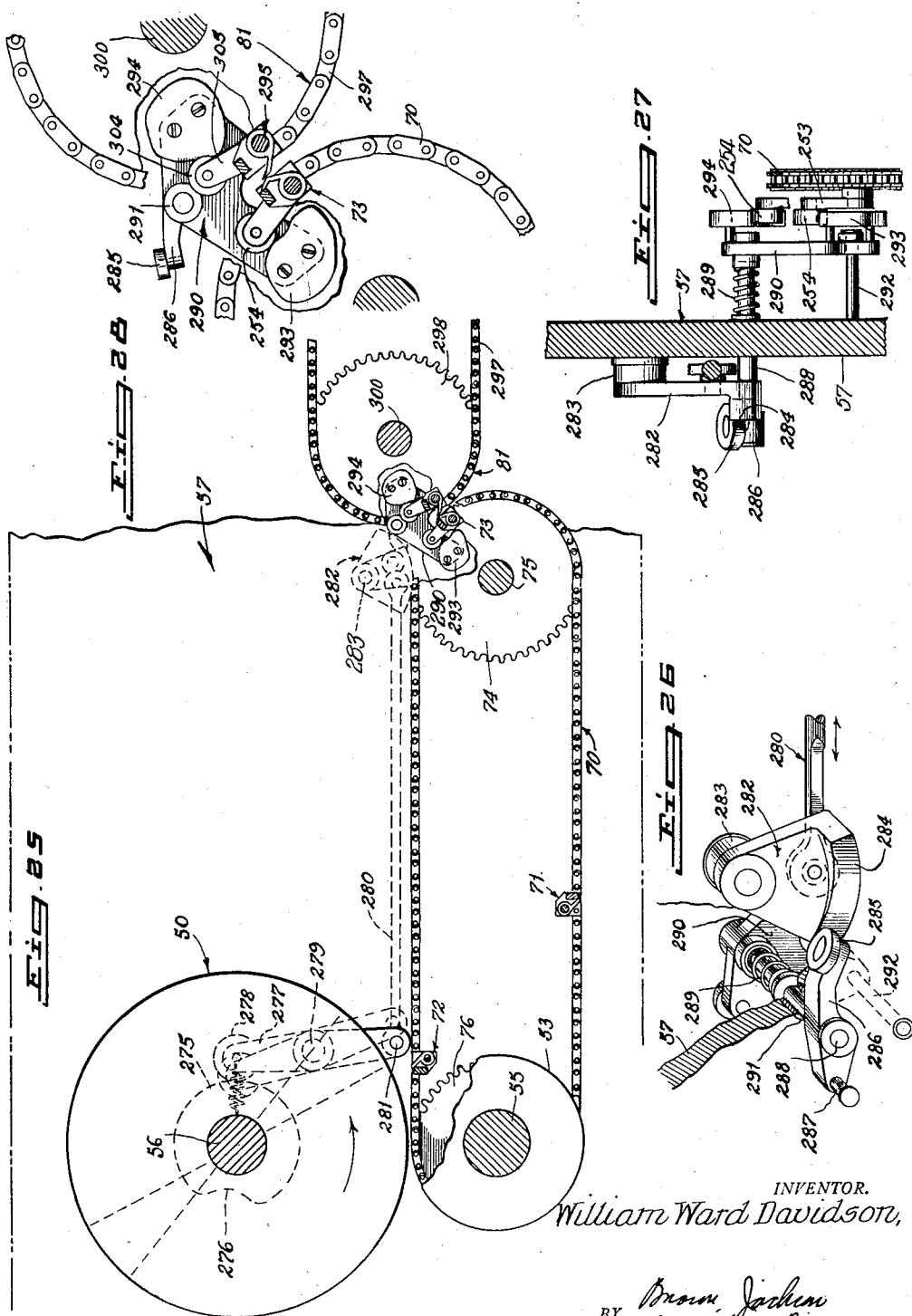
W. W. DAVIDSON

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Filed Oct. 28, 1955

30 Sheets-Sheet 10



INVENTOR.

William Ward Davidson,

BY *Brown, Jackson*
Butcher & Dennis
ATTORNEYS

Nov. 10, 1959

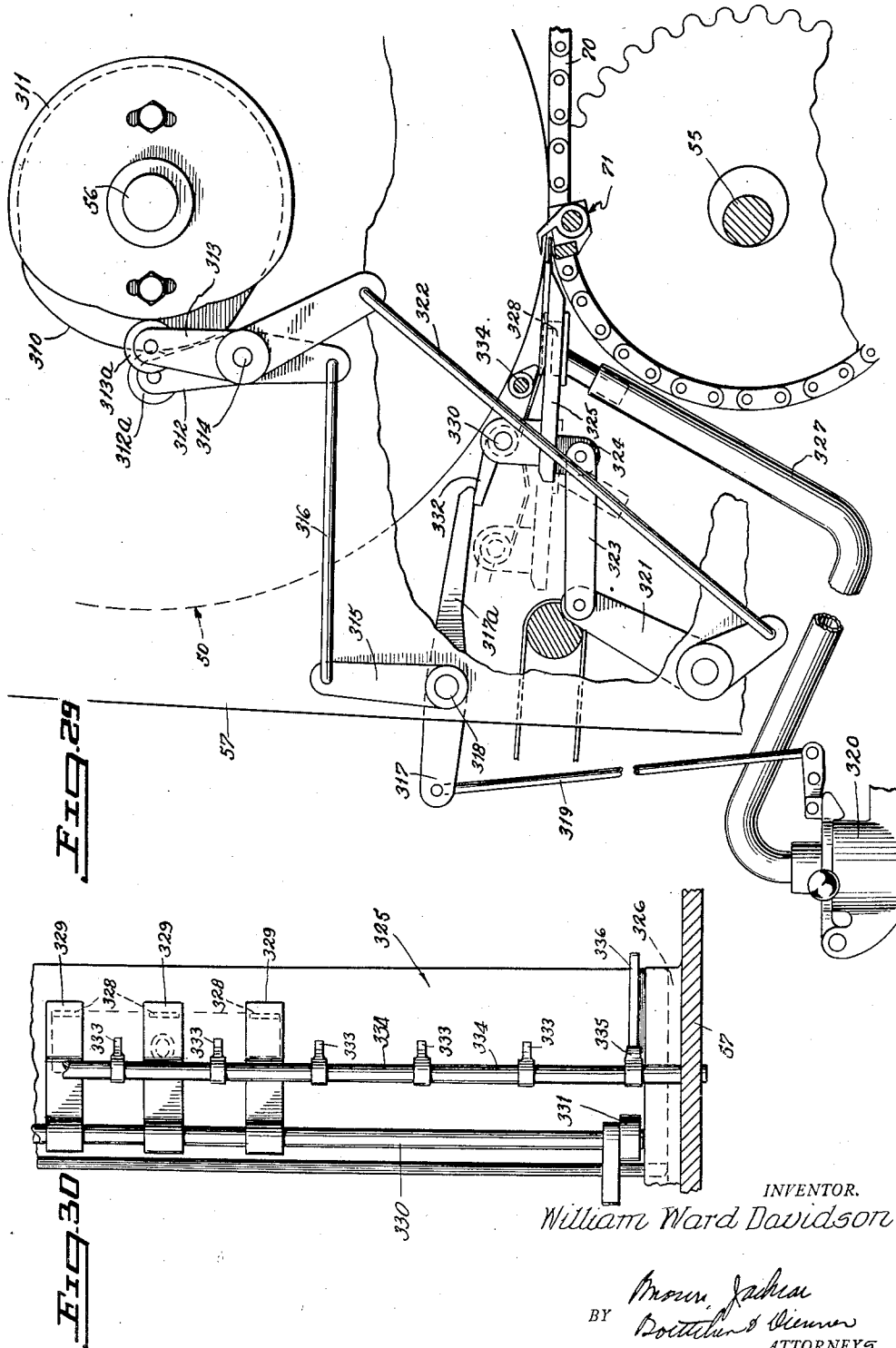
W. W. DAVIDSON

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30 Sheets-Sheet 13

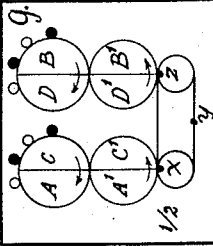
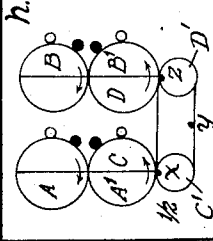
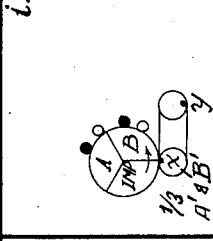
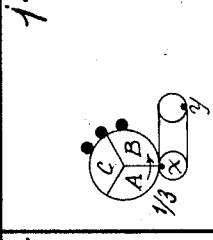
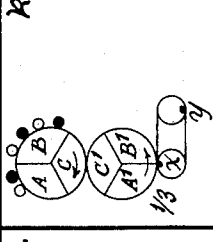
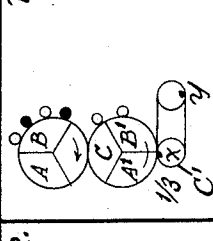
	4 Colors offset on 1 side	$\rightarrow 1-X-A'-B'$ $\rightarrow 2-Z-A'-D'$ $\rightarrow 1-X-C'-D'$ $\rightarrow 3-Y-A'-B'$ $\rightarrow 2-Z-C'-D'$ $\rightarrow 4-X-A'-B'$ $\rightarrow 3-Y-C'-D'$
	2 Colors offset on each side	$\rightarrow 1-X-A'-C'-B/D'$ $\rightarrow 2-Z-A'-C'-B/D'$ $\rightarrow 3-Y-A'-C'-B/D'$ $\rightarrow 4-X-A'-C'-B/D'$ $\rightarrow 5-Z-A'-C'-B/D'$
	1 or 2 Color offset (colors separated) on 1 side	$\rightarrow 1-X-A'-B'$ $\rightarrow 2-X-A'-B'$ $\rightarrow 3-X-A'-B'$ $\rightarrow 4-X-A'-B'$ $\rightarrow 5-X-A'-B'$
	3 Color L.P.	$\rightarrow 1-X-A$ $\rightarrow 2-Y-A$ $\rightarrow 1-X-B$ $\rightarrow 2-Y-B$ $\rightarrow 3-X-A$ $\rightarrow 2-Y-C$ $\rightarrow 3-X-B$ $\rightarrow 4-Y-A$ $\rightarrow 3-X-C$ $\rightarrow 4-Y-B$
	3 Color offset 1 side	$\rightarrow 1-X-A'$ $\rightarrow 2-Y-A'$ $\rightarrow 1-X-B'$ $\rightarrow 2-Y-B'$ $\rightarrow 3-X-A'$ $\rightarrow 2-Y-C'$ $\rightarrow 3-X-B'$ $\rightarrow 4-Y-A'$ $\rightarrow 3-X-C'$ $\rightarrow 4-Y-B'$
	2 Color offset 1 side - 1 color offset other side	$\rightarrow 1-X-A'$ $\rightarrow 2-Y-A'$ $\rightarrow 1-X-B'$ $\rightarrow 2-Y-B'$ $\rightarrow 3-X-A'$ $\rightarrow 2-Y-C'$ $\rightarrow 3-X-B'$ $\rightarrow 4-Y-A'$ $\rightarrow 3-X-C'$ $\rightarrow 4-Y-B'$

Fig. 32

INVENTOR.
William Ward Davidson
BY *Murray J. Adams*
Ortelson & Adams
ATTORNEYS.

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W. W. DAVIDSON

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MULTI-PURPOSE ROTARY PRINTING PRESS

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30 Sheets-Sheet 14

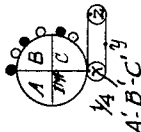
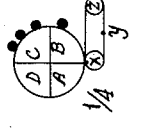
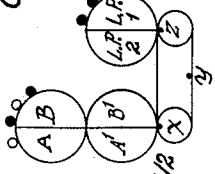
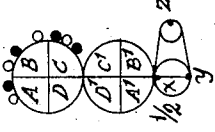
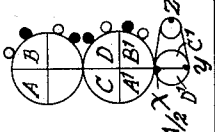
m.  1/4 A'-B'-C'-D'	n.  1/4 A'-B'-C'-D'	o.  1/2 A'-B'-C'-D'	p.  1/2 A'-B'-C'-D'	q.  1/2 A'-B'-C'-D'
12 or 3 color offset (colors separated) 1 side	4 color L.P.	2 color offset on 1 side and 2 L.P. on same side	4 color offset 1 side	2 color offset each side
X IMP/A-B'-C'- Y-A/A' Z-B/B' X-C/C' Y IMP/A'-B'-C'- Z-A/A' X-B/B' Y-C/C' Z IMP/A'-B'-C'- X-A/A' Y-B/B' Z-C/C' X IMP/A'-B'-C'- Y-A/A' Z-B/B' X-C/C'	1-X-A Y-D Z-C 1-X-B 2-Y-A 2-D 1-X-C 2-Y-B 3-Z-A 1-X-D 2-Y-C 3-Z-B 4-X-A 2-Y-D 3-Z-C	1-X-A'-L.P.1 Y-B' 2-Z-A'-L.P.1 1-X-B'-L.P.2 3-Y-A'-L.P.1 2-Z-B'-L.P.2 4-X-A'-L.P.1 3-Y-B'-L.P.2 5-Z-A'-L.P.1 4-X-B'-L.P.2	1-X-A' Y-D' Z-C' 1-X-B' 2-Y-A' Z-D' 1-X-C' 2-Y-B' 3-Z-A' 1-X-D' 2-Y-C' 3-Z-B' 4-X-A'	1-X-A'/D' Y-C-C' Z-D-D' 1-X-B'/C' 2-Y-A'/D' Z-C-C' X-D-D' 2-Y-B'/C' 3-Z-A'/D' X-C-C' Y-D-D' 3-Z-B'/C' 4-X-A'/D'

Fig. 33

INVENTOR.
William Ward Davidson.

BY *Marion Jaden*
Butcher & Dierman
ATTORNEYS.

Nov. 10, 1959

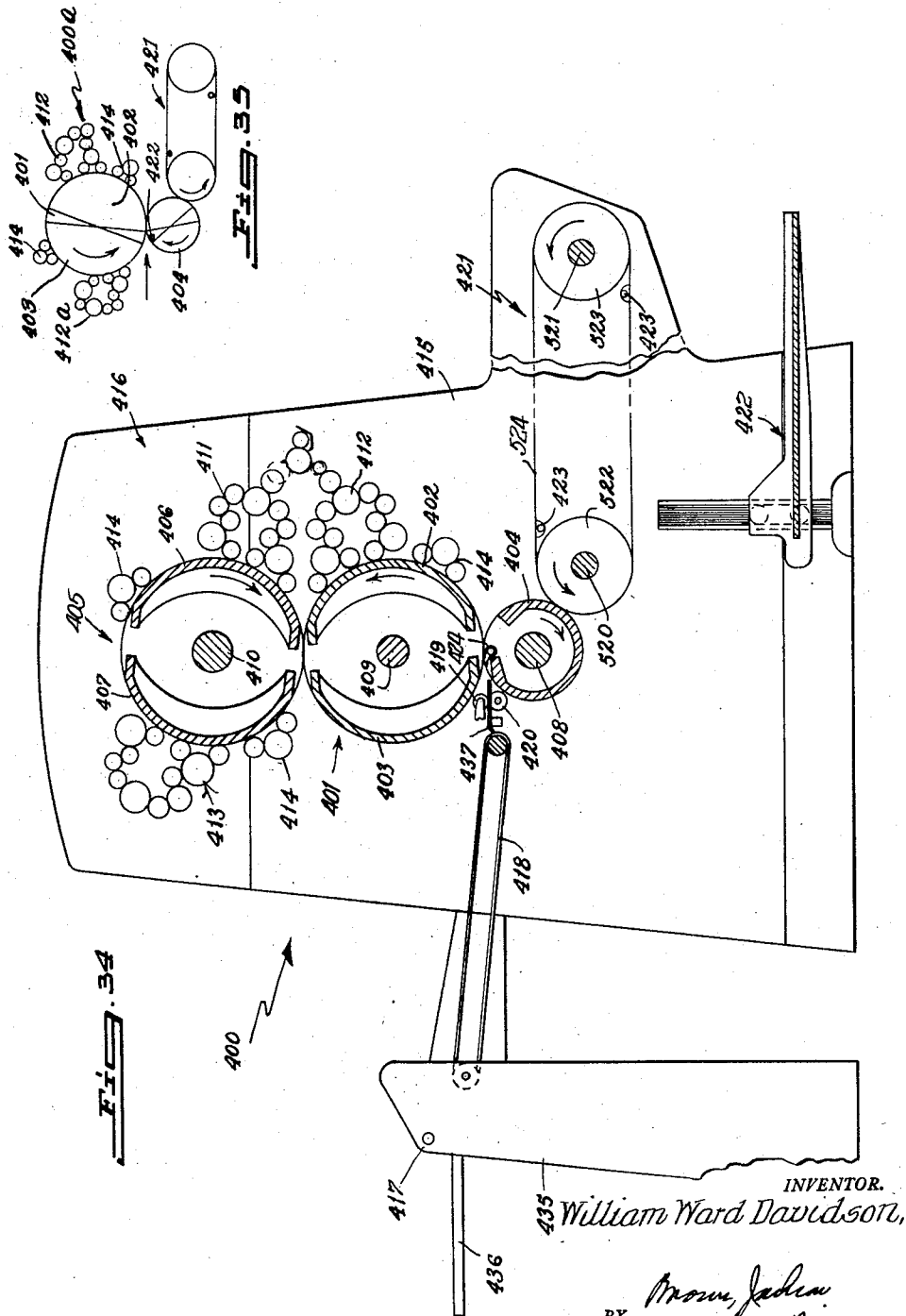
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 15



INVENTOR.
William Ward Davidson,
BY *Wm. J. J. J.*
BUTLER & SONS
ATTORNEYS

Nov. 10, 1959

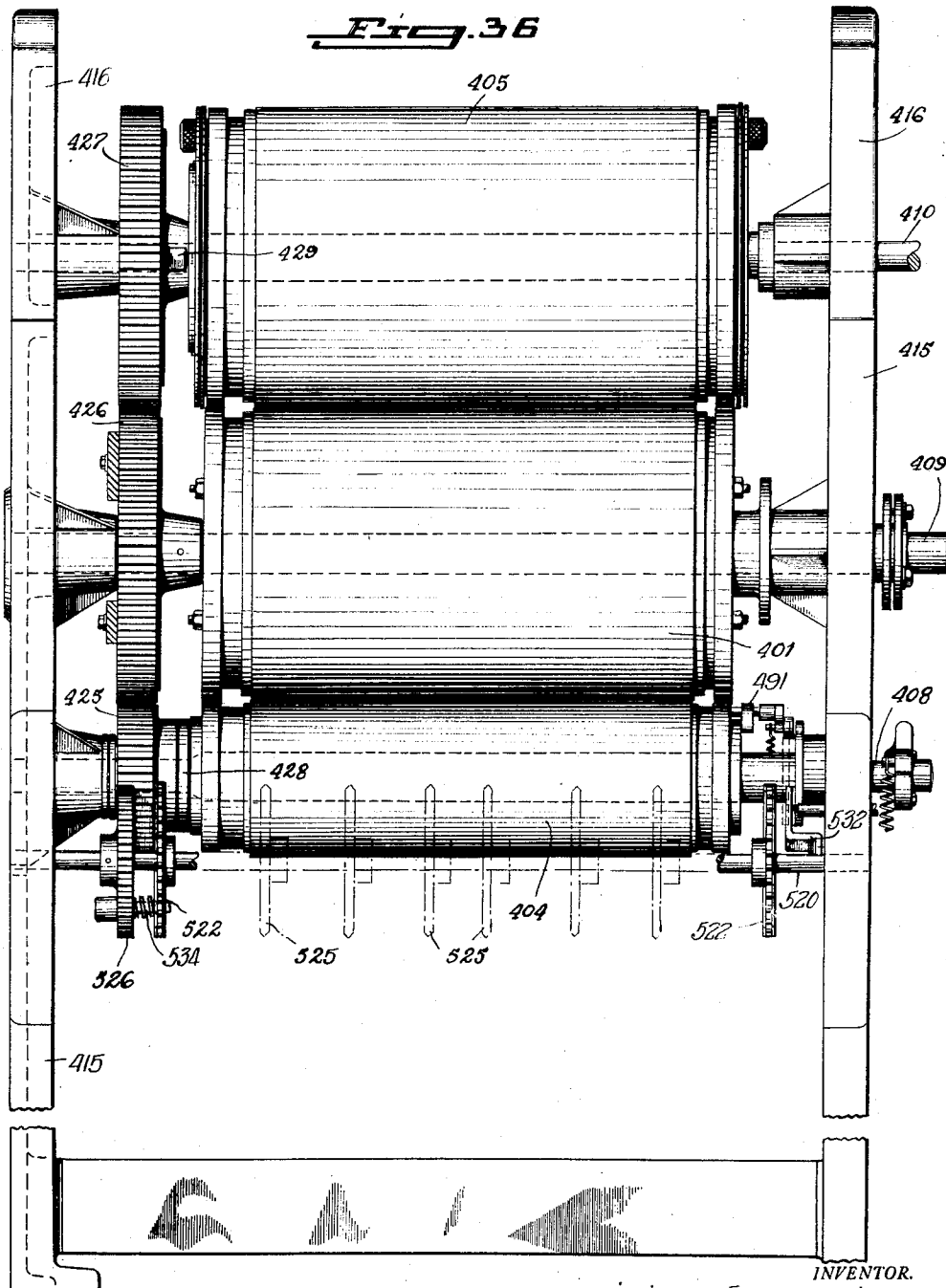
W. W. DAVIDSON

2,911,907

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30 Sheets-Sheet 16



INVENTOR.

William Ward Davidson,

BY *Mon. J. Schen*
Boettcher & Schen
ATTORNEYS.

Nov. 10, 1959

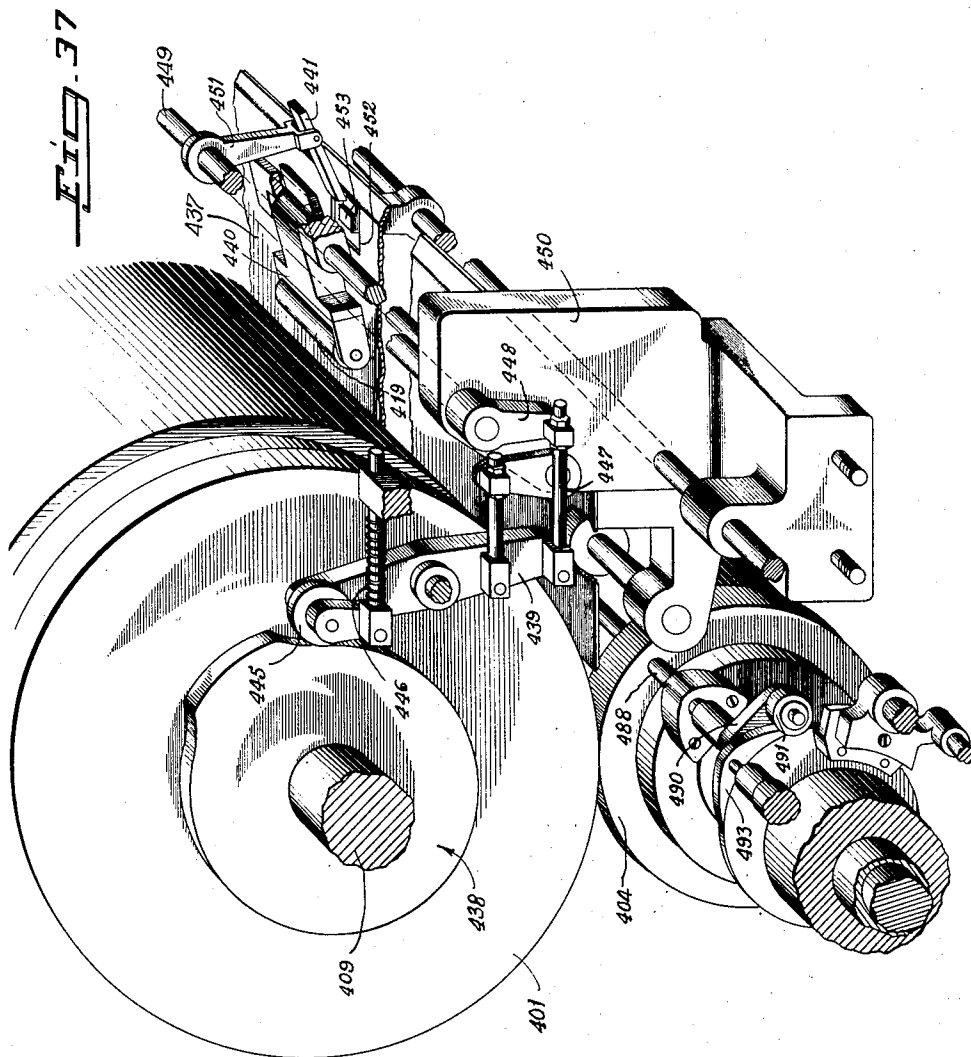
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 17



INVENTOR.
William Ward Davidson

BY *Brown, Jackson*
Boettcher & Deemer
ATTORNEYS

Nov. 10, 1959

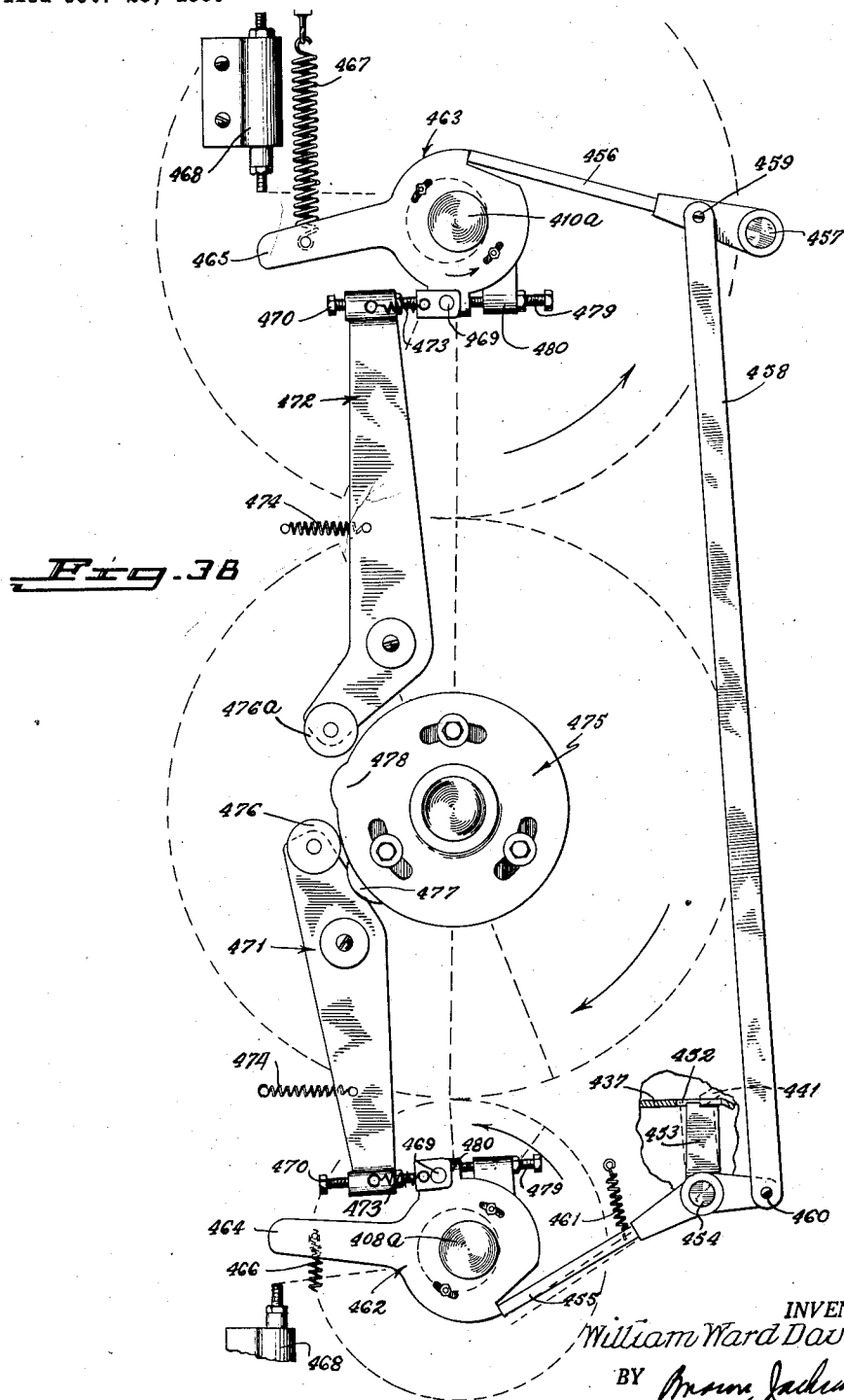
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 18



INVENTOR.
William Ward Davidson,
BY *Mrs. Jackson*
Booth & Dienes
ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

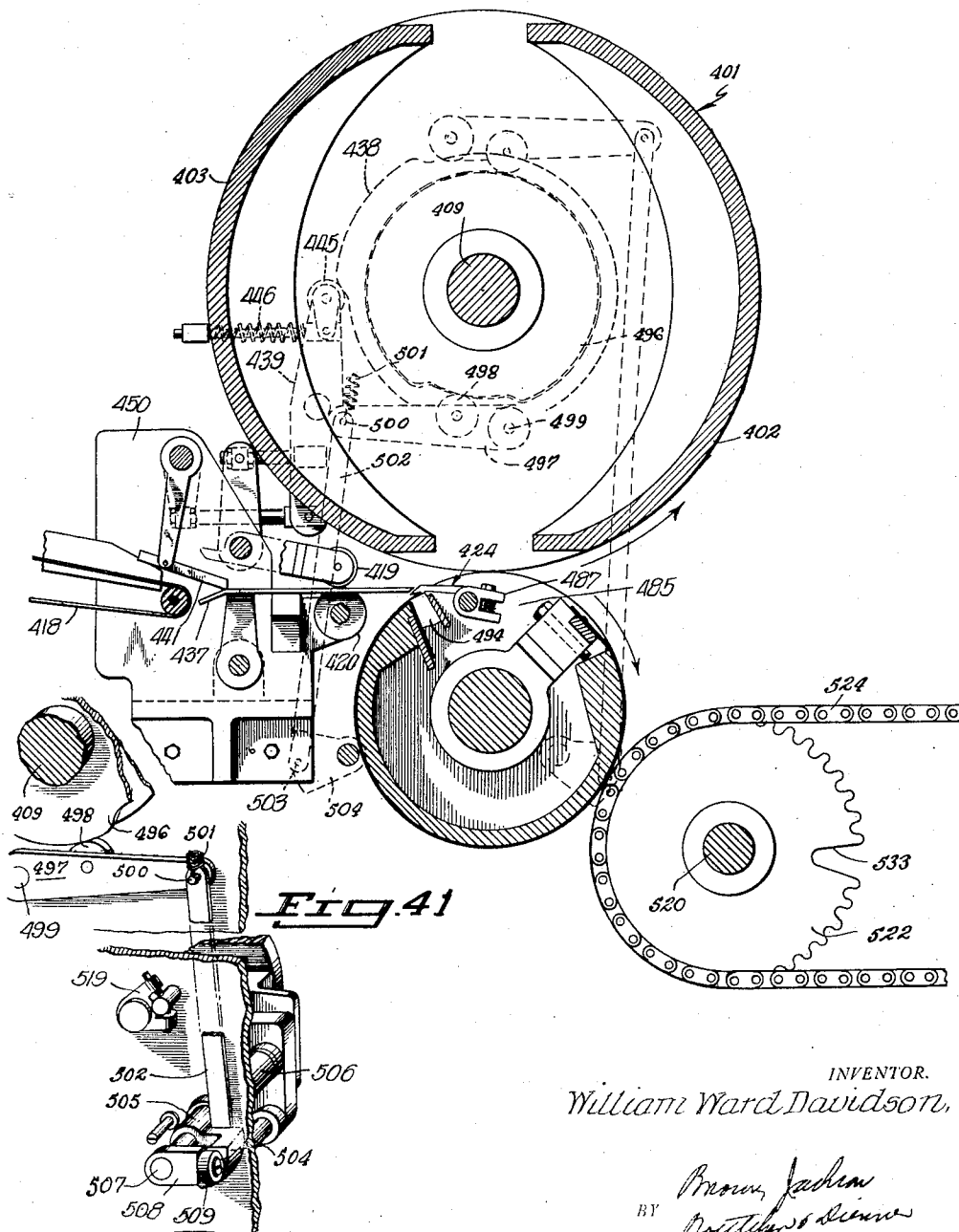
2,911,907

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30 Sheets-Sheet 19

Fig. 39



Nov. 10, 1959

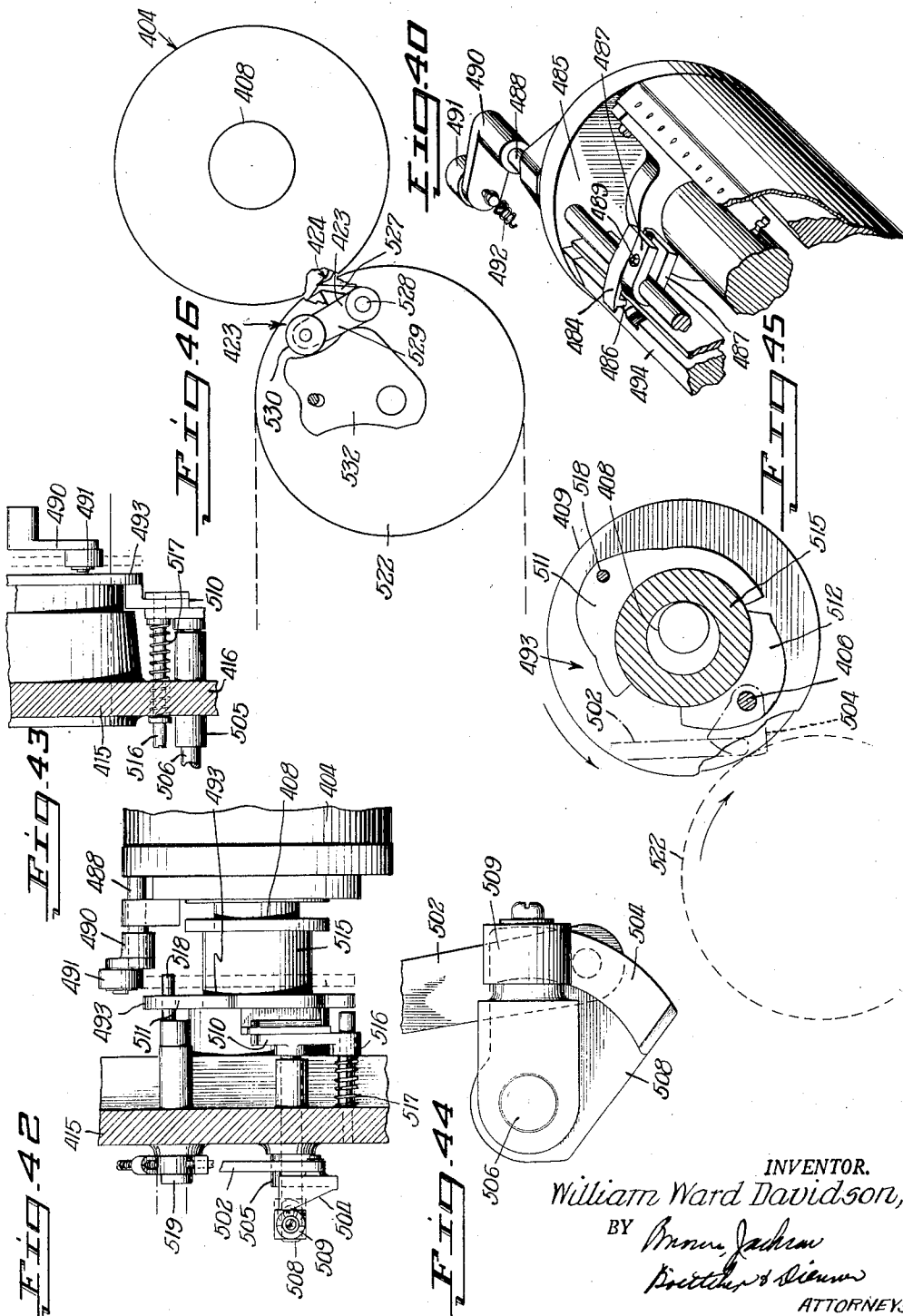
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 20



INVENTOR.
William Ward Davidson,
BY *Monroe Jackson*
Smith & Dixon
ATTORNEYS

Nov. 10, 1959

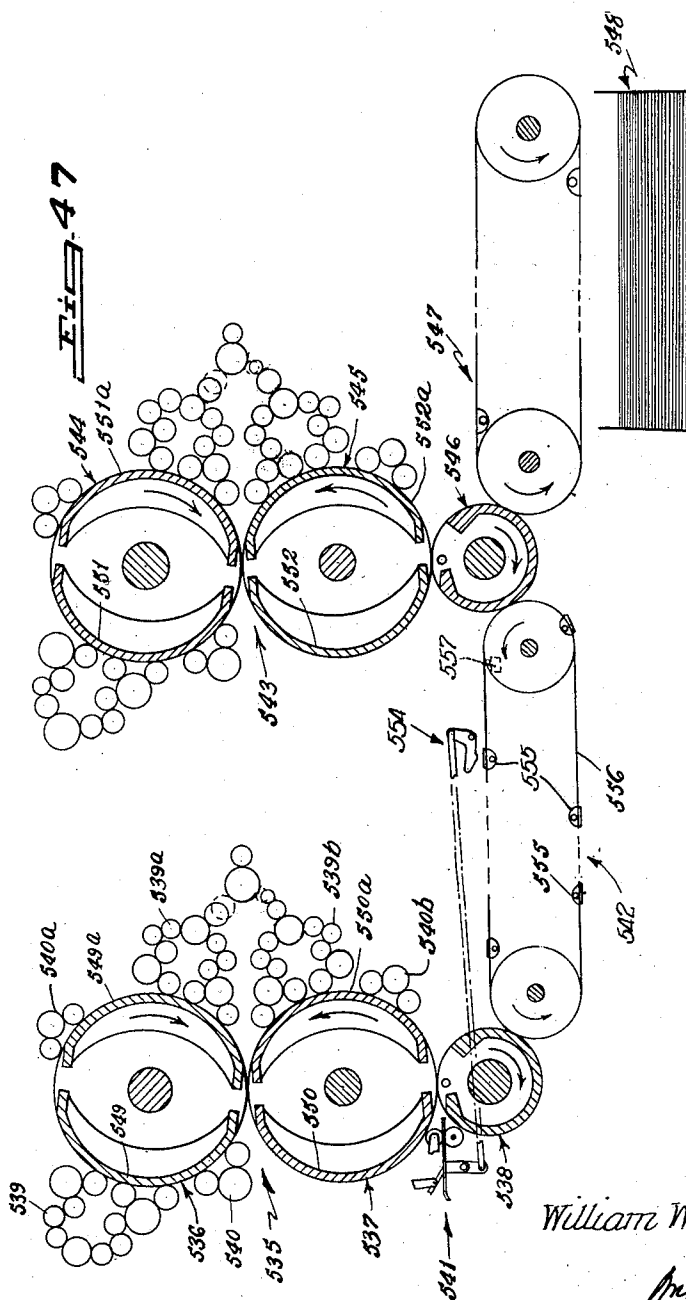
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 21



INVENTOR.

William Ward Davidson

BY *Monroe Jackson*
Boettcher & Reimer
ATTORNEYS

Nov. 10, 1959

W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

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30 Sheets-Sheet 22

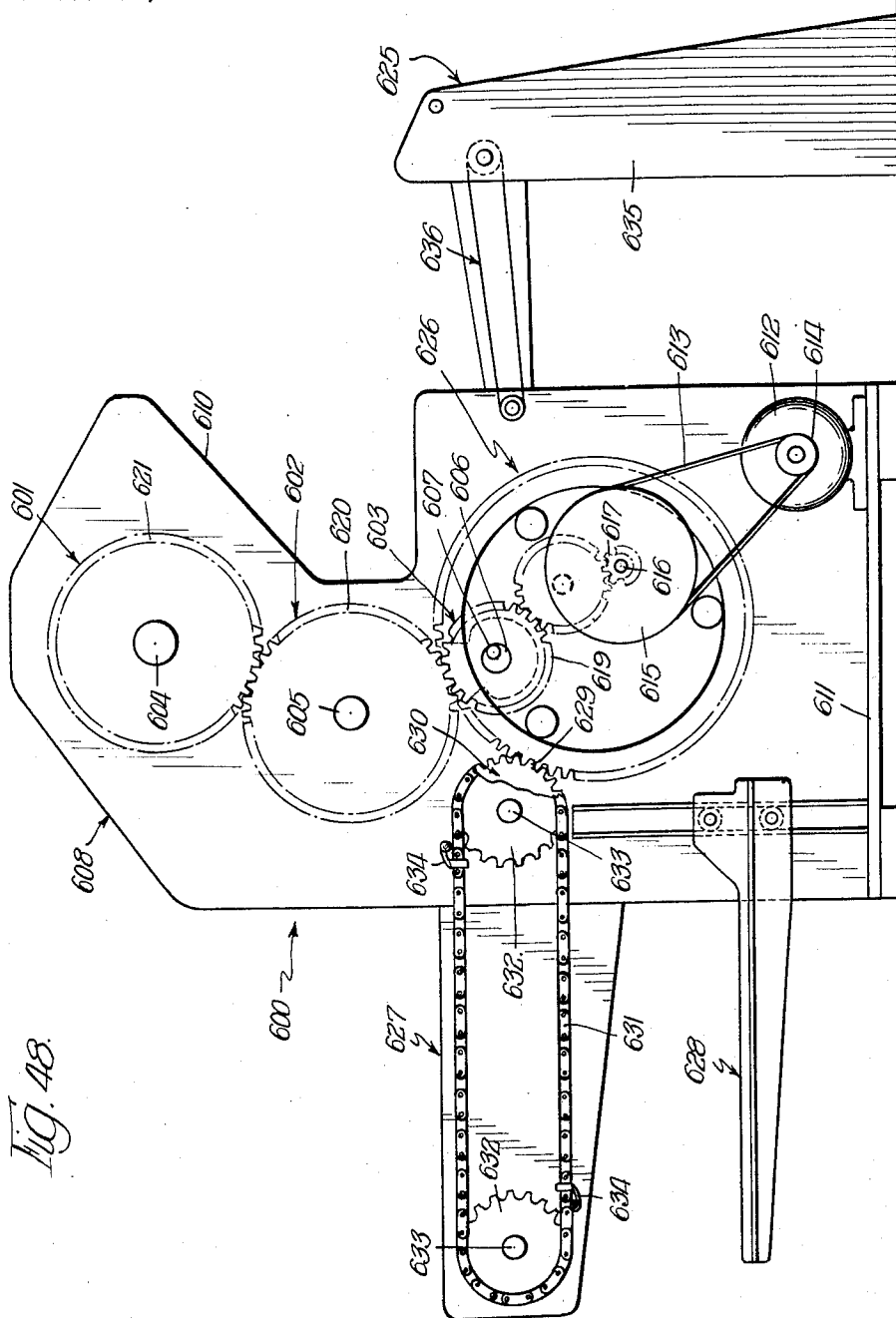


Fig. 48.

INVENTOR.
William Ward Davidson,
BY *Brown, Jackson*
Bolton & Davis
ATTORNEYS.

Nov. 10, 1959

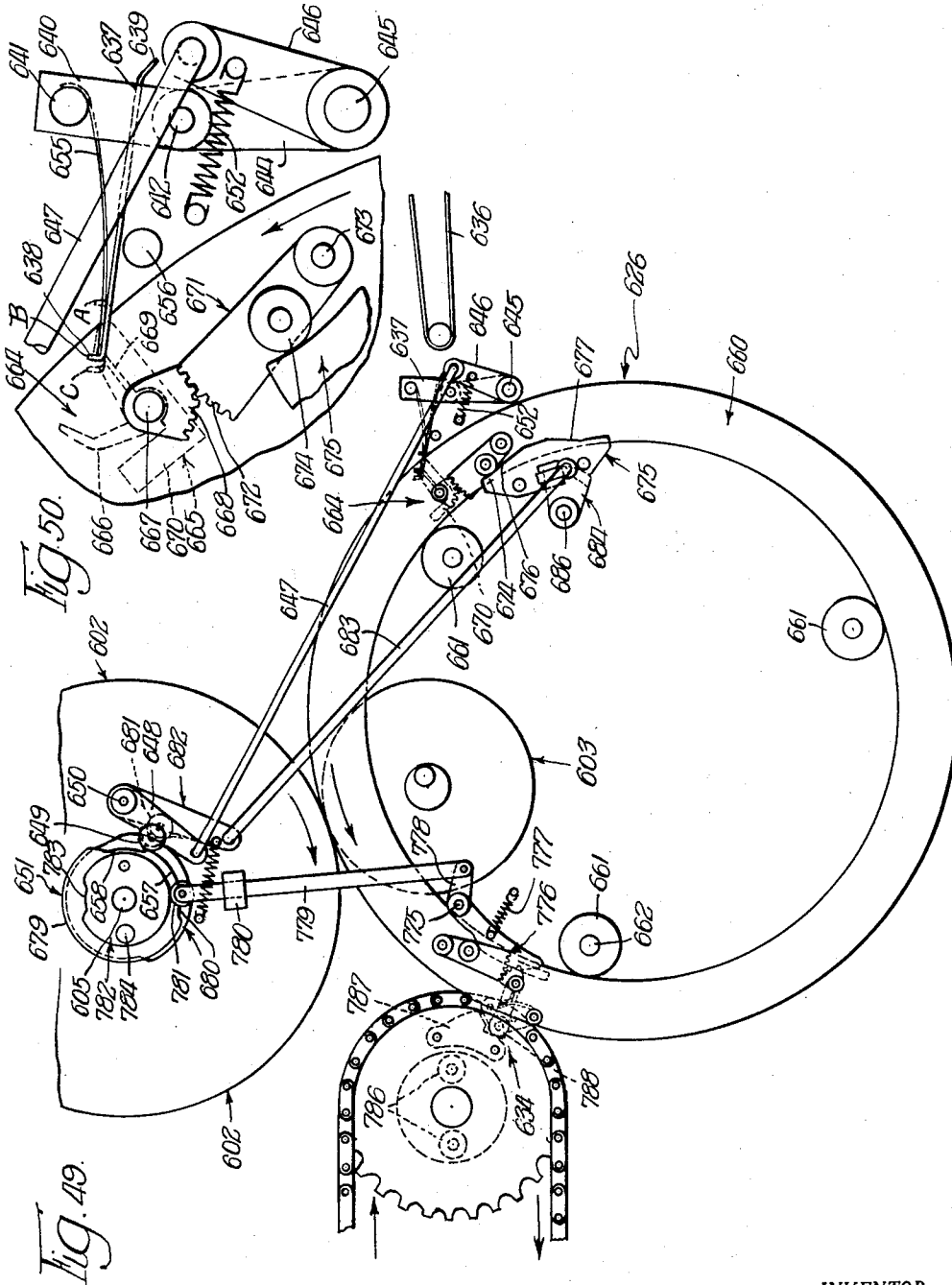
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 23



INVENTOR.
William Ward Davidson,
BY *Max Jaden*
Boettcher & Nieme
ATTORNEYS.

Nov. 10, 1959

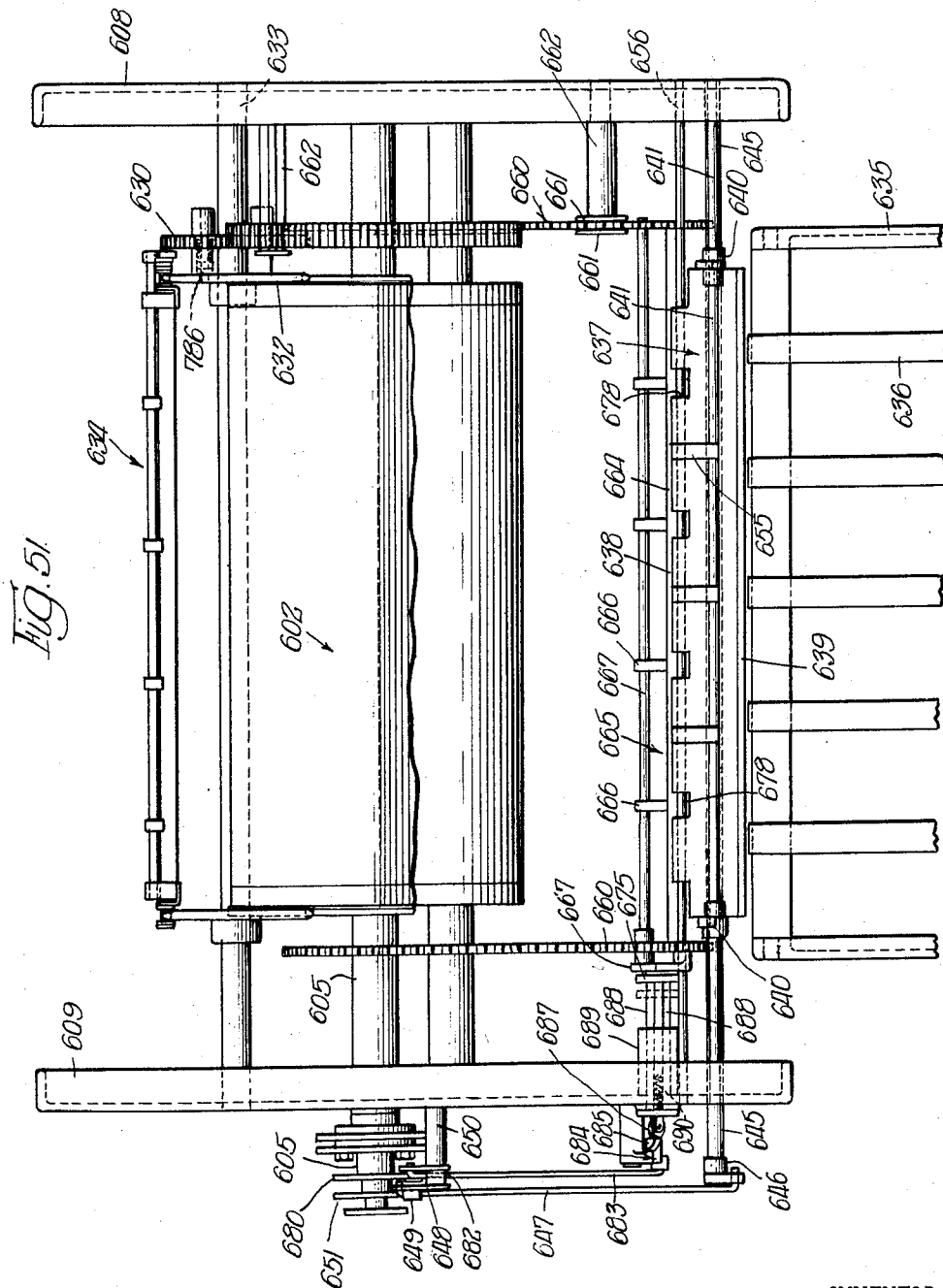
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 24



INVENTOR.
William Ward Davidson,
BY *Morgan, Jackson*
Boettcher & Dickman
ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

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30 Sheets-Sheet 25

Fig. 53.

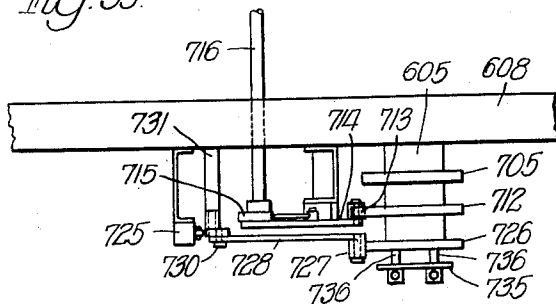
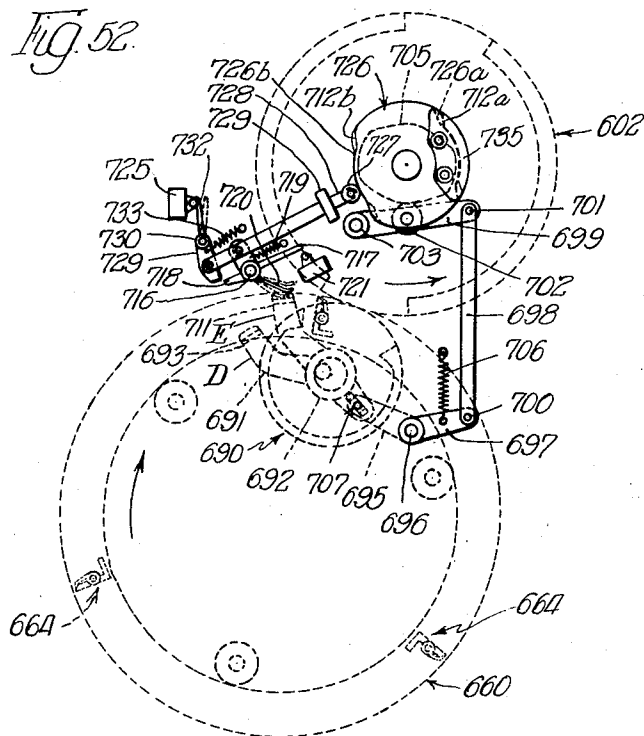


Fig. 52.



Nov. 10, 1959

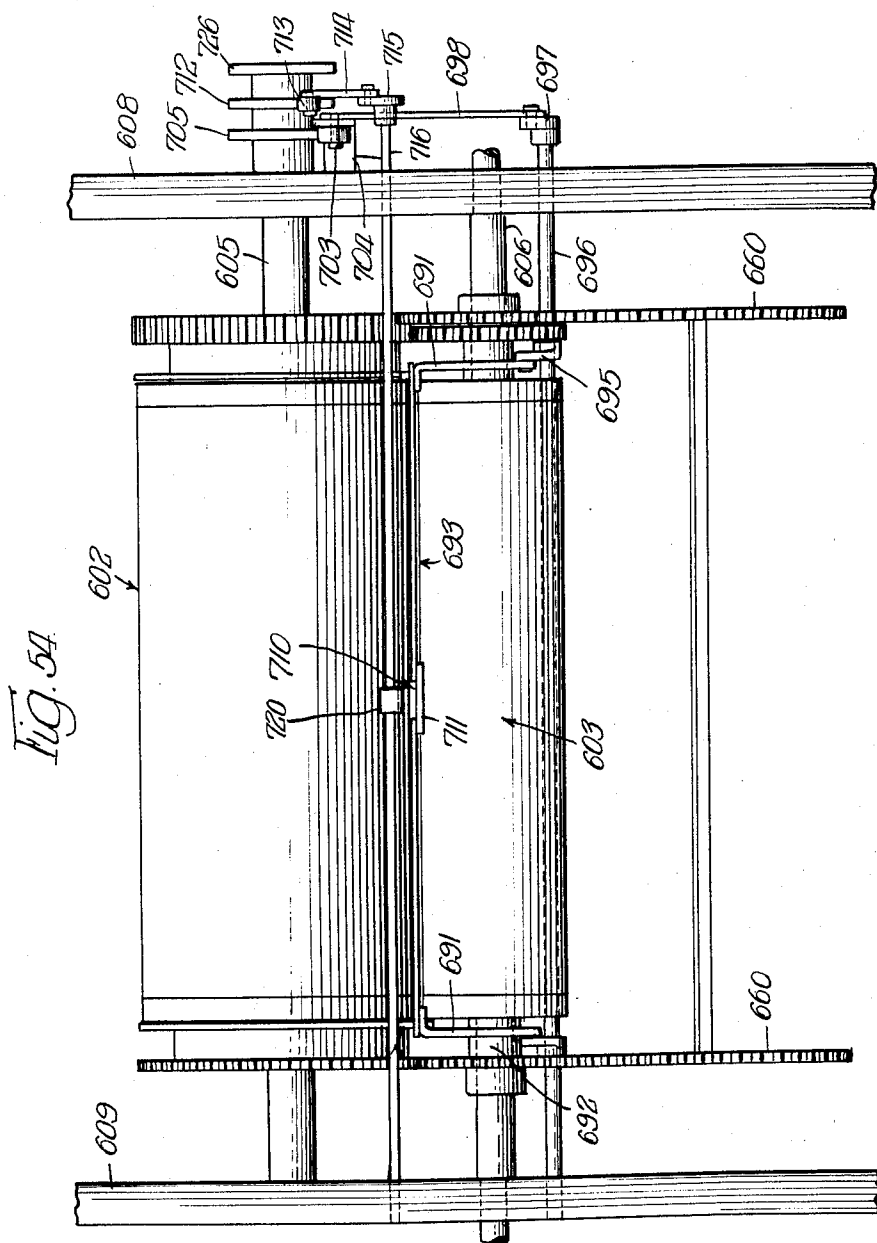
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 26



INVENTOR.
William Ward Davidson,
BY *Monroe Jackson*
Boettcher & Co.
ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

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30 Sheets-Sheet 27

Fig. 58

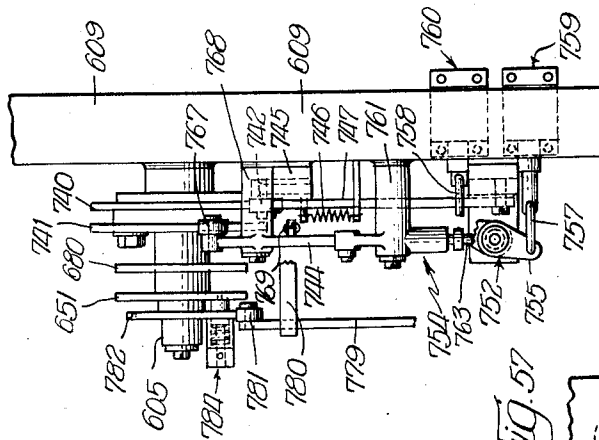


Fig. 57

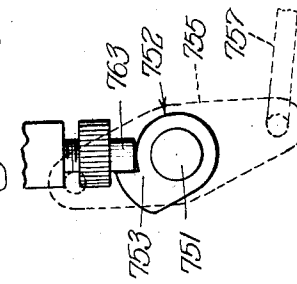


Fig. 55

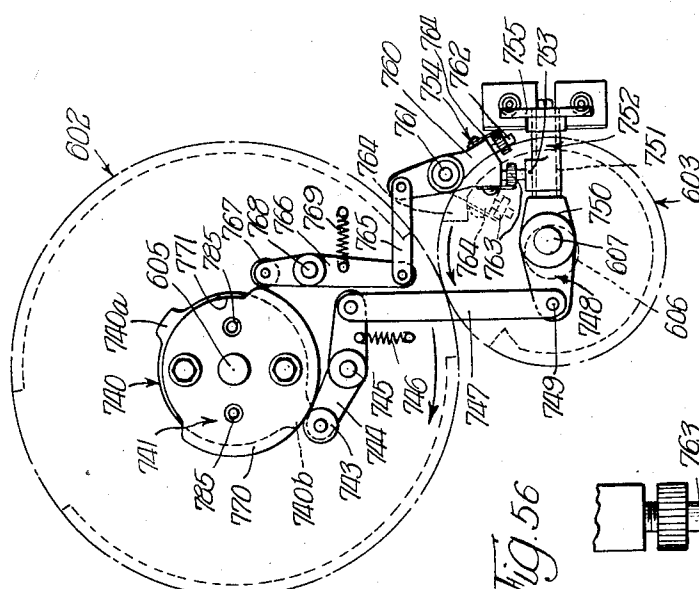
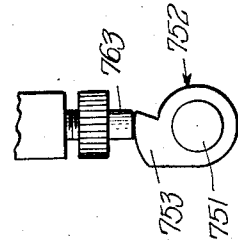


Fig. 56



INVENTOR.
William Ward Davidson
BY *Wm. J. Johnson*
Boyd & Co.
ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

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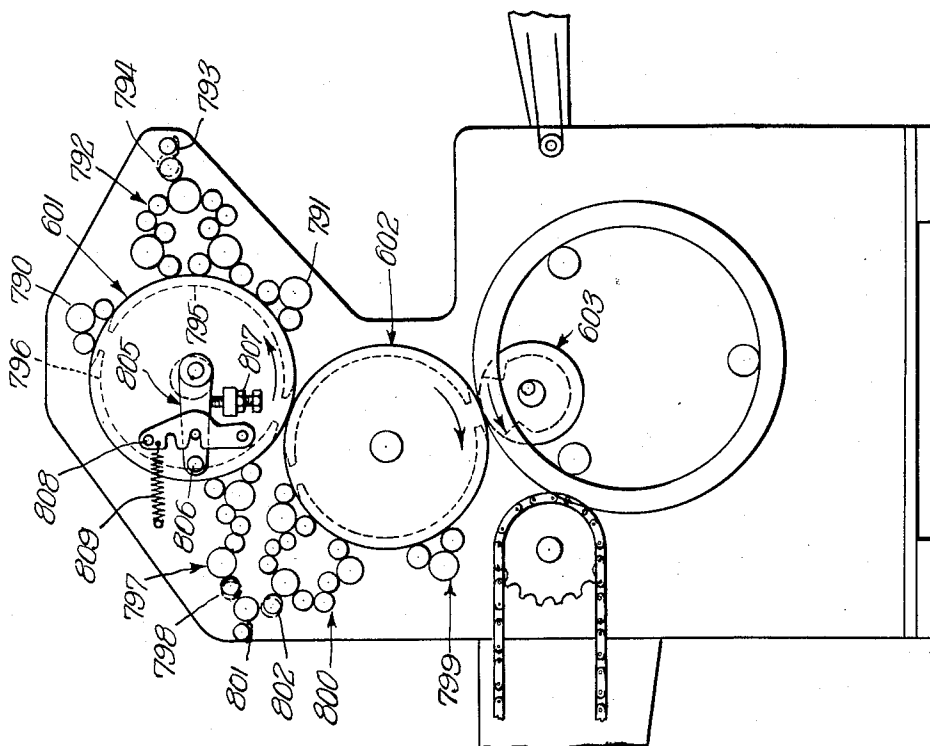


Fig. 59.

INVENTOR.
William Ward Davidson,
BY *Maun, Jackson*
Boettcher & Beine
ATTORNEYS.

Nov. 10, 1959

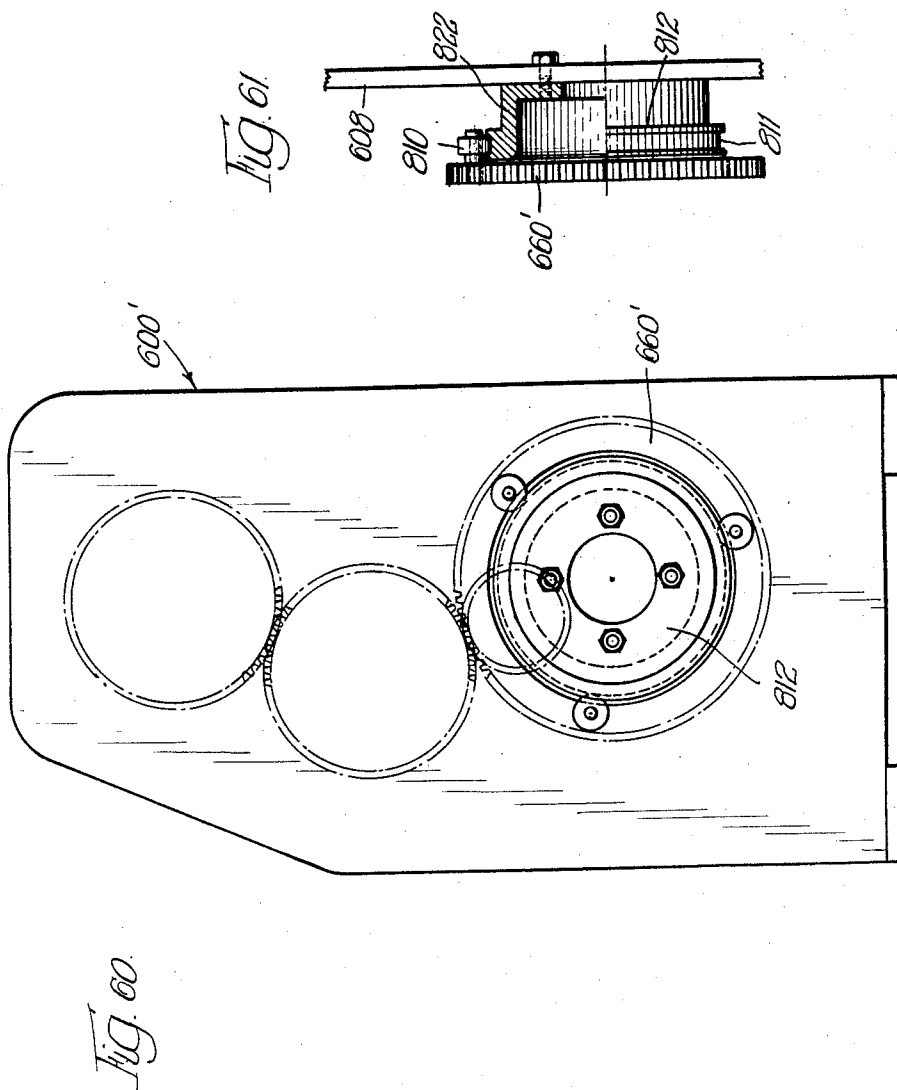
W. W. DAVIDSON

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

Filed Oct. 28, 1955

30 Sheets-Sheet 29



INVENTOR.
William Ward Davidson,
BY *Mann, Jackson*
Wootch & Green
ATTORNEYS.

Nov. 10, 1959

W. W. DAVIDSON

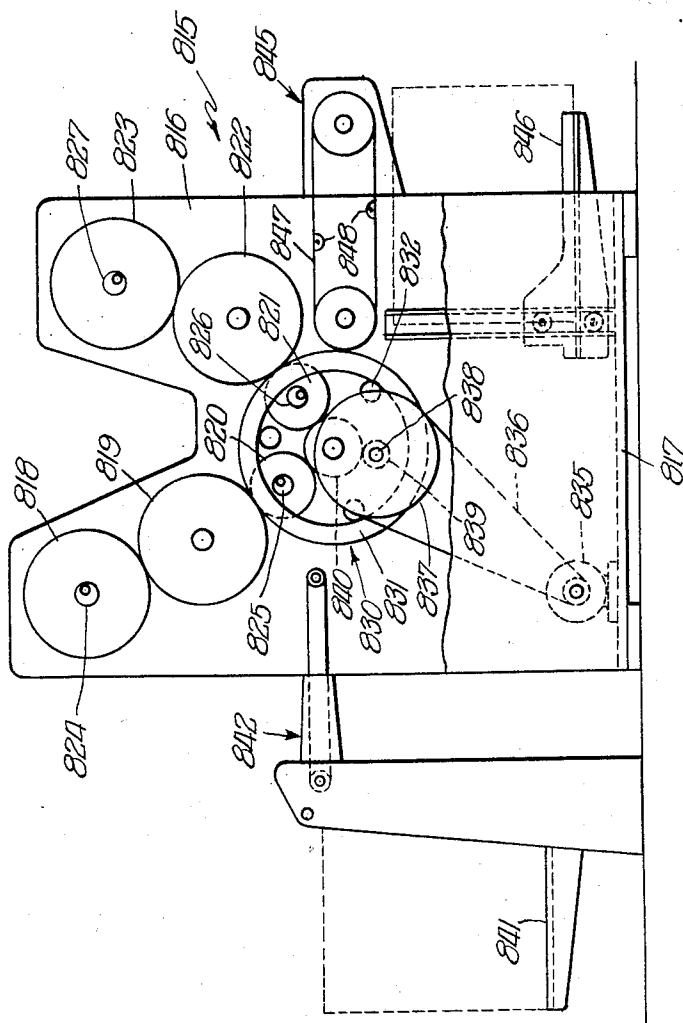
2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

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30 Sheets-Sheet 30

Fig. 62.



INVENTOR.
William Ward Davidson.
BY *Max J. Jackson*
Robert J. Jackson
ATTORNEYS.

1

2,911,907

MULTI-PURPOSE ROTARY PRINTING PRESS

William Ward Davidson, New York, N.Y.

Application October 28, 1955, Serial No. 543,305

72 Claims. (Cl. 101—137)

The invention described hereinafter is concerned with the general art of printing. Broadly considered, my invention comprises basic improvements and advanced concepts for mechanisms and their arrangement in multi-color offset, and multi-color perfection printing presses whereby I provide a new and improved combined offset and/or letterpress printing machine distinguished by its adaptability for performing a wide variety of basic printing operations.

The arrangement and structural aspects for my new printing press offer among others, the following features which make it a practical mechanism for its intended uses and purposes and which serve to distinguish the same from past known printing presses of the same general class.

Considerable advantage is provided by the basic cylinder arrangement in my press which makes it possible to locate various working systems and mechanisms, particularly those which must be constantly supervised by the operator, in such a position and manner that they are conveniently accessible and visible to promote ease and efficiency of operation. Such mechanisms and systems include, by way of example, the inking and dampening systems, the feeding and delivery systems and the printing mediums.

Another basic advancement in my press is presented in an improved means for carrying paper sheets through the printing couple of the press, once and more than once as desired or selected, depending on the particular printing operation to be performed.

Still further advantage is found in the substantial straight line flow of paper through the press or the printing couple thereof. That is to say, the cylinders of the printing couple, the feeder system, the delivery system and the grippers are so arranged that paper enters and exits from the bite of the press on opposite sides of a vertical line passing through the point of contacting tangency for the cylinders of the printing couple. This arrangement permits the uniting of successive presses in tandem relation in certain forms of my invention to advance and broaden the versatility and working range of my invention. Further, since it is desirable, as paper is being fed to the gripper mechanism for passage through the printing couple, that a sheet to be printed be prevented from contacting an inked surface of the blanket cylinder, I have also made specific provisions to meet this necessity by directing the sheets directly into the bite of the printing couple.

It is also an underlying concept and intention in this invention that the surface area of the blanket cylinder bear a certain ratio to the surface area of the plate cylinder which it engages. That is to say, it is my intention in all forms of my improved press that the printing couple comprise at least two cylinders of unlike diameter. The smaller of these two cylinders is related in size to the larger so that the diameter of the larger cylinder is always wholly divisible by the diameter of the smaller cylinder. Further, in certain forms of my new

2

press, I intend that there be three cylinders, one small and two large, the latter of which are of like diameter. In all cases, at least one large cylinder of the printing couple is provided with multiple work areas on its periphery. This feature combined with means for carrying a sheet of paper through the bite of the printing couple once and more than once, plus improved inking, feeder, gripper and delivery systems, all arranged according to my teachings, produces a remarkably versatile printing machine.

For instance, in the basic form of my invention, the press has two cylinders of unlike diameter. The larger cylinder has two or more equal working areas at its periphery, each of which areas may be utilized to accommodate a printing plate member or a platen-pressure member. The smaller cylinder's diameter will always divide wholly into the diameter of the larger cylinder a number of times depending on the number of working areas the larger cylinder bears. Therefore, in the instance where the larger cylinder has two working areas, the smaller cylinder normally will be one half the diameter of the larger. While normally one working member will be carried within each working area of the larger cylinder, certain circumstances may permit multiple members in each working area.

It is an additional general rule in my press that the smaller cylinder be completely rotated for each working area of the larger cylinder. Such exceptions to this rule as may be employed will be brought out later hereinafter. Thus, in the case of two working areas on the large cylinder, the smaller cylinder will rotate twice for each complete 360° revolution of the larger cylinder. This is all by way of pointing out that the surface area or circumference of the smaller cylinder is substantially equal to the area or peripheral extent defining each working area and separating gap on the larger cylinder. Of added consequence, the small cylinder, like the larger cylinder may be provided with a gap or gaps to separate working areas in its surface which register with separated working areas of the larger cylinder during each revolution or cycle of the printing couple. The gaps in the smaller cylinder are provided for the purpose of accommodating the passage of improved gripper means in one form of the machine and to accommodate means for attaching cylinder covering materials.

With the above outlined features and concepts in mind, it will be realized from descriptive materials which follow, that I have arranged the several portions of my improved press in an improved workable order whereby I may accomplish a wide range of printing operations with a single machine.

By way of brief illustration, in one preferred form of my press, having a two cylinder printing couple, the larger cylinder is capable of carrying at least two working members. Such members may comprise letterpress printing members and if such be the case, I therefore may accomplish two letterpress operations on one side of a sheet of paper by passing the paper through the bite of the printing couple twice for each 360° of large cylinder revolution. By providing separate inking systems for each working area of the large cylinder two color letterpress printing on one side of a sheet may be gained. It will also be appreciated and understood that one or more printing members may be used in each working area of the large cylinder to increase the number of individual printing operations capable of being performed under this arrangement.

An alternate arrangement of this form of press may comprise the replacement of one of the two printing members with a platen-pressure member which will then permit one color offset printing, the smaller cylinder's surface being provided with an offset blanket in this

instance. In this arrangement the paper is carried through the bite of the printing couple once for each 360° of larger cylinder rotation.

In another preferred form of my press, a second larger cylinder is added to the basic two cylinder machine, the added cylinder preferably being disposed tangentially with the first large cylinder only and generally thereover. By having the initial large cylinder carry offset blanket members in its working areas and the second large cylinder carry printing members in its working areas, two color offset printing on one side of a sheet of paper is accomplished by passing the paper sheets through the bite of the printing couple twice. An outstanding advantage in this last described arrangement is found in the fact that the second larger cylinder need not be lifted for each 180° of its rotation as has been done in the past in some machines employing two larger cylinders for two color offset printing. If desired, printing plates may be placed on opposed halves of each of the large cylinders, one transferring its image to a blanket member on the other large cylinder and the other transferring its image to a blanket on the small cylinder. In that case a sheet is passed through the bite once for each 360° revolution of the large cylinders thus accomplishing two sided printing.

The above outlined features are but a few of the outstanding advantages and improvements which are to be found in my present invention. Others will be set forth more fully in the specifications and descriptions which follow hereinafter as I set forth in detail the preferred means and mechanisms by which I propose to carry out the following stated objects of my invention.

Among the outstanding objects of this invention is the provision of a new and improved multi-color, multi-purpose printing press capable of performing offset, dry offset and letterpress printing operations.

A further object of this invention is to provide a new and improved printing press unit embodying means to pass a sheet through the bite or bites of the cylinders thereof once or more than once and which is capable of selectively accomplishing multiple color printing on one or both sides of a sheet of paper.

Another object of this invention is the provision of a new and improved printing press, having means to accommodate the passage of a sheet of paper through the bite of the printing couple once and more than once as selected.

An additional object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, means for the feeding and delivery of paper to and through the bite of the printing couple in substantially a single plane, the feeding and delivery operation occurring on opposite sides of a vertical line passing through the point of tangency of the printing couple cylinders.

A still further object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, at least two cylinders, one of which is larger than the other, with the larger cylinder thereof being arranged and adapted to carry individual working members at separated portions of its circumferential area.

An additional object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, at least two cylinders of unlike diameters of which the larger cylinder thereof is capable of carrying separated working members in separated areas of its circumference and having individual inking and dampening systems, where required, for such separated working members.

An additional object of this invention is to provide a new and improved printing press in which the flow of

paper through the bite of the printing couple is substantially horizontal such that multiple printing presses or units of this character may be arranged in tandem fashion without transfer of the sheet from the gripper means to accomplish a wide variety of multiple printing operations.

A still further object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, at least two cylinders of unlike diameter, the larger of which is capable of carrying individual printing members on separated portions of its circumferential periphery, each of such portions being inked and dampened, where required, by separate means so that the press is capable of multi-color printing operations.

Another object of this invention is to provide a multi-purpose printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, at least two cylinders of unlike diameter, the larger cylinder being provided with a plurality of gaps defining separated areas in its circumference, and which is coupled with a means movable between and through the bite of the two cylinders for advancing gripper means through the printing couple; the gaps or separated working areas in the larger cylinder and the number of gripper means being related such that if there are an odd number of gaps or separated working areas, an even number of grippers are provided, or if there are an even number of gaps or working areas an odd number of grippers are provided; the linear distance between grippers being substantially equal to the arcuate distance between the centers of adjacent gaps or separated working areas on the larger cylinder.

A still further object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, one large cylinder and one smaller cylinder, the diameter of the smaller cylinder being wholly divisible into the diameter of the larger cylinder which carries two or more working members or separated working areas associated with one or more inking means so as to accomplish two or more letterpress or offset printing operations.

A still additional object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, a minimum of two cylinders of unlike diameter, the smaller cylinder of which has its axis located below the center or axis of the larger cylinder.

Another object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, an improved arrangement of cylinders whereby the several gripper, delivery, stacking, inking and dampening systems are freely accessible and visible to the operator to promote improved convenience and efficiency of operation.

A further object of this invention is to provide a new and improved printing press including means to pass a sheet of paper through the bite of the printing couple once or more than once, in which the arrangement of cylinders is such as to permit the positioning and operation of the feeding mechanism on one side of the press while the delivery system is located on the opposite side thereof; a sheet of paper fed through the printing couple or bite between the cooperating cylinders of the printing couple following substantially a horizontal plane.

A still further object of this invention is to provide a new and improved printing press comprising, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, three cylinders, two of which are of equal diameter and larger than the third, and having coupled therewith at least two

inking systems one adjacent each of the two larger cylinders plus means for selectively operating said inking systems as desired.

Still another important object of this invention is to provide a new and improved printing press having, in association with means to pass a sheet of paper through the bite of the printing couple once or more than once, a gripper means for carrying a sheet of paper to be printed through the bite of the printing couple which is so associated with the feeder system that a surface of a sheet of paper facing upwardly when emerging from the feeder or when seized by the provided gripper means, faces upwardly as it emerges from the bite of the printing couple, after it has passed through the bite once or more than once.

A further object of this invention is the provision of a new and improved printing press having means forming a printing couple, the diameter of one cylindrical member of which is larger than the diameter of the other cylindrical member, the diameter of the first member being wholly divisible by the diameter of the latter member, the circumferential surface of the larger cylinder being separated into two or more work areas, and capable of performing two offset printing operations on one side of a sheet fed to the bite of the printing couple.

Still another object of this invention is to provide a new and improved means for separating the cylinders of the printing press to plural preselected positions thereby to control contacting pressure at the bite of the printing couple.

A still further object of the invention is to provide an improved cylinder separation and contact pressure control system capable of partially and fully separating the printing couple cylinders of a press so that different contact pressures may be maintained between one cylinder of the couple and distinct plural work areas on the periphery of a second cylinder of the printing couple.

A still additional object of the invention is to provide a new and improved sensing finger system for use in conjunction with the aforementioned improved cylinder separating and contact pressure control system and including means for conditioning such systems for either one side or two side printing operations.

Still another object of the invention is to provide a new and improved feeder means for use in conjunction with an encircling gripper system which is arranged to transfer paper to the said gripper system within the orbit of the latter's encircling path.

A still further object of the invention is to provide a new and improved means for detecting both the presence and/or absence of a sheet of paper prior to its first or subsequent entry into the bite of the printing couple cylinders and in the event of such sheet absence to activate a new and improved means for separating such cylinders.

The above listed objects define what I believe to be some of the more outstanding features and principles to be found in my improved printing press. However, as the description of the preferred and modified embodiments of this invention are set forth hereinafter, it will become apparent that other features, advantages and characteristics of improved operation are also present in my invention. In any event, it is believed that such objects, features and advantages will best be understood from the following detailed specifications for several forms of my invention which are illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a view in side elevation with portions shown in cross-section substantially along the longitudinal centerline of a three cylinder press embodying the concepts of my invention;

Figure 2 is an end elevational view of the machine

illustrated in Figure 1, but at an enlarged scale thereof, with parts broken away;

Figure 3 is a cross-sectional view taken substantially along line 3-3 of Figure 2 and looking at the direction of the arrows thereon to illustrate the drive mechanism employed in the press of Figure 1;

Figure 4 is an enlarged detail view in side elevation of the feed roll mechanism associated with the machine of Figure 1;

Figure 5 is an enlarged partial perspective showing of the printing couple, cylinder throw-out and other related mechanisms employed in the machine of Figure 1;

Figures 6 and 7 are enlarged operational views in side elevation of the sensing finger system illustrated in Figure 5;

Figure 8 is a partial view in side elevation illustrating the sensing finger system of Figures 6 and 7 as well as additional sensing finger means relating to the blanket gripper means;

Figure 9 is an enlarged detail view showing the side elevation of a removable cam node for use with the sensing system illustrated in Figure 8;

Figure 10 is a partial end elevational view of the cam node shown in Figure 9 with parts thereof broken away in cross-section to illustrate its detail of construction;

Figure 11 is a partial enlarged end elevational view of the assembly illustrated in Figure 10;

Figure 12 is a partial view in side elevation showing details of the chain carried sensing finger system illustrated in Figure 8;

Figure 13 is a partial view in side elevation illustrating the means for operating the actuator set forth in Figure 12;

Figure 14 is an end elevational view of the sensing finger actuators shown in Figures 12 and 13;

Figure 15 is an enlarged partial view in side elevation of the actuator of Figure 12 and its relationship to a means for deactivating the same;

Figure 16 is a partial enlarged view in side elevation with parts broken away in cross-section illustrating a typical coupling means employed with the cylinder throw-out mechanism of the press illustrated in Figure 1;

Figure 17 is a partial perspective showing the coupling device set forth in Figure 16;

Figure 18 is a schematic representation in end elevation of an improved inking means used with the three cylinder press of Figure 1;

Figure 19 is a partial enlarged view in front elevation showing the details of an improved ink ductor control mechanism employed with the inking means of Figure 18;

Figure 20 is a cross-sectional view of the ductor control mechanism taken substantially from vantage line 20-20 of Figure 19 and illustrating the relationship of such mechanism to the inking means of Figure 18;

Figure 21 is an enlarged partial top plan view showing the details of construction for the gripper bar mechanism associated with the blanket cylinder of the printing press;

Figure 22 is a schematic representation of a gripper register means for the chain gripper system employed with the improved press of Figure 1;

Figure 23 is an enlarged schematic representation of an improved sheet register system used with the chain carried gripper means set forth in Figure 22;

Figure 24 is an enlarged partial representation in perspective of an improved control means for regulating the opening and closing of the gripper means shown in Figure 22;

Figure 25 is a partial view in side elevation setting forth the operational concepts and details of a new means employed for transferring paper from the chain carried blanket gripper system to the grippers of chain delivery means;

Figure 26 is an enlarged detail in perspective of the control means for the means of Figure 25;

Figure 27 is a large view in end elevation of the mechanism detailed in Figure 26;

Figure 28 is an enlarged partial view in side elevation, with parts thereof broken away, showing the details of operation and arrangement for the blanket gripper and delivery gripper means at the instant of transferring paper between two such gripper systems;

Figure 29 is an enlarged partial view in end elevation schematically setting forth the details and operational relationships of an improved and modified feeder and sheet registry means to be employed with the printing presses of this invention;

Figure 30 is an enlarged partial top plan view, foreshortened, showing the details of the improved vacuum gripper and registry means set forth in Figure 29;

Figures 31, 32 and 33 comprise a series of diagrammatic views and operational information illustrative of modifications, variations and rearrangements of the preferred printing press found in Figure 1 of the drawings;

Figure 34 is a view in side elevation with parts shown in cross section, substantially on the order of Figure 1, illustrating a first modified form of press made in accordance with my invention;

Figure 35 is a schematic representation of a two-cylinder printing couple embodying the features and concepts of the modified press shown in Figure 34;

Figure 36 is an end elevational view of the press of Figure 34, demonstrating particularly the drive mechanism for the cylinders thereof;

Figure 37 is a perspective view, similar to Figure 5, showing the arrangement of elements for the feeder and blanket gripper actuating systems employed in the press of Figure 34;

Figure 38 is a partial enlarged view in side elevation showing the details and arrangement of a cylinder throw-out actuating mechanism employed in the press of Figure 34;

Figure 39 is an enlarged side elevational view, with parts thereof in cross section, demonstrating the features of the sensing finger system employed in the press of Figure 34;

Figure 40 is a partial perspective showing of the gripper means carried with the blanket cylinder of the Figure 34 press;

Figure 41 is a partial perspective view, similar to Figure 24, demonstrating the features of a control mechanism for the blanket cylinder gripper means shown in Figure 40;

Figure 42 is a partial enlarged view in end elevation, demonstrating further the features of the gripper actuating mechanism of Figure 41;

Figure 43 is a partial enlarged top plan view of the gripper actuating mechanism found in Figure 42;

Figure 44 is a partial enlarged view in side elevation showing the features of an improved shifting cam arrangement employed in the mechanism of Figure 41;

Figure 45 is a schematic view in side elevation taken at one end of the blanket cylinder and demonstrating the features of a gripper operating cam employed in the mechanism of Figure 41;

Figure 46 is a schematic representation of the blanket cylinder and discharge means, particularly setting forth the features of a delivery gripper means employed for removing sheets from the blanket cylinder of the Figure 34 press;

Figure 47 is a schematic representation demonstrating two machines of the character set forth in Figure 34 coupled together in tandem relation for accomplishing four color printing;

Figure 48 is a schematic representation, similar to Figures 1 and 34, showing in side elevation the arrangement of elements and particularly the drive mechanisms of a second modified form of press embodying the concepts of my invention;

Figure 49 is an enlarged partial view in side elevation

demonstrating the features and arrangement of an improved encircling gripper system employed in the press of Figure 48;

Figure 50 is a partial view in side elevation showing in detail the intermediate feeder mechanism and gripper means of the encircling gripper system set forth in Figure 49, but at an enlarged scale thereover;

Figure 51 is a partial top plan view, with parts therein broken away, of the machine in Figure 48, such particularly demonstrating the arrangement of the feeder and intermediate feeder mechanisms shown in Figures 49 and 50;

Figure 52 is a partial side elevational view, similar to Figure 49, but looking at the opposite end of the press therefrom, to demonstrate the concepts and features of an improved sensing finger system and undersheet support system employed in the press of Figure 48;

Figure 53 is a top plan view of the mechanism illustrated in Figure 52;

Figure 54 is a partial end elevational view of the press of Figure 48, looking particularly at the printing couple cylinders thereof and the improved undersheet supporting mechanism shown in Figure 52;

Figure 55 is a side elevational view, similar to Figure 52, showing the printing couple cylinders employed in the press of Figure 48 and demonstrating the concepts and features of improved cylinder throw-out mechanism employed therewith;

Figure 56 is a partial enlarged view in end elevation showing a first operational condition for an improved adjustable stop means employed with the cylinder throw-out mechanism of Figure 55;

Figure 57 is a partial enlarged end elevational view, similar to Figure 56, showing a second operational condition of the improved stop means employed in the cylinder throw-out mechanism of Figure 55;

Figure 58 is an end elevational view of the mechanisms set forth in Figure 55;

Figure 59 is a schematic view in side elevation, similar to Figure 48, illustrating particularly improved inking and dampening mechanisms employed therein as well as hand-operated cylinder throw-out means utilized with the upper cylinder of such modified press;

Figure 60 is a schematic view in side elevation demonstrating the features of an improved or modified form of supporting means for the encircling gripper system shown in Figure 49;

Figure 61 is a partial end elevational view of the improved support means shown in Figure 60; and

Figure 62 is a schematic representation in side elevation, similar to Figure 48, demonstrating the features and arrangement of parts for modified form of the Figure 48 press arranged to accomplish four color printing.

General arrangement

Briefly, the several printing presses pictured in the accompanying drawings comprise a number of components and basic mechanisms arranged and combined in a manner to provide a new and versatile printing press designed so that it may be purchased in a basic two cylinder form and expanded as the scope of operation is augmented. The general arrangement of the basic unit includes a lower small cylinder and an upper larger cylinder arranged to carry either two separated printing members of which one may be replaced by an impression member. The necessary feeding and delivery systems are arranged so that the path of paper flow is through the bite of the cylinders from the front to the back of the press. Suitable water and novel inking units, for reasons that will become more apparent hereinafter, are arranged adjacent the plate cylinder (see Figure 18). A basic fundamental of the cylinder arrangement lies in designing the two basic cylinders of different size with the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder and with the axes of rotation for such

cylinders disposed in a position suitable for permitting a substantially horizontal feed of the paper through their bite.

A further distinguishing characteristic of the press is presented in the provision of plural working members on separate work areas of the surface of the larger cylinder in the printing couple. The arcuate extent of each such working member or work area normally corresponds substantially to the circumference of the smaller cylinder such that 360° rotation of the larger cylinder is accompanied by multiple revolutions of the smaller cylinder; the number of such smaller cylinder revolutions per cycle corresponding to the number of working members or work areas arranged on the periphery of the larger cylinder. In one exceptional case it is desirable that this generality be violated so that two working areas on the larger cylinder pass through the bite of the couple for each 360° rotation of the small cylinder.

While the basic structure and cylinder arrangement of my improved press includes the two cylinders as described, it is also contemplated and expected that the two cylinder press may be converted to a three cylinder press by the addition of a second larger cylinder in a manner and for purposes which will be amplified later hereinafter.

Basic machine

The general arrangement of the basic printing machine is shown schematically in Figure 25, but is best illustrated and will hereinafter be described in conjunction with the showing of a preferred form of three cylinder press found generally in Figures 1-28 of the drawings.

From Figure 1 in particular, it will be recognized that the basic two cylinder press embodied therein comprises a large cylinder 50 carrying plural separated working members such as 51 and 52 at its periphery. A blanket cylinder 53 of smaller diameter carries the usual blanket cover 54 which conventionally cooperates with the working members or work areas carried by the adjacent large cylinder 50. The two cylinders 50 and 53 are arranged in tangential engagement with the larger cylinder being located over the blanket cylinder. Note further that the alignment of the cylinders is preferably such that their rotational axes are substantially coplanar, although this is not a necessary limitation. Particularly blanket cylinder 53 is located beneath the adjacent large cylinder 50 so that its supporting axle member 55 lies substantially vertically beneath axle 56 which supports the adjacent large cylinder 50.

As will be understood best from Figure 2 of the drawings, axles 55 and 56 are carried in horizontal position between a pair of side frame plate members 57, 57 which are disposed in spaced parallelism and registeringly aligned in a manner conventional in this art. The side frame plate members 57 are held apart adjacent their lower ends by means of cross-connector bars 58 and a bed plate 59 (see Figure 3). Bearing means 60, 60 which are attached to the side frame members 57, 57 carry the end portions of the axle member 56 while similar bearing means 61, 61 support the ends of the lower cylinder axle 55.

Cylinders 50 and 53 are rotatably driven on their respective shafts by a conventional driving gear train means comprising, for example, drive gear 62 associated with cylinder 50 and drive gear 63 associated with cylinder 53 (see Figure 3). The two drive gears 62 and 63, of course, intermesh and the blanket cylinder drive gear 63 engages a below positioned idler gear 64 mounted on shaft 65. The source of power for the drive may constitute any conventional source as, for example, an electric motor 66 mounted on bed plate 59. The motor serves to rotatably drive a belt 67 and a sheave wheel 67a mounted on shaft 68 which also carries a reduction pinion 69 having meshing engagement with the idler gear 64. Such drive gear train is located on the left hand side of the press (as viewed in end view Figure 2) between the

left hand ends of the cylinders and the adjacent side plate 57.

A unique blanket cylinder encircling gripper system is provided for both the basic two cylinder and three cylinder presses embodied in Figure 1, comprising substantially a pair of parallel spaced members such as chains 70 carrying spaced gripper bar means 71, 72 and 73, a first set of sprocket wheels 74, 74 supported on shaft 75 and a second set of sprocket wheels 76, 76 carried at the opposite ends of the blanket cylinder 53. It will be perceived particularly that with such a gripper system the multiple gripper bars are carried at spaced intervals and move through the bite of the printing couple in response to and with the rotation of the printing couple; the purposes and operational ramifications of which will be more appreciated from materials found later hereinafter.

A feeder system 80 of a conventional variety is utilized to advance paper sheets to be printed to an intermediate feeder system which supplies the printing couple. A chain delivery system, indicated generally at 81, is employed to receive imprinted paper from the blanket cylinder gripper system and deliver the same to a stacking station or means 82. The exact details and operational features of the feeder system 80, the delivery system 81 and the chain gripper system associated with the blanket or lower cylinder will be particularized presently.

To enable one to convert the basic two cylinder press, as outlined briefly hereinabove, to a three cylinder press of the order illustrated particularly in Figure 1 and subsequent figures, the side frame members 57, 57 are each adapted to receive and mount a removable upper extension plate or member 83. Such extension plates 83 are designed to carry and support a third cylinder 84 comprising a second larger cylinder substantially of the same order as cylinder 50 heretofore described. Cylinder 84 is also carried on a horizontal shaft 85 which in turn is supported in bearing means 86, 86 connected to the side extension plate members 83.

In addition to the feeding and delivery means above noted, the two cylinder press also includes at least one dampening roller unit 87 and inking roller unit 88 adjacent cylinder 50. As shown best in Figure 3 of the drawings, the dampening roller unit 87 shown as driven off the main drive gear 62 of the intermediate cylinder 50 by means of a pair of intermeshing pinion gears 89, 89a. The inking unit 88 is likewise powered off the main drive gear 62 by take-off gear 90. In certain instances to be described, two or more ink units will be required in association with cylinder 50 (see Figure 31, Example b).

Upon the addition of the third or plate segment cylinder 84, provision is made to incorporate therewith two additional dampening units 91 and 92 driven by gears 93, 93a and 94, 94a, respectively, plus two inking units 95 and 96 driven by take-off gears 97 and 98 respectively. The purpose and functional aspects of the novel inking and dampening system outlined schematically in Figure 1 will be dwelled upon more particularly hereinafter.

Generally speaking, the utilization of the basic two cylinder press, as outlined, is directed especially to the printing of a single offset, dry offset or double letterpress operations while the addition of the removable cylinder unit 84 augments the operation of the press considerably and diversifies its operations to fields of multiple color offset, dry offset and letterpress printing on one side of a paper sheet or separate offset or dry offset printing operations on opposite sides of the paper sheets. Such printing operations with the three cylinder press include one or more color operations depending on the number of working areas provided on the large cylinders as will be detailed later.

Now to more fully understand the features and concepts of the basic two cylinder and preferred form of three cylinder press illustrated especially in Figures 1-33 of the drawings, the following particularized descriptions of the several operational portions of these machines will be set forth; the two cylinder press being incorporated

within the description for the preferred three cylinder press.

Feeding system

The initial feeding system includes the feeder 80 which may comprise a conventional or known style of feeder such as a suction feeder of standard design with possible variation as to dimension or other standard types of feeders may be employed likewise with advantage in these circumstances. Basically, the feeder 80 shown comprises a supporting structure or pedestal 99, a loading table or tray 100 and bracket supports 101, 101 attaching the pedestal to the side frames 57 of the printing press. A belt conveyor 102 is employed to transfer paper from the loading table 100 to an intermediate feeding table 103 opposite the bite of the printing couple of the press. The belt conveyor system comprises an idler roller 104, a conveyor belt 105 and a powered roller 106. Roller 106 is driven by any suitable power source as, for example a motor and belt drive, not shown, but conventionally employed for such purposes.

With particular reference to Figures 1, 4 and 5 of the drawings, a more thorough comprehension of the feeder system employed will be gained. Assuming, for example, that a sheet of paper rests on the feeding or loading tray for eventual delivery to the blanket cylinder grippers, a conventional suction device (not shown) is designed to pick up a sheet of paper from the table 100 and deliver it to the belt conveyor 105. As the paper leaves the belt 105 it encounters the intermediate feeding table 103 where it is engaged by an intermediate feed system employed to advance the paper into the grippers associated with the printing couple and the blanket cylinder in particular.

Intermediate feed

The intermediate feed system as shown comprises a pair of rollers 107 and 108, best seen in Figure 4 of the drawings. These rollers are commonly referred to as upper and lower feed rollers, respectively. The lower feed roller 108 is driven by a pinion gear member 109 (see Figure 3) responsive to the rotational movements of the printing couple and particularly the intermediate plate segment cylinder, according to conventional practice. Specifically with reference to Figure 3 of the drawings, it will be seen that the intermediate plate segment cylinder drive gear 62 is equipped with an adjacent cam plate member 110 which is mounted on shaft 56. Cam 110 is engaged by a roller 111 carried at the upper end of a rocker arm 112 pivoted intermediate its ends on a pivot 113. The rocker arm 112 supports a segmental gear portion or arcuate rack sector 114 at its lower end and is normally biased in a direction to engage roller 111 with cam 110 by means of a spring 115. The gear segment or sector engages the pinion 109 and acts as a rack means to partially rotate or rock the same thus driving the lower feed roll 108 mounted on shaft 116 (see Figure 4). After a sheet of paper has advanced onto the driven lower feed roll and against a system of stops (not shown) it is contacted by the upper feed roll 107 which applies pressure to the paper to cause its driven advancement toward the bite of the printing couple in response to rotation of the lower feed roll 108. The upper feed roller particularly, is lowered periodically into contact with the lower feed roller in timed relation to the rotation of the printing couple by a suitable linkage system driven off of a cam actuated lever 118 as best shown in Figure 5 of the drawings.

Specifically, the means for motivating the upper feed roll includes a shaft means 117 which extends through and is journaled in bearings carried by two intermediate side plate frame members 120, 120. The shaft 117 extends beyond one of the frame plates to connect with a short lever or crank 121 provided with a pivotal block 122 at its upper end. A push rod 123 extends between the pivotal block 122 and a similar pivotal block 124

mounted on the cam actuated lever 118. Lever 118 is pivoted centrally on a pivot axle 125 and carries a roller means 126 adjacent its upper end for cooperating following engagement with the cam periphery of plate cam 127 which is rotatable with the intermediate cylinder 50. As will be realized from this arrangement, cam initiation or rocking action of the lever 118 causes responsive rocking activity of shaft 117.

An arm 128 fixed to shaft 117 intermediate the side frame members 120, 120 carries the upper feed roll 107 which is rotatably supported on axle member 129 extending between bifurcated leg portions 130, 130 at the outer end of arm 128 (see Figure 5 in particular). Arm 128 is mounted on shaft 117 and is formed with a rearward extension or lip portion 131. Such lip portion is straddled by a U-shaped saddle 132 which is fixed to shaft 117. The saddle has a portion or section 133 of thinner cross-sectional area where it straddles the extending lip portion 131 of the lever arm 128. This relation may best be understood by examining Figure 4 of the drawings. Note that the lip portion 131 extends beneath reduced portion 133 of the saddle member. An adjustment bolt 134 passes through portion 133 of the saddle and threads into lip 131. The bolt works with a spring means 135 and adjustment nuts 136 for adjusting the contacting pressure of the upper feed roll with the lower feed roll. This assembly provides a variable and yielding pressure for applying the upper feed roll as desired in the feeding of paper.

It will be recognized that the aforementioned shaft 117 is rocked in response to rotational movement of the cam member 127 and that the upper feed roller 107 is therefore periodically pressed onto the driven lower feed roller to advance paper toward the bite of the printing couple. The immediate action of the saddle 132 causes an automatic compression of the spring means 135 so that the reaction of the bolt 134 compels lever arm 128 to move in a counterclockwise direction, as seen in Figure 4, thus pressing the paper onto the rotating lower roller 108 and assuring its positive contact therewith. It will be understood that using the upper feed roll in this manner in response to the cycle of the intermediate cylinder brings about operation of the intermediate feed system in timed relation to the rotational cycle of the printing couple.

Sensing finger system

As in other mechanical printing presses having automatic feeding means of the order hereinabove described, some system must be devised and provided for guarding against the failure of the feeding mechanism to deliver a sheet of paper to the bite of the printing couple as intended. When such a situation arises it is necessary that the printing couple be separated immediately until a sheet of paper is registered in proper position and in proper timed relation with the operational cycle of the printing couple. If this were not done the surface of the blanket or smaller cylinder would soon become heavily coated with ink and thus seriously impair effective production of acceptable printed copy.

In order to accomplish this function a sheet detector or sensing mechanism is provided which works in timed relation to the rotational operation of the printing couple and the feeder mechanism. This system initiates a cylinder throw-out mechanism which separates the cylinders upon the failure of the feeder mechanism to deliver a sheet of paper in the proper sequence of events. The features of the sensing finger system employed in the present machine may be best understood by an examination of Figures 5, 6 and 7 of the drawings, in particular. It will be recalled that the left hand end of the intermediate cylinder 50 (as viewed in the end view Figure 2) is fitted with the actuating cam 127 which is associated with the upper feed roll actuating linkage. Such cam is mounted, as mentioned, on shaft 56 for rotation with the intermediate large cylinder. The edge portions or camming

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surface of this cam works against the roller 126 and operates rocking lever or arm 118. A spring and rod means 137 are suitably associated with roller 126 and the arm 118 to normally bias the roller 126 into resilient engagement with the cam 127. Near the lower end of the arm 118 a pivot block 138 is provided to pivotally connect arm 118 and one end of a push-pull rod 139. The other end of the push-pull rod 139 is connected by pivot block means 140 to the lower end of a crank arm 141. The upper end of crank lever 141 is rigidly joined to a horizontal sensing finger shaft 142; such crank 141 being located outwardly of the left hand secondary side frame plate 120 when looking at the machine as in Figure 2. With particular regard to the intermediate side frame plates 120, the same are located, as mentioned; between the main side frame members or plates 57 and are held thereto by bracket portions 143 (see Figure 5).

A depending arm or lever 145 is fixed on shaft 142 between intermediate frame members 120, 120; the same lever extending downwardly where its lower end is distinguished by a bifurcated portion 146. Such lower bifurcated end of the lever 145 carries a pivot pin for pivotally supporting a sensing finger 147 just above feed table 103. It will be understood that while the upper end of the detector finger 147 is pivotally carried by the lever 145, the lower end thereof is free to ride back and forth across the feed table 103 atop sheets of paper as they advance to the upper and lower feed rolls 107 and 108.

In the absence of a sheet of paper on table 103; motion of the detector finger toward the bite of the printing couple in response to cam actuated activity of the rocker arm 118 and the attendant linkage, permits the same to enter an opening 148 formed through the table 103. Thereat the detector finger 147 engages a relieved portion in the upper end of an upwardly extending crank 149 (see Figures 6 and 7). Crank 149 is carried on shaft 150 which extends through the secondary side frame plates 120 and is supported in bearing collars 151 extending upwardly of the brackets 143 which support the frame plates 120. As a result of the interengagement between the detector finger 147 and the crank 149, the latter member is moved from its dotted line position to its full line position as shown in Figure 7 and responsively rocks shaft 150 therewith. Such motivation of shaft 150 serves to initiate a cylinder throw-out mechanism to be described, and more immediately to cause movement of a latching finger means 152 as best shown in Figure 8 of the drawings. Particularly, as the crank 149 is rocked in response to its engagement with the detector finger 147, the latching finger 152, which pivots on shaft 150, is likewise urged in a counterclockwise sense or downwardly, as shown in Figure 8.

Cylinder throw-out mechanism

From Figure 8 it will be understood that the outer end of the latch finger 152 is designed to engage and sit within a recess portion of a latching collar member 153 which is mounted near the outer end of an eccentrically disposed stub portion 154 of the blanket cylinder supporting axle or shaft 55. Suitable adjustment slot and bolt means 155 are provided for rotational adjustment of the latching collar 153 with respect to the stub axle 154. It will be understood that the counterclockwise movement of the latching collar (as seen in Figure 8) serves to shift the eccentrically disposed stub shaft 154 in a manner appropriate to drop the axis of the main axle 55 and thus the axis of the blanket cylinder which rotates on shaft 55. Normally, the latching finger 152 is positioned, as illustrated in Figure 8, so that it engages the notch-out of the latching collar 153 to prevent counterclockwise rotation of the latter member, except as desired.

Since the latching collar and latching finger are normally engaged the finger 152 is not free to move to a

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lowered position against stop 156 until contacting pressure thereof with collar 153 is removed. Therefore, a mechanism is needed to relieve and control engagement between the latching collar 153 and latching finger 152. The mechanism employed herein comprises an ear projection portion 157 formed on the latch collar 153 which is designed to cooperate and work against an adjustable stop bolt 158 carried on a stationary finger 159; such stop bolt serving to regulate clockwise throw of the latching collar 153. Ear 157 in turn is engaged by an adjustment bolt 160 located at the lower end portion of a bell crank lever 161 to urge collar 153 clockwise. Bell crank lever 161 is pivoted intermediate its ends on pin 162 and carries a cam following roller 163 at its upper end. Such roller works against the camming edge of a plate cam 164 supported at the end of shaft 56 (outwardly of cam plate 127 which actuates sensing finger 147 and the upper feed roller in the manner previously described). It will be seen in particular that cam 164 contains two nodes; a fixed node 165 and a diametrically opposed node cam 166 which is removable for reasons to appear presently. Each node engages roller 163 to rock the bell crank 161 counterclockwise about its pivot center 162. Such activity of the bell crank drives bolt 160 against ear 157 thereby bringing the latter member into engagement with the stop bolt 158. This in turn moves the latch collar clockwise to relieve its contacting engagement with latching finger 152. If the sensing finger member 147 is appropriately activated to engage lever 149, shaft 150 will be rotated counterclockwise as viewed in Figure 8 to tension a spring 167 mounted between two pins 168, 168 one of which is connected to shaft 150 and the other of which projects from the latch lever 152. Such tensioning action of spring 167 is in addition to tensioning of a secondary return spring 169 which is held stationary at one end and has its opposite end connected to shaft 150 for normally biasing the latch finger 152 clockwise as viewed in Figure 8 to return such to its full line position of that figure of the drawings. The general arrangement and functioning of this mechanism is substantially the same as the corresponding mechanism found in my prior Patent No. 2,387,750, issued October 30, 1945. Reference may be made to this patent for greater amplification if desired.

Tensioning of the spring 167 urges the latch finger 152 away from the latching collar 153 and in a direction opposite to the return movement imposed by tensioning spring 169. However, before finger 152 and collar 153 may be disengaged, their contacting pressure as caused by their abutting engagement must be relieved. The mechanism for relieving such abutting pressure is found in the cam 164 and the rocker arm 161.

Once either node 165 or 166 of cam 164 engages roller 163, latch 152 is free to drop and collar 153 is free to rotate in a reverse sense or counterclockwise to shift the rotational axis of the blanket cylinder thereby separating the printing couple. Specifically, the axis of the blanket cylinder is shifted to the axis of the eccentric stub shaft portion 154 which is carried within the latching collar 153. The shift of the axis to such eccentric stub portion acts to cooperate with a throwout coupling to be described in perfecting the separating action.

Return of the separated printing couple cylinders to their contacting or tangential relationship, occurs when either node 165 or 166 again engages the roller 163 to drive collar 153 clockwise by means of engagement between the adjustable bolt 160 and the ear portion 157 thereon. If the latch 152 is properly conditioned, or that is the tension of spring 167 has been relieved, the latch bar will be in a position to engage and lock with the latch collar 153 thereby maintaining the printing couple cylinders in their operating condition. Since the motivating force for driving the bell crank lever 161 is supplied through the power source which activates

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the printing couple of the press, engagement of bolt 160 with ear 157 of the latch collar serves to drive such latch collar clockwise and return the same to its Figure 8 position against the stop bolt 158. In this regard, movement of the latch collar 153 in a counterclockwise sense during its separating action is arrested by its engagement with bolt 160 at the end of arm 161 which in effect acts as a stop means to limit such counterclockwise rotation.

From the above it will be understood that while the separation of the cylinders is due largely to the force of gravity on the lower or blanket cylinder, the return of such cylinders to a printing or tangentially engaged position is brought about through the positive drive of the main power system for the press as accomplished through the activity of the bell crank lever 161 and the cam activating means 164 related thereto.

As mentioned previously cam 164 is equipped with two actuating nodes of which 165 is formed integrally with the cam plate and the other comprises a removable cam member. The specific details of this removable cam are shown in Figures 9, 10 and 11 of the drawings. In those instances of operation where a single pass of the sheets through the printing couple is required, as in two sided, two color offset work, cam node 166 is removed from its operational engagement with the roller 163. This function is gained by manipulating the mechanism illustrated in Figures 8, 9 and 10 comprising the node cam 166 mounted on two spaced guide shafts 172, 172 and a central mounting post 173. Cam 166 is provided with a collar 174 also, which contains a central opening to receive the mounting post 173. The post 173 is provided with two openings 175 which extend transversely therethrough.

To move the cam 166 from its operating position shown in Figure 11, it is first necessary to unthread a knurled operating nut 176 from the collar member 174 sufficiently to expose a locating pin 177 which passes through an opening in collar 174 and one of the locating holes 175 in the mounting post. When the operating nut achieves this position, the pin 177 may be withdrawn to free the collar. The cam 166 may then be backed off to its dotted line position as shown in Figure 10 whereat it is again locked in place by aligning the hole in the collar 174 with the second opening 175 in the mounting post 173. The pin 177 thus locks the cam node in its dotted line or inoperative position. Thereafter the knurled nut 176 is threaded tightly on the collar to enclose the pin 177 and prevent it from dropping out. To return the cam in its operative position, the above procedure is reversed.

Gripper bar sensing system

The preferred form of three cylinder press illustrated in Figure 1 includes a unique blanket encircling gripper mechanism. As will be explained presently, the feeding operation of this press and the arrangement of the blanket gripper system is such that paper is always fed to alternate grippers of the encircling gripper system for movement through the printing couple once or more than once as selected. In the event of multiple passage of the paper through the couple, it is necessary that some type of sensing finger system be provided to detect the absence of a sheet of paper in the grippers, which are erroneously empty due to previous malfunction of the feeder system, before such again enter the bite of the printing couple. That is to say, when the sensing finger 147 detects the absence of a sheet of paper on feed table 103, the cylinders are separated as I have outlined previously. As a consequence of thus missing the feeding operation, one gripper of the encircling gripper system which would normally have carried paper in the given printing cycle, will be empty. Due to the encircling gripper set-up, the printing couple will be returned to its normal printing condition prior to the

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time such empty gripper again approaches the printing couple for the second time, etc. In order to avoid engagement of the lower and intermediate cylinders at a time when the same would normally print upon paper carried by such empty gripper, a secondary sensing finger system as shown in Figures 8, 12, 13 and 14 is provided. As illustrated in Figure 8, the secondary sensing finger system about to be described is related to a "tandem" arrangement of printing couples in which the encircling gripper means coupled two presses together and commonly serves such for successive printing operations.

The secondary sensing finger system, termed herein a "grripper bar sensing system" as distinguished from the feeder sensing finger means 147, etc., is activated by rotation of shaft 150 which moves a lever 178 connected pivotally by link 179 to one end of a bell crank lever 180. Bell crank 180 is supported on a pivot 181 which is carried on the main frame of the press. With this arrangement the bell crank 180 pivots about its axle in response to rotational movement of shaft 150 which is brought about by the engagement of the sensing finger 147 with lever 149 at the feeding station as described previously. When shaft 150 is rotated, levers 178 and 180 assume their dotted line position shown in Figure 8. In this actuated position, the bell crank lever 180 intercepts the path of camming mechanisms 182 (of which there are three in the illustrated case) carried by one of the encircling gripper chains 70. Such camming mechanisms 182 are detailed in Figures 12, 13 and 14 and are provided for the purpose of relaying "missed sheet" signals for the following gripper to micro switches 183, 183' located strategically adjacent the gripper chains and designed to electrically actuate solenoid means 184 and 184' connected to the latching levers 152 and 152' of the "tandem" presses arrangement shown. Each solenoid 184 and 184' is arranged to depress or lower its respective latching finger 152 and 152' to permit cylinder throw-out or separating functioning of the printing couples, as an empty gripper bar approaches the respective bites thereof.

Each camming mechanism 182 as seen in Figure 12 includes a block 185, fastened to one of the chains 70 of the encircling gripper system, and two cam shoes 186 and 187. The two cam shoes are interconnected by a pair of spaced pin rods 188 which slide through the block 185 and support the cam shoes above and below the chain on opposite sides of the block member. The upper cam shoe 186 is constantly urged away from the block 185 by means of a compression coil spring 189 disposed between such shoe and the block member. The activity of the spring 189 thus keeps the lower shoe 187 in constant engagement with the block member 185 and elevates shoe 186 into a position for interfering engagement with the depressed bell crank lever 180 related to the first or right hand printing couple in Figure 8.

Each cam mechanism 182 also includes a pivotal latch member 190 which is biased by spring means 191 to advance toward a lip 192 formed on the shoe 186. Figure 13 shows a camming assembly 182 after the chain of the gripper system has advanced such to a position wherein it is engaged by the depressed bell crank lever 180. Such engagement forces shoe 186 toward the block 185 whereat it is held by the spring actuated latch means 190. Conversely, the shoe 187 has moved away from the block 185 and with such shoe 187 thus extended to its furthest location within the bounds of the chain, such will serve to trip the micro switches 183 and 183' to energize the solenoids 184 and 184' successively at the proper time and thereby cause separation of the cylinders of the two "tandem" coupled presses.

Since the camming mechanisms 182 are mechanically locked in their depressed condition by the activity of the bell crank lever 180 and latch 190 as described hereinabove, it is necessary to provide some means for relieving or disengaging the latch mechanism from the lip

of shoe 186 to thereby return such shoe to its normal operating condition. This mechanism is shown generally in Figure 8 of the drawings and more particularly in Figures 14 and 15.

The return mechanism includes a cam 193 carried adjacent cam plate 164 and rotatable with cylinder 50. This cam engages a pivoted lever 194 carrying a roller 195. Lever 194 serves to activate a transfer rod 196 having pivotal connection with a triangular shaped key plate 197 which is pivotally supported from the main frame on a pivot axle 198. A spring means 199 serves to bias the plate 197 in a clockwise direction, as seen in Figure 15, to raise such into engagement with stop means 200. When the key plate is against stop 200 it is disposed in interfering alignment with the passage of latch 190 so that as the latter passes the key plate it is disengaged from lip 192 and the outer cam shoe 186 is released for return to its normal operating position by spring 189.

Since there is but one cam node 193' on cam member 193 actuating the key plate and attending linkage, it is axiomatic that such key plate is depressed to its dotted line inoperative position as shown in Figure 15 only once for each 360° revolution of the intermediate cylinder 50, thereby unlocking or engaging every other cam mechanism 182 during each complete cycle or the first printing couple. Since the two presses shown in the tandem arrangement of Figure 8 are arranged for synchronous operation, control of the unlatching mechanism from cam member 193 serves to regulate both presses.

Considering the two described sensing finger systems in conjunction, it will be recognized that when a sheet of paper is absent on the feed table 103, separation of the cylinders will immediately take place as caused by the operation of the initial sensing finger 147 and the linkage described in association therewith. When a gripper of the blanket cylinder gripper system is empty improperly, the passage of such empty gripper through the secondary sensing finger system will again cause cylinder separation of both the first and second printing couples of Figure 8 in succession.

Throw-out coupling

In order to accomplish the aforescribed activity of the sensing finger systems and the attendant separation of the cylinders, a means is required for permitting separating movement of the printing couple cylinders while maintaining their proper timing and operational connection with the gear drive mechanism of the press. One such device capable of this function and conventionally used for this purpose in the art is known as an Oldham coupling, which is shown in Figures 16 and 17 in its relation to the blanket cylinder 53.

As will be understood, the throw-out mechanism or coupling device illustrated includes the blanket cylinder drive gear 63 which is carried on a tubular shaft 201 supported at its ends in the bearing assemblies 61 which house the eccentric stub portions 154 of shaft 55. Gear 63 remains rotatable with respect to shaft 201 and is provided with an enlarged or oversized hub portion 202 from which extend two projections 203, 203. Projections 203 are located diametrically opposite or 180° apart on the face of the hub portion 202 and interlock with what is commonly termed a floating member 204 formed with two key-ways 205, 205 in its one face for receiving the diametrically opposed key projections 203. The opposite face of the floating member 204 likewise is provided with diametrically opposed key-ways 206 (see Figure 17) which are related transversely with respect to key-ways 205. Keyways 206 are designed to engage additional projections or keys 207 which are associated with the end face of the lower cylinder 53. It will be understood that with this type of coupling displaced movement of the lower cylinder along the transverse axes defined by keys 203 and 207 is permitted

without disturbing the intermeshing relationship of the several drive gears of the cylinder drive train for the press. Since the features and operational characteristics of an Oldham coupling are generally well known and recognized in the art, further description thereof will not be dwelled on herein. Particular amplification of this feature may be found in my Patent No. 2,387,750 referred to hereinbefore.

General working member arrangement

From the various portions of my improved press which have been thus far described, it will be recognized that I have disclosed the mode of driving the various cylinders of the press, a means for delivering paper to the bite of the printing couple and means for guaranteeing positive separation of the printing couple in those instances where the feeding mechanism fails to supply paper to the encircling gripper means in proper timed relation with the printing cycle involved. As mentioned previously the intermediate cylinder 50 and the upper cylinder 84, in the particular three cylinder press illustrated in Figure 1 of the drawings, are each designed to carry two working members on separated work areas such as members 51 and 52 on cylinder 50 and 208 and 208a on cylinder 84. Each of such members (as shown) is arcuately shaped to comprise substantially one-half of the circumference of the particular cylinder to which it is attached and gaps or spaces are provided between adjacent ends of related members or work areas. Adjustable means (not shown) are employed for regulating the arcuate positioning of each work member and each thereof may comprise either a printing member, a platen, or a blanket transfer member as dictated by the particular use to which the press is to be put. It will further be noticed also that each of the larger cylinders carries two work members or separated work areas as mentioned and the blanket cylinder 53 bears a diameter of one-half the diameter of either of the larger cylinders. This relationship is provided so that during each 360° of the blanket cylinder's rotation one of the work members or work areas 51 or 52 will pass through the bite of the printing couple. It is feasible and certainly contemplated that in obvious variations of the multiple work area system shown for the larger cylinders, more than two such working areas or members may be supplied as, for example, three work areas, four work areas, etc. The diameter of the lower or blanket cylinder is usually regulated to a size sufficient to accommodate its complete revolution during the passage of one of the working areas through the bite of the printing couple. Specific examples of work areas and working member arrangement and variations in the printing operations capable of being accomplished with both the basic two cylinder and three cylinder machines of this invention will be laid out more fully in descriptive material which follows: For present purposes, however, the general features of the work area arrangement as described hereinabove will suffice.

Inking and dampening system

To accommodate the use of the various working members of the larger cylinders in a manner to be described, I have devised a new and improved inking and dampening system which presents, I believe, marked operational advantages in this art.

In general, the plan of the inking and dampening system employed in the preferred three cylinder press of Figure 1, for example, includes the three individual inking units 88, 95 and 96 and three associated dampening units 87, 91 and 92 as mentioned earlier. Inking unit 88 and dampening unit 87 are related with the intermediate cylinder 50 while the remaining two inking and dampening units are suitably related with the individual working areas on the upper or removable cylinder 94. Since the inking and dampening systems employed are

substantially identical, a description of units 87 and 88 will suffice for present purposes.

Generally, dampening unit 87 constitutes two water applicator rolls 209, 209a and a ductor roll 210 which receives water from a conventional fountain roll 211. Rollers 209 and 210 are powered by take-off gears 89, 89a as shown in Figure 3 while the applicator roller 209a and fountain ductor 211 are frictionally driven through engagement with the ductor roller 210. The usual lifting system of conventional design is employed with the dampening unit 87 for disengaging the same and such unit is disposed, as required, in advance of the inking unit 88.

Inking unit 88, as schematically diagrammed in Figures 1 and 18, comprises 13 rollers of which three applicator rollers 212, 212a and 212b have surface engagement with the periphery of the working members carried by the intermediate cylinder 50. Roller 212 is powered directly off of the drive gear 62 for the intermediate cylinder 50 by means of the take-off gear 90 as previously discussed. Gear 90 in turn meshes with one of ten adjacent gears forming a drive gear train indicated generally by numeral 213 in Figure 3 of the drawings. Rollers 212a and 212b are each driven by frictional engagement with a neighboring roller in the inking roller train and the entire system is carried as a unit between frame plates 214.

It will be noticed that the ink unit 95 contains one less roller than ink unit 88 due to the difference in rotational direction of cylinders 50 and 84 and that both units are supplied from a common ink fountain 215 by means of a common ductor roll 216 which is power driven off of cylinder 50 by means of a toothed drive belt 217, and wheels 218 and 219. In this respect, wheel 219 is attached and mounted for rotation with shaft 56 and sheave 218 is mounted for rotation with the ductor roll 216 and its supporting shaft 220. The ductor roll 216 normally engages the ink supply roller 221 which rides in the ink of the fountain 215 and a pair of transfer ductors comprising an upper transfer ductor 222 and a lower transfer ductor 223, respectively, connect the common ink fountain to the upper and lower ink units 95 and 88. A mechanism, as illustrated best in Figures 19 and 20, is arranged to selectively engage the transfer rollers 222 and 223 for conducting ink from the fountain to either or both of their respective ink units as will now be described.

It will be understood from Figure 20, especially, that the ductor roll 216, ink supply roll 221 and fountain 215 are supported between bracket plates 224 and a cam member 225 is supported on shaft 220 by means of an internally splined collar 226. The cam 225 therefore is arranged for sliding movement along shaft 220 as induced by a knob means 227 mounted at one end of shaft 220, and connected to a collar portion 226 of the cam member. The roller members 222 and 223 are rotatably carried on shafts 228 and 229, respectively, which are supported at one end by bell crank levers 230 and 231, respectively. The bell crank levers are commonly pivoted on a pin means 232 and each carries a cam following roller 233. Spring means 234 and 235 respectively bias the levers 230 and 231 in a direction suitable to engage the rollers 233 with the surface of the cam member 225 (see Figure 20). When the rollers 233 of either of the arms 230 or 231 engage the raised portion 236 of the cam 225, then the related lever 230 or 231 is biased outwardly to bring the transfer rollers 222 or 223 into engagement with associated inking units 88 or 95. Particularly, when arm 230 is biased outwardly, roller 222 thereon engages roller 237 of the inking unit 95 and when arm 231 is biased outwardly, roller 222 thereon transfers ink to roller 238 of inking unit 88. When the depressed portion of cam 225 engages either of the rollers 233 the related arm and transfer

roller 222 or 223, as the case may be, will engage the surface of the ink ductor 216 which is constantly supplied with ink by the fountain ductor roller 221. Therefore, during the periods when the rollers 222 or 223 are engaged with their associated rollers 237 and 238, ink is transferred to the rollers of the inking units as desired.

It will be recalled that cam member 225 may be slidingly shifted along shaft 220 in either direction by pushing or pulling on the operating knob member 227. The range of movement for this cam is designed for selective activation of two bell crank arms 230 or 231 as described, or to actuate both rollers 222 and 223 simultaneously if required. Therefore, either or both of the inking units 88 and 95 may be inked as selected from the common ink fountain 215.

While the above described ductor and ink supply system and the two typical inking units 88 and 95 have been described as having a specified number of rollers, it is obvious that a greater or lesser number of rollers may be utilized in each of the inking units according to conventional practice and the dictates of particular requirements. In any event, it is my primary purpose and intention that the ink and dampening system for the three cylinder press illustrated in Figure 1 include two individual inking and dampening units for the upper cylinder while the intermediate cylinder is supplied with a third inking and dampening unit; each of such inking units being selectively engaged as required. In this regard, the second inking unit 96 for cylinder 84 will preferably have its own ink fountain and be selectively supplied from said fountain according to conventional and known practice. In operation only two ink units will normally be employed at one time as in two color offset printing on one side of the paper sheets, inking units 95 and 96 will be employed, each with one of the work areas on the upper cylinder. These areas will constitute plates in this instance which will offset on blanket areas or members carried by the intermediate cylinder and which in turn will cooperate with a platen surface on the blanket cylinder.

The dampening and inking units 87 and 88 respectively, will be applied to a plate of the intermediate cylinder and one of the inking and dampening units 95—91 or 96—92 will cooperate with one plate area on cylinder 84 if two-sided offset work is desired. Other examples of uses and the operational arrangement for the inking system and working area relation are outlined more fully later hereinafter.

It should now be recognized that the several systems described thus far include all the basic mechanisms required to print copy in the press of Figure 1 with the exception of a gripper system for carrying paper through the printing couple and means for delivering printed copy from the press. Such items will now be dwelled on.

Blanket cylinder gripper system

The gripper system related with the blanket cylinder may best be understood by examining Figures 5 and 21-24 of the drawings. It will be recalled that by the operation of the upper and lower feed rolls, a sheet of paper is advanced to a position ready for engagement by the gripper means of the printing couple. In the present disclosure for the press shown in Figure 1, such gripper system comprises the pair of spaced encircling members or chains 70, 70 which carry three spaced gripper bars 71, 72 and 73. Such chains and gripper bars move about the circumference of the blanket cylinder on sprockets 76 to pass through the bite of the printing couple. As best shown in Figure 21, each of the gripper bars 71, 72 and 73 comprises a conventional mechanism including a plurality of spaced fingers 240 supported on a rocker shaft 241 which is carried by extending portions 242 associated with a fixed bar 243 against which the gripper fingers 240 work to engage a sheet of paper.

In Figures 22 and 23 I show a means for registering the

chain grippers comprising a V-shaped block 244 at the opposite ends of each gripper bar 243 for engaging pins 245 projecting from the inside faces of sprocket wheels 74 and 76. The cooperation of the pins 245 with the blocks 244 provides an effective means for registering the gripper bars in fixed positions at the circumference of the several sprocket wheels regardless of wear and stretching of the chains 70. Note also that the chains 70, 70 carry the three gripper bars at spaced intervals approximating the circumference of the intermediate cylinder in the particular machine shown in Figure 1.

In order to provide means for registering paper accurately in the grippers, the lower cylinder 53 carries a cam system as best shown in Figure 23. Specifically, shaft 55 which supports the lower cylinder is provided with a register finger cam member 246 of the order schematically illustrated. This cam has a continuous track portion 247 in which a follower roller 248 rides and which is carried at one end of a follower rod 249. Follower rod 249 is suitably guided in bearing means 250 for rectilinear motion and has a projecting finger portion 251 at its outer end. This finger portion is designed to pass through the gripper bars 240. Due to the formation of the cam track 247, movement of the roller 248 therealong causes periodic movement of the finger 251 radially inwardly and outwardly of the blanket cylinder's circumference. Thus when a sheet of paper, for example sheet 252 illustrated in Figure 23, is fed to the grippers, the same is abuttingly engaged and registered against the projection finger 251. In this manner accurate registration of copy in the grippers is gained.

As shown best in Figure 5 of the drawings the gripper shaft 241 is equipped with a roller arm 253 at its one end which supports a roller 254. Roller 254 is designed to engage and roll along the peripheral contour of a gripper actuating cam 255 for periodically opening the grippers carried by the chain members 70, 70. Such cam also causes the closing of the gripper bars after such have received a sheet of paper from the feeding mechanism.

Due to the fact that the printing press in both the basic two cylinder and three cylinder forms is intended, in certain instances, to operate in a manner providing multiple printing operations on one side of a sheet, as for example, in two color printing on one side of the paper, it is necessary in such circumstance that the paper pass through the bite of the printing couple more than once. Understanding this requirement, it is obvious that the means for opening the grippers, such as cam 255, must be selectively operable to accommodate the opening of alternate grippers to permit this multiple passage of the paper through the bite. If this were not so, paper having received its first impression during initial passage through the printing couple would be automatically released by engagement of the roller 254 with release cam 255 as it approached the printing couple for its second pass. Specifically, in the press embodying two working segments on the intermediate cylinder, it is essential that every other gripper be opened to accept paper from the feeding mechanism so that the feeding operation will, in effect, take place for each 360° revolution of the larger or intermediate cylinder of the printing couple or each 720° revolution of the smaller blanket cylinder.

The mechanism for accommodating such selective operation of cam 255 is best seen in Figures 5 and 24 of the drawings. One basic requirement of such a mechanism is that it operate in timed sequence to the printing couple. Basically, therefore, it should operate in response to rotation of the intermediate cylinder to insure the proper sequential operation of the lower or blanket cylinder grippers.

As illustrated in Figure 24, I employ a plate cam member 256 which is mounted on shaft 56. A rocker arm 257, carrying a cam following roller 258, pivots about one end beneath cam 256 and is held or biased toward such cam by means of a spring 259. The movable end

of the rocker arm 257 is pivotally joined to a substantially vertical link 260 which cranks a wedge block 261 located at its lower end. A roller arm 262 and roller 263 are adapted to work against an inclined face 264 of the wedge block to slide a shaft or rod 265 which supports the arm 262. Shaft 265 is supported in a suitable bearing collar 266 and also extends through a collar portion 267 comprising an integral portion of the wedge block 261. A bracket 268 is connected to shaft 265 on the opposite side of the side frame plate 57 from the wedge block 261 and a rod 269 supports such bracket from plate 57. Movement of shaft 265 serves to move the bracket 268 and an attached bracket plate 270 which carries the gripper actuating cam 255.

Thus, as the rocker arm 257 is periodically lowered in response to the activity of cam 256, the wedge block 261 is alternately raised and lowered with a pivotal motion to alternately slide shaft 265 inwardly and outwardly of the bearing sleeve 266. This motion of shaft 265 produces responsive lateral displacement of the attached cam 255 placing the same in interfering and non-interfering positions with respect to the roller 254 associated with the gripper operating shafts 241; one of which is related to each of the gripper bar assemblies. The design of the cam 256 is such that it serves to displace the gripper actuating cam 255 in proper timed sequence to the feeding operation of the feeder mechanism. That is to say, in the three cylinder press embodying two working members on each of the larger cylinders, the shift of cam 255 is timed so that the grippers are opened to receive paper from the feeding mechanism at substantially each 360° revolution of the larger, intermediate cylinder of the printing couple, i.e., to alternate grippers on chains 70, 70.

Blanket gripper discharge

Additional means must be provided for discharging the paper from the encircling blanket cylinder gripper system, again in timed sequence to the rotational operation of the printing couple and again for each 360° of revolution of the larger cylinder 50. However, it must be remembered that in the operational instance of the three cylinder press illustrated in Figure 1, wherein two color printing on one side of the paper is accomplished, a double passage of the paper through the printing couple must take place. Conversely, with one color printing on two sides of the paper only a single passage thereof through the bite is required. As a consequence, the means for discharging the paper from the gripper system must necessarily remove the sheets appropriately to accommodate both the single and double passage through the printing couple.

To establish a better and more thorough understanding of such a discharge means, reference is now made to Figures 25, 26, 27 and 28 of the drawings wherein the mechanism for operating the chain carried gripper system is set forth. As shown best in Figure 25, the intermediate cylinder's shaft 56 is arranged to carry a shifting cam member 275 having a single depression or node 276 in its periphery. A roller arm 277 carrying a cam following roller 278 is pivotally supported intermediate its ends on shaft 279 and connected at its lower end to push rod 280 as by pivot means 281. The push rod 280 is disposed substantially parallel and adjacent the upper flight of the chain 70 and extends along one side frame plate 57 for pivotal connection with a quadrant member 282 which is pivotally supported on pin means 283 and carries an inclined wedge cam portion 284 extending from one face thereof.

A roller member 285 carried on arm member 286 is designed to roll along the inclined cam surface 284, as best shown in Figure 26 of the drawings. This roller carrying arm member 286 is guided as by pin means 287 and is supported on a shaft means 288 which extends through the outside frame plate 57 and is surrounded

by a compression coil spring 289 located intermediate the side frame 57 and a cam supporting shifting plate 290 (see Figure 27). Shaft 288 is slidably supported for movement through the side frame plate 57 by bearing means 291. Plate 290 is fixed to the end of shaft 288 and is held against rotation as by a rod means 292 which passes through plate 290 and is fixed to frame plate 57. Plate 290 slides on rod 292 for movement parallel and relative to frame plate 57. Such plate also carries two gripper actuating cams 293 and 294 of which cam 293 is arranged and positioned appropriately to open and close the gripper bars associated with the blanket gripper system. Cam 294 serves to activate cooperating gripper bars 295 which are in all respects similar to the blanket cylinder grippers and which are associated with the delivery system 81 as will be described in further detail presently (see Figure 28).

As will be noted from Figures 26 and 28, rocking motion of the quadrant member 282 in response to activity of the push rod 280 causes an in and out motion of shaft 288. Such motion of shaft 288 serves to displace the cam carrying plate 280 and cams 293 and 294 thereon toward and away from frame plate 57, alternately positioning the cams in interfering and non-interfering positions with the path of the roller members 254 which operate the blanket cylinder gripper means 71, 72 and 73. When, as shown in Figure 28, cam 293 is positioned appropriately to engage the gripper rollers 254, the blanket grippers concerned are gradually opened to release the paper. As the paper is released from each gripper (71, 72 or 73) it is simultaneously received by a gripper 295 of the delivery system 81, as will be explained more fully later herein in discussing the delivery system.

While as stated hereinabove, it is necessary that the paper be discharged from the blanket grippers for each 360° revolution of the larger cylinder 50 of the printing couple, certain printing operations with this type of press require that the discharge point take place in a different position of the printing couple's cycle from that illustrated in Figure 25. That is to say, in certain instances of operation it is necessary that the discharge of the paper from the blanket grippers take place approximately 180° out of phase from the normal discharge position of cam 275 as illustrated in Figure 25. In such event, provision is made for rotating the push rod activating cam 275, 180° from its Figure 25 position to change the cycle point of discharge for the blanket gripper system. Requirements for this adjustment or regulation will be understood better from operational descriptions which are found later hereinafter.

Delivery system

The delivery system 81 as shown briefly in Figure 1 of the drawings comprises a pair of continuous delivery chains 297 which are spaced laterally and trained over pairs of cooperating sprocket wheels 298, 299 carried on spaced horizontal shafts 300, 301 respectively. The two spaced chains 297 are designed to carry the gripper bars 295; there being three such delivery gripper bars in the particular embodiment illustrated in Figure 1 of the drawings. Suitable drive means such as gears 302 and 303 (see Figure 1) serve to motivate the delivery chain system synchronously with the printing couple and the blanket gripper system. As described briefly hereinabove, the cam means 294 carried by the shifting plate member 290 is designed to periodically open the discharge grippers 295 by contacting a roller 304 carried by a roller arm 305 associated with each of the delivery gripper means.

The relation of transfer between the blanket grippers and the delivery grippers may best be understood by studying enlarged Figure 28 of the drawings from which it will be appreciated that the position of cam 294 is such as to open the delivery chain grippers in advance

of the opening of the blanket chain grippers followed by closing of the delivery chain grippers over the sheet of paper in the blanket grippers and before release of the latter from grippers 71, 72, 73 etc. so that the paper is always engaged. In this manner the successful transfer of imprinted sheets from the encircling gripper to the delivery system 81 is accomplished.

A suitable cam means 306, similar to cam 294 is provided to open the delivery system so that the papers may be discharged from the delivery system and deposited on top of stacking table 82 illustrated in Figure 1.

Modified feeder

From the foregoing it will be recognized that I have set forth the fundamental elements and mechanisms required for the successful operation of my basic two cylinder and three cylinder presses. Obviously, certain of the mechanisms I have described may be replaced with less conventional devices, but such modifications in the individual mechanisms will not detract and depart from the spirit and scope of the basic invention hereof.

In the field of such modifications, I fully contemplate that a mechanism of the order illustrated in Figures 29 and 30 may be utilized with either my basic two cylinder or three cylinder presses. Such modified means is for the purpose of feeding paper to the printing couple and assuring its accurate and positive registration in the chain driven gripper system which encircles the lower cylinder as described. Particularly, the mechanism of Figures 29 and 30 which I am about to describe is intended to eliminate the need for the registry system illustrated in Figure 23 and to replace the more conventional upper and lower feed roller system illustrated in Figure 5. It is further thought that the incorporation of this mechanism in the two and three cylinder presses will be obvious to those familiar with the art and so the exact mechanical changes and modifications required to incorporate the device of Figures 29 and 30 in the press of Figure 1, for instance, will not be described in particular detail herein.

Turning now to the features of the modified feeder and registry system shown in Figure 29, it will be understood that the device generally concerns a suction feeder system. This alternative means of introducing paper stock to the grippers of the printing couple includes a pair of plate cam members 310 and 311 which are secured to the middle or intermediate cylinder shaft 56 outside of the right-hand frame plate 57. A pair of levers 312 and 313 are independently mounted on a common fulcrum or pivot shaft 314 and said levers each carry a cam following roller 312a and 313a, respectively, for engagement with one of the cams 310 or 311. Lever 312 is fastened to a bell crank lever 315 by means of a connector rod 316. The particular arm of bell crank 315 to which connector rod 316 joins is located outside of the frame plate 57 and a double arm of the bell crank comprising portions 317 and 317a is located inside of frame 57. A stub shaft 318 serves to pivot the arms of the bell crank lever 315, such shaft passing through the frame plate 57. A connecting rod 319 associates the outer end of the bell crank arm portion 317 with an on and off suction valve, indicated generally by numeral 320. The connection of the bell crank lever 315 with the suction valve 320 is such that actuation of the bell crank lever serves to control the opening and closing of the suction valve 320 in response to the actuation of the cam member 310.

Cam member 311 acts on the cam following lever 313 to operate a second bell crank 321 which is joined to the lower end of arm 313 by means of connector rod 322. Crank 321 is pivoted from frame plate 57 and is further associated, by suitable linkage means 323, with a bracket means 324 fixed to a movable feed table 325. The feed table is accommodated for sliding movement along a pair of tracks 326 formed in the frame plate 57 (see Figure 30). It is to be understood, of course, that

two such tracks 326 are employed, there being only one shown in the foreshortened view of Figure 30. By this expedient the feed table 325 is guided for sliding rectilinear passage along the tracks and reciprocated in response to activity of bell crank 321, rod 322 and link 323.

The suction system controlled by valve means 320 is connected to the lower side of table 325 by means of a flexible hose member 327. The suction carried in hose 327 is ducted to the upper surface of the feed table by means of plural relieved ports or openings 328 as shown in dotted lines in Figures 29 and 30. In order to insure a proper suction on a sheet of paper laying on the top of table 325, flexible restraining leaves 329, 329 are provided directly over the suction ducts on the feed table. These restraining leaves are fixed to a rotatable shaft 330 journaled at its ends in supporting bearing brackets 331 which are fixed transversely to the movable feed table 325. Rotation of shaft 330 is initiated by a control lever 332 acted on by the arm portion 317a of the composite bell crank lever 315. The action of the bell crank lever 315 on the control lever 332 serves to raise or lower the restraining leaves 329 depending on the direction of movement imparted to bell crank 315 by cam 310 and so forth. Raising and lowering of the restraining leaves, of course, respectively releases and engages the paper on the feed table 325.

Stop fingers 333 are located in advance of the feed table when the latter is in its dotted or normal position, as shown in Figure 30. Such stop fingers 333 are mounted on shaft 334 which extends across the width of the machine and is journaled in the side frame plates 57. The stop fingers extend outwardly from shaft 334 and are of sufficient length to insure registration of incoming sheets. A cam follower 335, located near one end of shaft 334, permits the stops to be rotated out of the path of the feed table as the latter is moved toward the bite of the printing couple due to the presence of an inclined camming member 336 which engages the follower 335 (see Figure 30). Due to the advance positioning of the stop fingers forwardly of the table 325 paper registered on top of said table and gripped by the vacuum system illustrated has a leading edge portion in advance of the leading edge of table 325. Thus, when a sheet is registered against the stop fingers 333, it will overhang the feed table and provide a suitable gripping surface for engagement by the chain carried grippers 71, 72 and 73 as described hereinbefore.

In regard to the operation of this device, it will be understood that a sheet is first registered against the stop fingers, the suction is turned on by activation of valve 320 in response to motivation of cam 310 and the restraining leaves 329, 329 are activated to exert a clamping action on the paper located atop the feed table. The feed table is then advanced toward the bite of the printing couple which movement automatically lifts the stop fingers from the paper and introduces the forward or extended leading edge portion of the sheet to the grippers of the blanket cylinder gripper system. The suction through ports 328 is simultaneously cut off at this stage to permit the grippers 71, 72 and 73 to seize the paper.

It is felt that this modified feeder and registry system may be more qualified and desirable in certain instances of operation and that such mechanism advances a new and improved means for automatically feeding and registering paper which is particularly helpful when using the chain carried gripper system of my press.

Use and operation

Having thus described the portions and mechanisms which make up the basic two cylinder and three cylinder press embodiments of my invention, various ramifications, basic modifications and aspects of operation which such machines may take will now be described. To recognize these possibilities and variations in the construction and arrangement of my press, reference should be made at

this time to Figures 31, 32 and 33 wherein the more prominent and practical variations of which I speak are outlined schematically with explanatory operational data.

Before entering into a discussion of the individual operational diagrams found in Figures 31-33, it is best first to consider the basic modification schemes of the Figure 1 press as found in such figures. Essentially, possibly the most obvious modification of the Figure 1 press resides in eliminating one of the larger cylinders, as illustrated diagrammatically in Figure 31, Example *a*. The modification produces the basic two cylinder press of this invention, discussed hereinbefore. It will be recognized that the printing couple of this press comprises the smaller cylinder in tangential engagement with an overlying larger cylinder corresponding, respectively, to cylinders 53 and 51 of the press shown in Figure 1. In the employment of the basic two cylinder printing couple, plural work members or separate work areas are carried on the larger diametered cylinder, as for example the two members represented by the vertical dividing line in Figure 31(a). It will be remembered, of course, that these members are suitably separated by gaps to provide time and leeway in the printing cycle for feeding operations, etc. The smaller cylinder gripper system of such two cylinder modification may be used in conjunction with a delivery system of the order shown at 81 in Figure 1 or without such delivery system as preferred. If the encircling chain gripper system related to the blanket cylinder is used without the delivery system 81, then the chain gripper system, in and of itself, also constitutes a delivery means for depositing paper directly at a delivery station, such as table 82 of Figure 1.

Since two working members or separated work areas are used with the basic machine of Figure 31(a), three grippers, *x*, *y* and *z*, are employed in the chain gripper system; it being remembered that the number of grippers on the blanket gripper system normally differs from the number of work areas carried by the larger cylinder by one. Therefore, if there are an even number of work areas, there are an odd number of grippers and vice versa. An additional inking unit (not shown) may be provided for the larger cylinder according to the concepts illustrated for the upper cylinder 84 of the Figure 1 press so that each of the segments or work areas thereon may be individually inked in certain operational instances.

Such a basic two cylinder press is designed particularly to accomplish one side offset printing by substituting a platen for one plate in the work areas or two color letterpress printing on one side of the paper by using two printing plates in separated work areas, as will be explained more fully hereinafter.

The second basic scheme for modification of the Figure 1 press is typified by Figures 32(g) and (h) and the corresponding adaptation of the basic two cylinder press is typified in Figures 31(c) and (d). This modification comprises the coupling of two printing couples in succession so that the discharge from the first couple is fed to the succeeding couple, etc. I refer to this as a "tandem" arrangement. The concept of employing more than one of the basic two cylinder or three cylinder presses in tandem arrangement requires the simultaneous motivation of their printing couples and the coupling of such machines with a common encircling gripper means.

Generally, such a tandem machine comprises two blanket cylinders which are commonly driven from a single power source as by a link chain belt means, or the like (not shown), or by means of an intermediate idler cylinder between the upper plate cylinders of the presses so that simultaneous driving of the two couples may be accomplished. A dual sensing finger system of the character set forth in Figure 8 which utilizes a second solenoid 184' and microswitch 183' for the second printing couple or a similar means capable of separating each printing couple in proper sequence to accommodate the misfeeding of the paper at the first couple during both

single and multiple passage of the paper through the successive couples is also required.

The tandem coupling of the basic two cylinder or three cylinder printing couple results in a printing press capable of performing multi-color offset work on either or both sides of the paper thereby providing wide diversification and operational versatility to my press. In certain instances, extra gripper means may be provided on the encircling gripper means to give sufficient clearance between machines in tandem. For example, in place of the three gripper bars *x*, *y* and *z* of the Figure 31(c) machine, five gripper bars may be employed as well to give the desired clearance; the operational sequence being maintained according to the rule of an even number of grippers for an odd number of work areas on the larger cylinder and vice versa.

Another general modification scheme of either the basic two cylinder or three cylinder presses of Figure 1 or the tandem modifications thereof resides in utilizing more than two working areas on the larger cylinders. This scheme is typified in Figures 32(i) and (k), for example, wherein a three segment arrangement is illustrated. Obviously, within practical limits of diameter for the larger cylinders, the number of segments or work areas mounted on larger cylinders may be increased upwardly from the two area systems shown in Figure 1 to diversify the overall operation of the printing press.

In Figure 33(o) the tandem couple of the basic two cylinder and the basic three cylinder press is set forth. This modification scheme is capable of performing two color offset printing on one side of a paper sheet and two letterpress operations on the same side of the sheet of paper.

Still another basic means of modifying the machines discussed so far comprises the selection and arrangement of printing members and impression members on the separated work areas of the larger cylinders to achieve various printing results. For example, in Figure 33(p) the upper large cylinder carries four printing members while the intermediate cylinder carries four transfer members to produce a machine capable of printing four color offset on one side of the sheet. The same machine, however, as shown in Figure 33(q) may be varied to two color offset on each side of the sheet of paper by eliminating two of the printing members on the upper cylinder and providing the intermediate cylinder with two transfer members and two printing plate members. It will thus be recognized that rearrangement of the working members on the larger cylinders and the interchanging of such members with transfer members, greatly diversifies and varies the operational results of my new press to a much larger degree than one might normally expect.

In light of the above general explanation and remarks regarding the basic modifications of the two and three cylinder presses a short description of the individual examples found in Figures 31, 32 and 33 will now be undertaken; it being felt that the operational diversification and versatility of my invention will best be understood and explained by a study of these examples.

The diagrams of Figures 31-33 set forth the sequential operation of the dampening and inking roller systems, variations in working members or area arrangements, gripper operation, feeding and discharge operation and sheet imprinting for what I consider to be the most practical modified uses of my invention. For a better understanding of these charted examples, reference should be made especially to the key provided at Figure 31.

With reference to Figure 31:

In Example *a* I have set forth an operational diagram for the basic two cylinder press in which the larger cylinder bears a printing plate *A* and an impression member, labeled (*Imp*). A single water and ink system is used, as shown, to supply plate *A*. The smaller cylinder is one-half the diameter of the larger cylinder and

an encircling gripper system embodying three chain carried grippers *x*, *y* and *z* is utilized. The sheet flow for one side offset operation with this press is set forth in the table below the figure.

As an example, the first line of the table bears the following legend:

→ 1—*x*—*Imp*/*A*→

The first arrow → indicates the feeding of the first sheet (as indicated by the numeral (1) following the arrow). Note that feeding is to every other gripper *x*, *y* and *z*. Sheet 1 is engaged by gripper (*x*) and passes through the couple between the impression member (*Imp*) and the blanket cylinder bearing the impression offset from plate member *A*.

As Sheet 1 passes through the bite of the printing couple it receives offset copy on its bottom side, as indicated by (/A). Note that each sheet passes through the printing couple only once and is then discharged as indicated by the discharge arrow (→) following the printing symbol (/A).

In Example *b* I have illustrated the same basic two cylinder press with two plate member on the larger cylinder; the press being set up for two color letterpress operation. Note that two individual inking units are involved, one for each letterpress plate *A* and *B* or one ink fountain can be employed when both letterpress operations are the same color. In this instance the paper passes through the couple twice as indicated by the occurrence of the arrows following the symbol for the impressions received from the primary printing units *A* and *B*, etc.

In Example *c* I have illustrated the two cylinder press of Example *b* set up in "tandem" with another like machine for accomplishing four color letterpress printing on one side of the sheets. Note that each machine in the tandem coupling is provided with two ink systems for the letterpress plates *A*, *C*, *D*, *B*. The flow of sheets through the two printing couples thus provided is set forth in the table below the figure. The paper passes alternately through the two printing couples until it has been through both couples twice after which it is discharged from the encircling gripper system.

In Example *d* I show the tandem two cylinder press of Example *c* rearranged for two color offset printing on one side of the paper, i.e., the bottom side. In this particular arrangement each of the larger cylinders is provided with an impression or platen work member as well as a printing member *A* and *B*, respectively. Each printing couple also utilizes a single ink and dampening unit as indicated. Note that each sheet of paper passes through the first and second printing couples only once and is then directly discharged.

In Example *e* I have illustrated the basic three cylinder press of Figure 1 in which the intermediate larger cylinder is provided with transfer members *A'*, *B'* for receiving offset impression from the plate members *A* and *B* carried on the upper large cylinder. The paper flow is as set forth in the box diagram below the figure. Note especially that each sheet passes through the printing couple twice in this arrangement; the smaller blanket cylinder being one-half the diameter of the larger cylinders and the gripper system using three grippers *x*, *y* and *z*. This press is equipped with two separate inking and dampening units, each associated with the plate members on the upper large cylinder and such are periodically operable so that the plates *A* and *B* are individually inked.

Example *f* shows the basic three cylinder press of Figures 1 and 31(e) arranged for two side offset printing; the intermediate cylinder carrying blanket member *A'* and a printing plate *B*. The upper cylinder carries only a single printing plate *A* which offsets on impression member *A'* of the intermediate cylinder. In this arrangement an individual ink and dampening system is

provided for plate A and a like individual inking and dampening system is provided for plate B of the intermediate cylinder. If desired, the ink rollers for plates A and B may be supplied from a common fountain if the same color is to offset on each side of the printed copy. While the diagram actually illustrates three ink and dampening roller units it will be understood that only two of the same are employed at any one time. In this example each sheet passes through the bite of the printing couple only once before it is discharged.

With reference to Figure 32:

In Example *g* I have outlined the features of tandem coupling two basic three cylinder presses embodying two presses of the character found in Example *e*. Each printing couple comprises one smaller blanket cylinder, two offset members on the intermediate cylinder as indicated (A', C' and D', B') plus two printing plate members (A, C and D, B) on the upper cylinders. Note that two individual inking and dampening units are provided for inking the separate plates on the upper cylinder of each printing couple. In this machine the paper passes through each printing couple twice to receive impressions from members A', B' and C', D' in that order, before it is discharged from the machine. The particular operational set up as illustrated accomplishes four color offset printing on one side of the sheets.

In Example *h* the tandem coupled presses of the character seen in Example *f* have been rearranged to produce four color offset printing (two colors on each side of the paper sheet). Each intermediate cylinder carries an offset transfer member (A' or B') and a printing plate C or D. Each of the upper cylinders involved carries a single printing member (A or B). Individual inking and dampening roller units are provided for each of the two printing plates involved in each of the printing couples, one set associated with the upper cylinder and one with the intermediate cylinder of each couple; there being four individual inking and dampening units in all. In this machine paper passes through the bite of each printing couple only once and is discharged with two offset colors or operations on each side as it receives impressions A' on top and C' on the bottom from the first couple followed by B' on top and D' on the bottom from the second couple.

Example *i* demonstrates the operational diagram for a two cylinder, three working area press in which one of the working members carried by the larger cylinder comprises an impression member (Imp) while the other areas support two plates A and B which offset in succession onto the smaller blanket cylinder. Individual inking and dampening units are provided for each of the two printing members A, B, with the paper passing through the bite of the printing couple only once to accomplish either one or two color offset printing on the bottom side of the paper sheet; the colors being separated. Note that the smaller cylinder of this press is $\frac{1}{2}$ the diameter of the larger cylinder and that two or an even number of grippers are used in the encircling gripper means.

Example *j* shows the features of the two cylinder press of Example *i* having three work areas on its larger cylinder arranged for three color letterpress operation. Note that in this situation three individual inking units are provided, one to supply ink for each of the printing plate members A, B and C carried by the larger cylinder. In certain cases only one or two ink units might be employed if all three operations from the work areas are of one color, as in printing a basic form plus a dealer imprint and a number etc. To accomplish three color letterpress operation, each sheet of paper must pass through the printing couple three times before it is discharged; the blanket cylinder being $\frac{1}{2}$ the diameter of the larger cylinder and the gripper system having only two grippers *x* and *y*, or any even number thereof.

Example *k* shows a three cylinder press employing three work areas on each large cylinder and capable of

accomplishing three color offset printing on one side of the paper. In this machine the intermediate cylinder carries three transfer or offset members A', B' and C' while the upper cylinder carries three corresponding printing plates A, B and C. That is to say, the copy on the upper plate carrying cylinder is offset to the transfer members carried by the intermediate cylinder from whence the impressions are transferred to the top side of the paper passing through the bite of the printing couple. In this press each sheet must pass through the bite of the printing couple three times to receive the three colors or operations involved.

In Example *l* I have diagrammed the three cylinder, press of Example *k* set up for two color offset on one side and one color offset on the opposite side of each sheet of paper. Note particularly that the intermediate cylinder carries two transfer members A', B' and one printing plate C, while the upper cylinder carries only two printing plates or members A, B which are designed to offset their copy to the transfer members A', B'. The smaller cylinder carries a transfer member C' which receives its impression from plate member C. In this operation each sheet passes through the printing couple only twice, the paper receiving impression from A' on its upper face during its first passage through the bite and impression B' on its upper face when passing through the bite the second time. Impression C' is transferred to the lower face of the sheet during each passage thereof through the bite.

With reference to Figure 33:

In Example *m* I show the operational features of a two cylinder press in which four work areas are provided on the larger cylinder. Note that three quadrants of the larger cylinder carry offset printing members A, B and C and that the fourth quadrant carries an impression member (Imp). The smaller cylinder in this press is only one-quarter the diameter of the larger cylinder and three inking and dampening units are provided, each individual to one of the printing members carried by the larger cylinder. With this arrangement, one, two or three color offset printing on the bottom side of the sheet may be accomplished as desired; the colors being separated in the printed copy. Note also that the paper passes through the bite of the printing couple only once before it is discharged, the printing of the offset copy from the three plates A, B and C taking place simultaneously as the sheet passes beneath the impression quadrant (Imp).

Example *n* illustrates the two cylinder press of Example *m* arranged for four letterpress operations. In this particular embodiment the larger cylinder carries four individual letterpress printing plates A, B, C, and D, each of which is supplied from its own individual inking unit. If desired, only one ink unit need be employed for each color used in the four printing operations accomplished with this press. Again the lower cylinder has a diameter one-quarter that of the larger cylinder. Note that in this press each sheet passes through the bite of the printing couple four times, or once for each operation, before it is ready for discharge from the press; receiving one impression during each pass.

In Example *o* I have shown an obvious, but novel arrangement of a basic three cylinder, two working area press coupled in tandem with the basic two cylinder, two working area press; the three cylinder press carrying two printing plates A, B on its upper cylinder and two transfer members A', B' on its intermediate cylinder. The two cylinder press of this tandem press carries two letterpress members LP₁ and LP₂ on its larger cylinder, each of which may be provided with its own individual inking unit. Individual inking and dampening units are associated with plates A and B of the first printing couple. With this arrangement it is possible to accomplish two color offset printing on one side of each sheet plus two letterpress operations on the same side thereof. Each

sheet of paper passes through the bite of each of the two printing couples involved twice. Note in particular that as a sheet passes through the first printing couple for the first time it receives one offset impression A' therefrom followed by one letterpress operation LP₁ as it passes through the bite of the second printing couple. The subsequent or second passage of the paper through the first printing couple serves to transfer the second offset impression B' thereto while the second passage through the two cylinder printing couple provides the second letterpress operation thereon. Therefore, when the paper is finally discharged from the machine it bears two color or separate offset operations on one face thereof plus two letterpress operations on the same face.

Example *p* sets forth the features of the basic three cylinder press arranged for four color offset work on one side of the paper sheet. In this modification the upper cylinder carries four plate members A, B, C, D, each of which may be provided with its own inking and dampening unit as diagrammed. The intermediate cylinder in this press carries four corresponding transfer members A', B', C' and D' which receive their impression from the plate members of the upper cylinder for transfer to the upper face of the paper sheets. Note in particular that the smaller cylinder bears a diameter equal to one-half the diameter of the larger cylinders so that each sheet must pass through the bite of the printing couple twice to receive the four offset impressions. This diameter relation is a departure from the general rule laid out hereinbefore for reasons of practicality.

In Example *q* I show the press of Example *p* arranged to accomplish four color offset printing, two colors on each side of a sheet of paper. Note in particular that the intermediate cylinder of this machine carries two plate members and two transfer members C, D—B', B', respectively. The upper cylinder carries two blank work areas and two printing members A, B. Each of the larger cylinders is provided with two inking and dampening units, each individual to one of the plate members. Note that the smaller cylinder of this press bears a diameter equal to one-half the diameter of the larger cylinders, as in Example 33*p*, and that the same is divided to carry two transfer members C', D' which receive their offset impression from plates C, D carried by the intermediate cylinder. Each sheet passes through the bite twice receiving impressions A' on top and D' on the bottom during the first pass and B' on top and C' on the bottom face during the second pass. Note that the second set of chain sprockets in the gripper system are one-half the diameter of the smaller cylinder to give clearance when three gripper bars *x*, *y*, *z* are used as shown.

It should be borne in mind that in all of the above examples, reference to color operations in a broader sense refers to printing operations, and not necessarily limited to the utilization of different color inks. Further, while the modified usage and forms illustrated are believed to represent the more practical modifications and variations of my invention, such are by no means all embracing and exhaustive of the varied combinations possible in following its teachings. Thus, it will be appreciated that even greater versatility than has been pointed out hereinabove may be brought forth by employing separate printing operations even though the same color ink be involved for each of the color operations indicated.

First modified press

The foregoing description of the basic two and three cylinder machines and their basic modifications and variations as shown in Figures 1-33 of the drawings set forth generally what I believe to be the preferred means of embodying the concepts of my invention. It will be appreciated, however, that such foregoing description concerns presses embodying a cylinder gripper system in which plural grippers are carried on means which encircle the blanket cylinder so that the grippers are car-

ried through the bite of the printing couple. Basically that system is sound in most applications, but experience has shown that a more economical and simplified machine is possible by resorting to a basic variation in the printing couple gripper means as described hereinbefore. By such variation a press especially suited for two color and perfection work is gained.

General arrangement

While it will be recalled from Figure 23 that I have shown the general features of an improved means for registering paper accurately in the chain carried gripper bar system, such a registering system is subject to wear and possible inaccuracy so that it is thought to be advantageous to avoid the need for such registration if possible. To that end and to avoid some of the difficulties and satisfy the requirements mentioned hereinabove, I revised the basic two and three cylinder machines of Figures 1-33 to present a second form of machine which is illustrated generally in Figures 34-47 of the drawings.

General features

The major difference between the machine of Figure 34 and the press of Figure 1, for example, resides in a modified gripper system and related mechanisms for carrying paper through the printing couple, as will appear from descriptive materials which follow.

The modified three cylinder press, indicated generally by numeral 400 in Figure 34, comprises an intermediate cylinder 401 carrying two working members 402, 403, a smaller or blanket cylinder 404 and a removable or detachable upper large cylinder 405 having working members 406, 407. As in the machine of Figure 1, the smaller cylinder and two larger cylinders are supported on horizontal axes as defined by shaft 408 for cylinder 404, shaft 409 for the intermediate cylinder and shaft 410 for the upper cylinder. Such shaft members are substantially aligned in vertical registry although one or two therein may be offset slightly with respect to the others to accommodate rearrangements of the cylinders, as will suggest themselves to those familiar with the art. Three inking units 411, 412 and 413 are provided in the manner prescribed for the press of Figure 1; each inking unit being accompanied by its individually associated dampening roller unit 414.

Vertical side frame members 415 support the axles of intermediate cylinder 401 and the lower cylinder 404 while the upper cylinder 405 is supported between detachable frame members 416, all in the manner as described for the Figure 1 machine.

A conventional feeder, indicated generally at numeral 417 is employed, such comprising a belt system 418 and intermediate upper and lower feed rolls 419, 420, respectively, as previously described in conjunction with the discussion of the Figure 1 machine.

The lower cylinder 404 is arranged to cooperate with a delivery means 421 comprising a chain delivery system substantially identical to the delivery system 81 heretofore described; such system serving to cooperate with and deposit paper on a suitable stacking table 422. The delivery system carries an even number of gripper bar assemblies 423 to cooperate with a single gripper means 424 carried by the blanket or lower cylinder as opposed to the chain carried grippers in the machine of Figure 1.

In Figure 36 it is shown that the several cylinders 401, 404 and 405 are supported on their respective axle shafts 409, 408 and 410 between parallel spaced side plates 415, as in the Figure 1 machine. A drive gear train comprising gears 425, 426 and 427 is arranged at the left hand end of the machine (as viewed in Figure 36) for rotatably driving the several cylinders synchronously and in proper timed relation. It will be noted that the lowermost cylinder 404 is equipped with a cylinder separating or throw-out mechanism embodying an Oldham coupling

428. The upper cylinder 405 is likewise equipped with an Oldham coupling and cylinder throw-out means 429 so that the intermediate cylinder may be completely freed of contact with adjacent cylinders as desired during the separation function, although this separating movement of the upper cylinder may be eliminated as shown in the Figure 1 machine.

In considering the modified three cylinder press 400 it is essential to include, as well, the basic two cylinder form thereof as outlined schematically in Figure 35 of the drawings. From that figure it is apparent that a two cylinder press 400a is formed by modifying the inking system of the three cylinder press 400 and eliminating the upper cylinder. The middle cylinder 401 then carries two working members 402, 403, and is adapted to cooperate with the lower cylinder 404 and delivery means 421. Each of the work members 402, 403 is dampened by its own dampening unit 414 and individual inking units 412 and 412a are likewise employed. With this arrangement two colors of ink may be used, each individually supplied to the separate work areas on the larger cylinder 401 or one of such units may be disconnected and both areas inked by a single inking and dampening unit if one color work is involved.

Generally speaking, it may be stated that the machines of Figures 34 and 35 are substantially identical to the basic two and three cylinder presses described heretofore with the exception of the delivery mechanism, and associated gripper means. Therefore, without dwelling and particularizing elaborately on each and every one of the mechanisms involved, I shall touch on the several operating portions of machine 400 briefly and treat the gripper system and related mechanisms more comprehensively hereinafter.

Feeding system

The feeder system employed with press 400 may be, as illustrated, identical to that used in the press of Figure 1, and may comprise any conventional known style of feeder 417, such as a suction type of standard design or other types of standard feeders. As illustrated, the feeder 417 comprises a supporting pedestal 435, a loading table 436, the belt conveyor 418, intermediate feed table 437 and the upper and lower feed rolls 419 and 420, respectively.

The general object and purpose of the feeder system, of course, is to advance sheets of paper from table 436 to a position opposite the grippers 424 on the blanket cylinder so that the paper may be carried through the bite of the press once and/or more than once, as desired, depending on the particular condition of operation for which the press is arranged. The details of the feeder system shown have been described fully hereinbefore, and so will not be repeated here, other than to mention that such is designed so that paper cooperates with a sensing finger system to control separation of the printing couple. Such sensing finger system is related with the intermediate feed system and includes a systematic organization of elements which are operated in response to the rotational cycle of the intermediate cylinder 401, substantially in the manner described previously.

Intermediate feed

The relationship of the intermediate feeding system and the intermediate feed table 437 may best be understood by examining Figure 37 of the drawings which corresponds closely to Figure 4.

Briefly, the feeder conveyor 418 delivers paper to the intermediate feed table 437 where it is engaged between the upper and lower feed rollers 419 and 420, respectively. The upper feed roll 419 is an idler which is lowered periodically to press the paper into frictional engagement with the rotatably driven lower feed roll 420 that is powered off of the drive gear train of the press. It will be recalled that the feed roller 419 is raised and lowered by means of a cam such as cam 438 mounted on shaft 409.

This cam works on a pivotal rocker arm 439 and a related linkage means interjoins such rocker arm with bracket arm 440 supporting the upper feed roll to motivate the latter, as previously related.

Sensing finger system

So long as paper is fed in proper timed sequence to the feed rollers, a sensing finger 441 will ride on top of such sheets and thus be prevented from signaling the cylinder throw-out system. However, if a sheet of paper is missing at the intermediate feed table 437, the sensing finger system must operate to cause immediate separation of the printing couple cylinders.

The features of the sensing finger system employed in the machine 400 differ slightly from the system used in the Figure 1 press as may best be understood from Figures 37 and 38. Briefly, cam 438 works on a roller member 445 carried by the fulcrum lever 439 to bias the latter against a return spring and guide rod means 446. The lever 439 is linked adjacent its lower end to one end of a push-pull rod 447 which operates a crank lever 448 fixed to one end of a rocker shaft member 449; the latter being journaled adjacent its ends in bearings carried by two secondary side frames 450, all substantially as previously described in the discussion of the Figure 1 machine, etc.

A depending arm or lever 451 located intermediate the ends of shaft 449 is bifurcated at its lowermost end to pivotally carry the sensing finger 441. It will be recalled that while the finger 441 is pivotally supported adjacent its one end, its opposite end rides freely over the feed table 437 along which sheets of paper are conveyed.

In the absence of a sheet of paper on table 437, the detector finger passes through an opening 452 in this table to engage a relieved or notched end section of an upwardly extending lever 453 fixed to a shaft 454 (see Figure 38). As a consequence, lever 453 and shaft 454 are partially rotated to initiate a cylinder throw-out means, and more particularly and immediately to rock or move a pair of latching finger members 455 and 456.

As shown in Figure 38, latching finger 455 is supported on shaft 454 for rotation with lever 453. Latching finger 456 is supported for rotation about a shaft 457, and the two latching fingers are pivotally interconnected by a vertical link member 458. The connection of link 458 with the latching member 456 is by a pivot pin 459 located intermediate the ends of that finger. Pivotal connection of such link with the latching member 455, on the other hand, is at the outer end of the latter by pin means 460; the axis of shaft 454 being intermediate the pin 460 and the actuating or outer end of finger 455. This arrangement of the two latching members serves to move the same in opposite directions against the force of spring 461 to simultaneously initiate two cylinder throw-out systems embodying Oldham couplings 428 and 429 associated respectively, with the lower and upper removable larger cylinders, as will now be described.

Cylinder throw-out mechanism

With particular reference to Figure 38 of the drawings, the outer ends of the two latching finger members 455 and 456 are designed to engage and sit within recess portions of throw-out or latching collars 462 and 463 which are mounted, one each, on eccentric stub shaft portions 408a and 410a associated, respectively, with the lower cylinder and the upper cylinder. The collar members are each provided with an elongated arm portion 464 and 465, respectively, biased in opposite directions by springs 466 and 467. Such springs serve to urge the collars in directions appropriate for their arm portions 464 and 465 to engage anvil stop members 468, 468 and to tightly abut the latch fingers 455 and

456. Particularly note that spring 467 is much heavier than spring 466 due to the fact that the separating action of the upper throw-out collar is against the force of gravity while the lower collar throws out with gravity. The anvil stop members are axially adjustable relative to their fixed position to permit regulation of the throw for each arm portion of the two latching or throw-out collars. Each of the throw-out collars is also provided with a projecting block portion 469 which co-operates with adjustable stop bolt means 470, 470 carried at the outer ends of two cam actuated bell crank levers 471 and 472. Spring members 473 serve to resiliently keep the ends of the bolt members 470 adjacent to the projecting blocks 469. Additional spring members 474 are employed to urge the inner ends of lever members 471 and 472 toward the actuating cam assembly 475.

The two bell crank levers 471 and 472 are slightly offset with respect to one another and each respectively supports a rotatable roller member 476 and 476a designed to engage a peripheral camming surface of the composite cam assembly 475 which in point of fact comprises two similar plate members disposed side by side and each provided with a single lobe as, for example, lobes 477 and 478. Such lobes periodically engage related roller members to throw the associated levers 471 and 472 in appropriate directions against the bias or tension of springs 474 and toward blocks 469. Such movement of the levers 471 and 472 momentarily rotates the latch collar members away from the stop anvils 468 to relieve abutting engagement of the throw-out collars with the latching fingers. Means for regulating the throw or movement of the collar members against their major biasing springs 466 and 467, respectively, comprise adjustment bolts 479 engageable with the ends of ear projections 480 on which the blocks 469 are supported.

From the above described elements, it will be seen that coordinating operation of the cylinder throw-out mechanism thus far described, includes disengagement of latching members 455 and 456 from the throw-out or latching collar members when properly conditioned by the operation of the previously described sensing finger system. Since the physical separation of the cylinders requires a greater force than is possibly provided by the action of the latching fingers plus the impulse of their major springs 467 and 468, the composite cam member 462 is provided to drive the two bell crank levers 471 and 472 to relieve abutting contact between the collars 462, 463 and latching fingers 455 and 456, respectively. Appropriate movement of such levers brings the stop bolts 470 into engagement with blocks 469 causing rotation of the throw collars or latch collars away from the latching fingers. This action permits the latching fingers to be lifted outwardly from the latch or notch portions of the collars 462 and 463. The lifting of the latching fingers, as described, permits movement of the arm portions 464 and 465 to engage the anvil stop members 468. This activity of the throw collars separates the cylinders 404 and 405 from the intermediate cylinder 401. It is interesting to note that the tension spring 467 is of heavier construction than tension spring 466, since gravity aids the separating movement of the lower blanket cylinder while gravitational force opposes the separating movements of the upper cylinder. As a result of this factor, spring 467 is purposely designed of sufficient magnitude to overcome the normal gravitational pull exerted on the upper plate cylinder.

A better comprehension of the cylinder separating operation will be gained if it is remembered that the shaft portions 408a and 410a are eccentrically related with respect to the longitudinal axes of their respective cylinder supporting shafts. Therefore, rotation of the eccentric shaft portions causes a shift in the rotational axes for cylinders 404 and 405 to cause their separation so

that the lower and upper cylinders depart from contacting engagement with the intermediate cylinder.

To accomplish the above discussed operation of cylinder separation it is essential that means be provided for maintaining the operational connection and timing of the drive mechanism for the several cylinders. This means must necessarily provide for maintaining driving relationship between the cylinders and the driving gear train while at the same time permitting required displacement of the rotational axes of the cylinders. For this purpose I employ known Oldham couplings, one of which is related to the lower cylinder and one with upper cylinder, as indicated generally by numerals 428 and 429 in Figure 36. Such Oldham couplings operate as described hereinbefore, and so will not be discussed further at this point.

Blanket cylinder gripper system

By operation of the feeder system as described, and particularly the upper and lower feed rolls, a sheet of paper is advanced to a ready position for engagement by the gripper means 424 associated with the lower cylinder 404. This gripper system may best be seen in Figures 39 and 40. Such system includes a plurality of individual gripper fingers 484 disposed in a gap 485 of the lower cylinder and each of which bears a sheet register portion comprising an integral depending lip 486, as seen best in Figure 40.

Each gripper finger is formed with a split gripper support collar portion 487 whereby such may be adjustably positioned and locked on a gripper shaft 488 by tightening a holding bolt 489. Shaft 488 also carries, at one end beyond the end of the blanket cylinder, a cam follower arm 490 which comprises a lever equipped with a rotatable cam follower roller 491 at its outermost end. A spring means 492 is arranged to maintain the roller 491 engaged with a compound gripper actuating cam 493 as will be described more fully hereinafter. The several gripper fingers are designed to work together against an elongated gripper bar 494 which is stationary and extends longitudinally of the lower cylinder adjacent one side of the gap opening 485.

Since my improved printing machine 400 (like the presses previously described) is designed for either multiple or single passage of sheets of paper through the bite of the printing couple, it is necessary, under certain printing conditions, to provide means permitting the gripper system of the lower cylinder to remain in locked engagement with the paper until multiple passage of the paper through the bite has taken place. In other circumstances, it is required that the gripper system release the paper at each revolution of the blanket cylinder, so that such paper sheets pass through the printing couple only once. To this end I have devised a new and improved gripper operating and release system which will now be set forth.

Gripper operating system

The basic portion of the gripper operating system is found in a gripper actuating cam member 493 (see Figures 37 and 45) which controls the grippers 424 during the feed and discharge cycles and is positioned adjacent one end of the blanket cylinder of the printing press. This cam is arranged to actuate the cam follower arm and roller system comprising parts 490—491. In order to control the sequence of closing and opening the grippers, however, special facilities must be engaged to properly position the gripper actuating cam.

From Figures 39 and 41 it will be understood that I have provided a control cam 496 which is mounted on shaft 409 at one end of and for rotation with the intermediate cylinder. This cam is arranged to responsively actuate a control lever arm 497 having a roller member 498 mounted intermediate its ends and pivoted at one end by pivot member 499. A pin means 500 is arranged

at the unpivoted end of the control arm 497 to which a spring member 501 is attached to bias that arm and its roller 498 into engagement with the edge of control cam 496. Pin member 500 also pivotally connects with a substantially vertical link member 502 which is joined at its lower end by pivot pin means 503 to a face cam 504 formed substantially wedge-shaped in end elevation (see Figure 42). Face cam 504 has a sleeve or collar portion 505 receptive of a pivot shaft 506 so that vertical actuation of the link member 502 causes vertical oscillation of the face cam. The shaft 506 supports a roller arm 508 having a roller member 509 at its outer end engaging the face of cam member 504 (see Figures 42 and 44). Movement of roller 509 along the sloping face of cam 504 causes shaft 506 to move rectilinearly in and out of the surrounding collar 505. This relation may best be understood by inspecting Figures 42 and 43 of the drawings.

While the outer end of the solid shaft 506 is connected to the roller arm 508, the opposite or inner end thereof joins to a support block 510 which mounts the gripper operating cam member 493. Specifically, the gripper operating cam member comprises two sectors or lobe portions, namely, lobe 511 arranged to open and close the grippers of the blanket cylinder when receiving a sheet of paper, and lobe 512 for effecting the discharge opening of the grippers 422 (see Figure 45). From Figure 45, especially, it will be noted that the composite cam 493 is formed with a hub collar 515 which slides over the outside of shaft 408 on which the lower cylinder is mounted whereby such moves between its dotted and full line positions as illustrated in Figures 42 and 43. A guide rod 516 extends between the side frame member 415 and the support block 510, as best seen in Figure 43; such rod supporting a surrounding compression spring 517 to normally urge the cam and supporting block 510 to a gripper actuating position as shown in dotted lines in Figure 42. A second rod 518 serves to maintain the cam member in proper alignment and has a micrometer adjustment means 519 for setting the angular position of the lobe 511 so as to regulate the opening and closing time of the blanket grippers.

From the foregoing it will be recognized that the periodic shifting of the gripper actuating cam 493 permits the selective opening of the grippers in time with the cyclic operation of the printing couple since such is controlled by the rotational operation of the control cam 496 and the interconnecting linkage system as described. It will also be appreciated that the described control of the grippers corresponds quite similarly to the gripper opening control system used in the Figure 1 machine.

A major difference between the gripper control mechanism of machine 400 and the Figure 1 machine, however, resides in the provision of the gripper release cam lobe portion 512 of cam 493 and its selected operation. From Figure 45, in particular, it will be seen that the two lobes 511 and 512 are disposed substantially 180° apart, and if such operating cam is maintained at its dotted line position, as illustrated in Figure 42, for example, the sequence of the gripper operation will involve opening and closing operation adjacent the intermediate feed table 437 for accepting paper from the feeding system on the feeder side of the couple or bite followed by a corresponding opening and closing action for the release of paper from the blanket cylinder after substantially 180° travel of the blanket cylinder as shown, or within 360° of blanket cylinder rotation. The operation of the printing press 400 in conditions where but a single passage of the paper through the printing couple is desired therefore requires that the gripper operating cam 493 be maintained at its inner or dotted line position, as indicated in Figure 42. Since the mechanism illustrated comprises a fixed linkage arrangement which operates for each 360° cycling of the middle cylinder and control cam 496, it is necessary in such circumstance to break the linkage to cam

493 as by disconnecting the link 502, for example. In other circumstances where the double passage of the paper through the printing couple is desired, the normal operation of the gripper actuating control system, as described, will automatically open and close the grippers 422 for each 360° revolution of cylinder 401 or 720° of blanket cylinder revolution. This provides double passage of the paper through the printing couple and the successful discharge and passage of such printed copy to the delivery system in a manner as will now be set forth.

Delivery system

I have discussed hereinabove the means whereby a sheet of paper fed to the grippers 424 of the lower or blanket cylinder may be selectively controlled for passage through the bite of the printing couple once, or more than once, in accordance with the positioning of the operating cam 493 as described. After the paper has passed through the bite of the couple it is necessary that the same be delivered to some means or system for carrying it away from the press and depositing such at a stacking station. For this purpose a delivery system 421 of the sprocket driven chain variety bearing two gripper bar means 423 is preferred in the particular embodiment shown in Figure 34. This delivery system comprises a pair of horizontally disposed shaft members 520 and 521 each of which rotatably carries pairs of spaced sprocket wheels 522 and 523, respectively, for supporting parallel chain members 524. The shaft 520 may support a plurality of toothed wheel members 525 (see Figure 36) which are adjustably spaced along its length to form a take-off cylinder arrangement if desired. Shaft 520 is powered directly off the drive gear system for the printing couple by take off gear 526 which is rotatable on shaft 520 for purposes as will appear presently.

The delivery system is disposed adjacent the lower or blanket cylinder with the axes of the two axle members 520 and 521 lying substantially coplanar and below the axis for the blanket cylinder. As the gripper fingers of the blanket cylinder are opened in response to engagement of roller 491 with the cam lobe 512, the leading edge of the paper is simultaneously engaged and held by delivery grippers 423, each comprising fingers 527 mounted for pivotal movement with a shaft member 528 that is actuated in response to the activity of a cam following roller arm 529 having roller 530 at its one end. Specifically a cam plate 532 is mounted stationarily outboard of the right hand sprocket wheel 522 in Figure 36 while the roller 530 and arm 529 are carried with the chains 524 to periodically engage the activating cam 532. A better understanding of this activity will be appreciated by a study of Figure 46 of the drawings. Of course, once the gripper fingers 527 have gripped the paper the same is transferred to and carried by the chain delivery system to a position opposite the stacking table 422 and deposited. Release of the paper from the delivery system occurs through engagement of the roller members 530 with a second cam plate member (not shown) similar to plate 532 positioned adjacent one end of shaft 521 or along the lower flight of the delivery chains, according to recognized practice.

It will be noted with particular reference to Figure 39 of the drawings, that the sprocket wheels 522 and 523 have cut-out areas or notches 533 in their periphery for clearing of the gripper bars 423 as such move around the sprocket wheels with the delivery chains. It should also be noted that the distance between grippers 423 is equal to the circumference of the intermediate cylinder so as to accommodate the discharge from grippers 424 depending on the number of times the paper passes through the printing couple according to the desired operation.

Considering the transferring of paper on the blanket cylinder grippers to the delivery system grippers, it should be pointed out that this operation takes place at different phases of the printing couple's cycle, depending on

whether single or multiple passage of the paper through the printing bite is to take place. Specifically, where double offset work is involved, the paper will pass through the bite of the printing couple only once before it is transferred to the delivery system. Contrastingly, multiple color letterpress operation of this press, requires that the paper move through the printing couple bite several times (two times in the case shown) before its discharge to the delivery system. As a result of such requirement for phase differential in the operation, means are required for selectively conditioning either the discharge opening and closing of the blanket cylinder grippers or the selective conditioning of the delivery system to satisfy the requirement for timing and phase operation selected. Since I have employed a fixed linkage system for operating the grippers on the blanket cylinder, I prefer to selectively condition the delivery system to meet the shifting in time phase required to satisfy the multiple and single passage conditions for the paper movement. To this end, I have provided a spring loaded plunger 534 illustrated best in Figure 36, which extends between the rotatable drive gear 526 and one of the sprocket wheels 522 which are fixed for rotation with shaft 520. Such plunger may be selectively withdrawn to disengage the sprocket wheels 522 following which the entire delivery chain may be shifted to bring the grippers thereon into proper phase for the operation selected, there being two diametrically opposed openings in the left hand sprocket wheel in Figure 36 for this purpose.

From the foregoing it will be recognized that the modified machine illustrated in Figures 34-46 is capable of operating substantially according to the concepts found heretofore in the description of the basic two and three cylinder presses of Figure 1 and the modifications and variations of use for such presses as outlined in Figures 31-33 of the drawings. Since the operational versatility of the invention is believed to have been amply set forth in such descriptions a further detailed discussion of the operation for machine 400 will not be made herein.

Of unique consideration, however, is the coupling of two or more of the three cylinder presses 400 in "tandem" arrangement. This modified use is schematically set forth and illustrated in Figure 47 of the drawings and brings about a departure from the tandem arrangement of the Figure 1 type press, for example.

Considering the disclosure in Figure 47, it will be recognized that two three cylinder printing presses of the order illustrated in Figure 34 are coupled in "tandem" arrangement substantially according to the concepts outlined previously. While the basic operation of such a tandem arrangement is substantially as discussed hereinbefore, it is worthwhile to note that the cycle of paper travel and printing sequence in the tandem machine of Figure 47 differs somewhat from the tandem coupling of two machines embodying a blanket gripper system in which the grippers are carried on encircling means through the bite of the two couples involved. Particularly, it will be understood that the first printing couple or press indicated generally at numeral 535 in Figure 47 includes two larger cylinders 536 and 537 and a single blanket or smaller cylinder 538. Three inking units 539, 539a and 539b are provided and three separate dampening units 540, 540a and 540b cooperate therewith. A single feeder system 541 is employed for both presses in the tandem arrangement and a transfer mechanism 542 is employed for transferring printed copy from the first printing couple to the second printing couple or machine 543. Machine 543 comprises two plate cylinders and one blanket cylinder 544, 545 and 546, respectively. The second printing couple is designed to deliver its printed copy to a delivery mechanism 547 which discharges the final copy to a stacking tray 548. Each large cylinder of the two presses is equipped with a pair of working areas carrying segments 549, 549a and 550, 550a of the press 535 and

551, 551a and 552, 552a of the second couple or press 543.

The operation of the first three cylinder press or couple 535 is as described and discussed for the three cylinder printing press of Figure 34, but the second printing couple or press 543 receives copy from the first press and includes a secondary sensing finger system 554 which is associated with and responds to the paper carried by the grippers 555 carried on chains 556 of the transfer mechanism 542; it being understood that transfer mechanism 542 is constructed substantially as the delivery system or means 421 in the Figure 34 press. The secondary sensing finger system operates responsively to the absence of a sheet of paper in the grippers of the transfer system to signal through micro switch 557, the cylinder throw-out mechanism of the printing couple or machine 543 thereby to prevent contact of the printing plates of the intermediate cylinder 545 with the blanket of the smaller cylinder 546. Details of this system follow closely the mechanisms for such function shown in Figure 8.

A remarkable thing to note in the tandem machine of Figure 47 as compared with the previously described tandem printing arrangements for the Figure 1 machine, for example, resides in the fact that in cases where multiple passage of the paper through the printing couple is required, such multiple passage occurs and is completed at the first printing couple prior to the delivery of the paper to the second printing couple. It will be seen then that this feature differs slightly from the tandem operation of the Figure 1 machine wherein the printing operations, for example in four color work, were carried on alternately in the two printing couples involved. Due to the fact that there is the lack of transfer between printing couples intermediate the operations performed in each printing couple, the problem of registration in the machine shown in Figure 47 is not as acute and serious as in the tandem machine outlined and diagrammed in Figure 32, Example G for instance.

Second modified press

In studying the aspects of the aforescribed two general forms of my invention, a still further basic form, approaching possibly more closely the teachings of the first described press of Figure 1, is to be considered. Such "second modified press" as it is hereinabove termed, is illustrated in Figures 48 through 59 of the drawings, and aside from certain novel particulars and modified devices and systems employed therewith, the machine basically comprises my invention as above related, in that an encircling gripper means is employed for carrying the paper through the bite of the printing couple once and/or more than once, as selected.

In contemplating various structures for embodying my invention, it was conceived that a closed ring-type of encircling gripper system afforded advantages of construction and compactness which are not as readily available in the two previously described basic forms or press structures. Employing such a rigid ring-type of encircling gripper means also permits the utilization of a tumbler gripper system or means for carrying paper through the printing couple which is believed to lead to a smoother and more efficient printing operation. I have also determined that this embodiment of the invention gives rise to improved control of the paper movement through the bite of the printing couple, the feeding and discharge cycles and cylinder separation; such separation being effected for both the normal missed sheet situation and for accommodating the passage of paper at various thicknesses through the bite of the printing couple as will be explained more fully hereinafter.

Within the bounds of the above mentioned generalities, the detail features and arrangement of elements which comprise the third basic embodiment of my invention will now be related to the press shown in Figures 48 through 59 of the drawings.

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In Figure 48, a modified press 600 is illustrated comprising two cylinders 601 and 602 which are of like diameter and termed "larger cylinders" and a smaller underlying cylinder 603; the "smaller" cylinder 603 in normal usage carrying a blanket covering at its periphery. At this juncture, it is well to recognize that while hereafter I describe the press 600 as a three cylinder machine, nevertheless such may assume a basic two cylinder form as previously related, comprising the one larger cylinder 602 and the one smaller cylinder 603. It is believed that from previous descriptions concerning such basic two cylinder modification of the present invention, the ramifications of that variation for my press 600 need not be dwelled on herein, but will be obvious to those familiar with the art.

The three cylinders 601, 602, and 603, are respectively mounted on shafts 604, 605 and 606, the latter of which bears eccentric stub portions 607 at its ends conventionally employed for cylinder separation as will be described more fully hereinafter. Such shafts 604-606 are supported in horizontal spaced parallelism between a pair of parallel spaced side frame plates 608, 609 which bear a cut-out portion 610 at the forward end of the machine for convenience of accessibility to the printing couple and reduction of weight. The side frame plates 608 and 609 are held in spaced parallelism by means of the shaft means 604-606 and a supporting base plate 611 located between the lower ends of such frame plates for supporting a drive motor 612.

Rotational drive of the three cylinders 601, 602 and 603 is accomplished by a belt means 613 driven from sheave wheel 614 on motor 612. Drive belt 613 trains over a large sheave wheel 615 which is associated with a first drive shaft 616 having a drive gear 617 thereon. Gear 617 engages with an idler gear 618 which in turn meshes with a gear 619 fixed to the smaller cylinder 603 for driving such cylinder rotatably about shaft 606. Each of the cylinders 601 and 602 is likewise fitted with drive gears 620 and 621, respectively, for simultaneous driving of the three cylinders.

A conventional feeder means, indicated generally at 625, serves to advance paper from a feeding station thereat to an encircling gripper means, indicated generally at 626, which carries paper through the bite of the printing couple and delivers the same to a delivery mechanism 627 for deposit at a stacking station 628.

The encircling gripper means is driven by a ring gear 629 (see Figure 48) meshing with gear 620 of the intermediate larger cylinder 602 and thereby such is simultaneously driven in proper sequence with the rotational cycle of the printing couple. The delivery system 627 is likewise driven directly off of the main drive system of the printing couple and specifically by means of a drive gear 630 which meshes with the large ring gear 629 of the encircling gripper means.

The delivery system or means 627 is generally of the type heretofore described comprising a pair of parallel spaced chains 631 trained over pairs of sprocket wheels 632 which are mounted on spaced parallel shafts 633, 633. The chains, of course, carry gripper bars 634, 634 in a manner which will be amplified more fully hereinafter.

To amplify the general description of machine 600 set forth directly hereinabove, I will now dwell on the individual systems therein, and particularly at this juncture with the feeding system.

Feeding system

As best shown in Figures 48, 49 and 50, the conventional feeder means 625 includes spaced pedestal frame plates 635, 635 between which a driven belt conveyor means 636 is arranged to deliver paper from an initial stacking station to an intermediate feed table 637 which forms a substantially inclined plane located between the side frame plates 608 and 609 of the press opposite the

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delivery end of the feeder system 625. The intermediate feed table 637 is formed with an upperly turned lip portion 638 at its outer end or that is, at its end closest to the printing couple, which serves as a registry stop for paper deposited by the belt conveyor 636. The opposite or inner end of table 637 is angled downwardly, as at 639, to act as a guide means for the paper when it advances onto the table 637. Table 637 is supported on and between block members 640, 640 which are pivotally supported at their upper ends on shaft 641 which extends between the side frame plates 608 and 609. Blocks 640 are connected by pivot pins 642 to the upper ends of crank levers 644 which are fixed to a transverse shaft means 645 disposed horizontally beneath the table 637. Such shaft 645 extends between the side frame plates 608 and 609 and extends beyond plate 609, as best seen in Figure 51, where it is joined to a crank arm 646. Crank 646 is pivotally connected to a reach rod 647 which extends to the lower end of a cam follower arm 648 having a roller 649 rotatably mounted intermediate its ends. Arm 648 is pivotally supported at its upper end on a post 650 projecting outwardly of side frame plate 609. Roller 649 contacts the edge of an actuating plate cam member 651 supported on the shaft 605 associated with the intermediate cylinder 602; the arrangement being such that cam plate 651 rotates with cylinder 602 of the printing couple to actuate the follower arm 648 against the force of a spring 652 connected to crank 646.

The rocking action of arm 648 in turn serves to rock crank 646, shaft 645 and the cranks 644. This motion in turn cranks blocks 640 about shaft 641 and thereby translates feed table 637 between its full position B and two dotted line positions A and C, as shown in Figures 49 and 50. The purpose of this translation of table 637 will be amplified presently, but generally it may be stated such motion is requisite for feeding paper to and properly clearing the encircling gripper means 626.

In addition to pivotally supporting the blocks 640, shaft 641 supports a plurality of leaf spring members 655 which depend therefrom and engage the upper surface of the feed table 637 to lightly hold the paper as it is advanced against the stop 638. It further will be noted that table 637 is supported for sliding movement on an underlying support bar or rod 656.

Normally, as shown in Figure 49, table 637 is disposed so that the stop portion thereon is outside of the periphery of the encircling gripper means, as at "A," but in response to the rocking activity of the link cranks 644 and 646, such stop portion 638 is moved to a first position "B" within the periphery of the encircling gripper means as dictated by a step portion 657 of the cam member 651. After engagement of the paper by the encircling gripper means, the table 637 advances quickly to a second inward position "C," shown as its extreme dotted line position in Figure 50, which is brought about by a second step 658 of cam 651. To better understand the reasons for such two-step inward movement of table 637, I will now turn to the features and operation of the encircling gripper means or system 626.

Encircling gripper system

The encircling gripper means 626 comprises a pair of rigid, parallel spaced, continuous rings 660 which are supported at and along their inner peripheries on grooved rollers 661 carried on stub shaft 662 projecting inwardly of the side frame plates 608 and 609, as best shown in Figure 51 of the drawings. In the particular embodiment shown in Figure 49 of the drawings, three rollers 661 are provided for supporting each ring, although more than this number is feasible, but not necessarily required. Such ring members are suitably interconnected to present a rigid cylinder by the plural gripper bar assemblies 664. Such rings are rotated with the printing couple by the ring drive gear 629 engaged with the driving gear train of the printing couple. As illustrated in the drawings,

three gripper bar means 664 are employed following the formula hereinbefore set forth in which an even number of working areas for the larger cylinder 602, for example, requires an odd number of grippers on the encircling gripper system and vice versa. The arcuate spacing between grippers is equal to substantially one-half the circumference of the larger cylinder 602, as shown.

Each of the gripper bar means 664 is preferably a modified "tumbler" type located radially inward of the periphery of the two ring members 660. As possibly best shown in Figure 50 of the drawings, each gripper bar assembly 664 includes an elongated L-shaped gripper bar member 665 which is fixed at its ends to the spaced rings 660 and which cooperates with plural tumbling gripper fingers 666 carried on a rocker shaft 667. The gripper fingers 666 work against the bars 665 and are automatically pivoted by means of an attached gear sector member 668 disposed at one end of the shaft 667. Each bar 665 includes a platform portion or surface 669 disposed substantially along a radius of the rings and a stop portion 670 transverse of the radial disposition of the platform portion 669 so as to present a limit stop to the tumbling gripper fingers 666.

The gear sector 667 engages a crank arm 671 having a segmental gear sector portion 672 at its outer end for meshing engagement with gear sector 668. Such crank arm 671 is carried on a pivot 673 disposed on the outside of one of the two ring members 660. Arm 671 further carries, intermediate its ends, a roller 674 for engaging a gripper activating cam 675.

Cam 675 is disposed adjacent but outwardly of the one ring member 660 which carries the roller arm 671, and so long as such is in proper position to be engaged by roller 674, the arm member 671 will be appropriately rocked by the sloping edge of the cam member 675 to move the gripper fingers 666 relative to the bar portion 669. Note that cam 675 is provided with two sloping surfaces 676 and 677, the first of which serves to open the gripper fingers and the latter of which serves to close the same. Thus, it will be recognized that as the rings 660 are rotatably driven, each time a roller 674 contacts cam 675, the fingers 666 associated therewith are automatically opened and closed to accept paper from the feed table 637.

Due to the fact that table 637 extends inwardly of the periphery of the ring members 660 during the transfer of paper thereto, the gripper fingers 666 and bar portion 669 are designed to comb through the leading edge of the table at openings 678 so that there is no contacting interference therebetween during the transfer operation from the delivery feeder system to the encircling gripper system.

By imparting the two stage stepping movement to table 637, a surprisingly effective and efficient transfer to the tumbler grippers is brought about. Briefly, the paper is both side and end registered on the feed table 637 prior to its engagement by the tumbler grippers. During the passage of the high step 679 of cam 651, underneath roller 649, the table 637 is withdrawn to its rearwardmost position "A" as shown in Figure 50, or that is, with the stop portion 638 thereof disposed outwardly of the periphery of the ring members 660. This position is maintained for approximately 180° of rotation for cylinder 602 so that paper is fed to every other gripper assembly. When roller 649, however, engages the step 657 of cam 651, the table 637 is advanced inwardly of the periphery of rings 660 to its full line position "B" where it is in interfering relationship with the tumbler grippers. Paper is fed to and registered on table 637 in this position. In this condition the open gripper fingers 666 are gradually closed downwardly toward the gripper bar 665 as they pass table 637; the fingers passing through the relief opening 678 of the feed table. Thereafter, the feed table 637 is advanced a second time to its innermost position "C" (see Figure 50) in response to

the engagement of roller 649 with step 658 of cam 651. This second inward movement of table 637 is required to permit the paper now engaged by the tumbler gripper fingers 666 to clear the stop lip 638 as it is lifted off of the feed table 637. In this manner a successful transfer of paper to the tumbler gripper system associated with the encircling rotating rings 660 is accomplished. Note that complete registry of the paper takes place on the feed table 637 and that no further register thereof is necessary in the gripper fingers themselves.

If it were not for the fact that the machine 600 is designed, as those previously described, to permit the passage of paper once and/or more than once through the bite of the printing couple, the fixed positioning of gripper actuating cam 675 adjacent a left-hand ring 660 would be sufficient to successfully carry out the above related opening and closing gripper operation. It will be recalled, however, that certain instances of operation require the paper to pass through the printing couple more than once (twice in the particular embodiment illustrated herein). This being the case, it is likewise requisite that the cam 675 be withdrawn from its actuating position as shown in Figures 49 and 50 to bypass every other gripper thereby avoiding unwanted release of a gripper carrying a sheet of paper during its second passage through the printing couple.

This function is carried out most successfully by providing a second plate cam 680 rotatable with the shaft 605 related with the intermediate cylinder. Such cam 680 is disposed adjacently inward of the feed table actuating cam 651 and acts on roller 681 carried on a pivotal arm 682 supported at one end on the pivot post 650 inwardly of arm 648. The lower end of arm 682 is connected with a reach rod 683 which joins at its opposite end to a wedge-shaped retracting cam 684 having a sloping cam surface 685. Cam 684 is pivotally supported on post means 686 outwardly of the left-hand frame plate 609. A roller 687 is connected to the outer ends of a pair of quill shafts 688 which slides through a collar housing 689 mounted through the side frame plate 609. The roller is designed to work shafts 688 against the force of a compression spring 690 held on collar 689. With this arrangement proper arcuate activation of the shifting cam 684 serves to push shafts 688 inwardly to carry the gripper activating cam 675 into a position where it may be engaged by the rollers 674 carried on the sector arms 671 and by which the opening and closing activity of the grippers 664 is controlled.

The sequence of movement and operation for cam 675 is such that for every 180° of rotation of the larger cylinder 602, cam 675 is shifted to its inner position for operating a passing gripper carried on the rings 660.

As the paper carried by the grippers 666 advances toward the bite of the printing couple, it necessarily tends to fall radially inward of the periphery of the encircling ring members 660. In order to prevent the paper sheets from contacting the smaller or blanket cylinder 603, I have devised a unique and effective sheet support system.

Under sheet support system

The under sheet support system of my invention is best shown in Figures 52, 53 and 54 of the drawings, whereat such is indicated generally by numeral 690. Such system comprises a pair of arms 691 located at opposite ends of the smaller or blanket cylinder 603, as shown best in Figure 54 of the drawings. Arms 691 are supported on hubs 692 rotatable about the shaft 606 for cylinder 603. A support bar member 693 extends between the arms 691 radially outward of the blanket or smaller cylinder 603. Extending substantially diametrically opposite arm 691 at the right-hand end of the press, is an ear portion 694 which connects with crank arm means 695 fixed to a shaft 696 extending between the side frames 608, 609 of the press. The crank

695, the arms 691 and the support bar 693 are all located intermediate the ring members 660, as best shown in Figure 54 of the drawings. At the right-hand end of the machine and outwardly of side frame plate 608, a linkage mechanism comprising crank arm 697, link 698 and cam follower arm 699 are arranged to activate the arm members 691 with rocking arcuate motion. Specifically, the crank 697 is fixed to the outer end of shaft 696 and at angular displacement with respect to the crank arms 695. The link 698 is pivotally connected to one end of crank arm 697 and one end of the rocker arm 699, as by pivot means 700 and 701, respectively. Rocker arm 699 carried a cam following roller 702 and is supported at its opposite end by pivot shaft 703 attached to side frame plate 608. Roller 702 engages a cam plate 705 which is rotatable with the intermediate larger cylinder 602 and is supported on the shaft 605 therefor outwardly of side frame plate 608.

Crank arm 697 is connected to a spring means 706 which opposes downward arcuate motion of such crank arm, as viewed in Figure 52. As shown best in the latter figure, a sliding connection is effected between the crank arm 695 and the ear portion 694 of the one arm member 691; this being carried out by pin and slot means indicated generally at 707 in Figure 52.

The aforesaid arrangement for the support means or system 690 is such that upon cycling rotation of the printing couple and in response to each 180° of revolution of the larger cylinder 602, follower arm 699 is rocked responsively downward about its pivot axis 703 and through the connecting linkage system 698, crank arm 697 and crank arm 695, such thereby serves to raise the arm members 691 from their downward position to their raised position, as shown in Figure 52; such positions being labelled, respectively, D and E. In this regard, it will be understood and recognized that in the downward position of arms 691 and thus of the cross connecting support bar 693, the latter member is disposed within the peripheral confines of the encircling ring members 660. At the height of its raised condition, the bar member 693 resides substantially at the peripheral limit of the registering aligned rings 660. The arrangement of the cam 705 and the interconnecting linkage is such as to time the raising of the bar 693 just slightly behind the passage of a gripper bar assembly 664 carried by the ring members 660.

Thus, in operation, the bar 693 virtually sneaks up behind the passing gripper bar assemblies carried on the encircling ring members 660 to undersupport a sheet of paper as it approaches the bite of the printing couple. The design of cam 705 is further intended to positively retract bar 693 well within the periphery of ring 660 and radially inward of the gripper bar assemblies prior to the approach of the following gripper bar to the bite of the printing couple. This unique support system adequately protects the paper from receiving ghost images and smudges from the surface of the blanket cylinder and insures that the sheets will pass through the bite of the printing couple in a proper manner.

Studying Figure 54, it will be appreciated that the support bar 693 of the undersheet support system hereinabove described bears a central depression or cut-out portion 710 located substantially midway of the length of the cylinders 602 and 603. Such depression is formulated by disrupting the bar 693 and intertying spaced ends thereof by a cross connecting plate 711, for example. Such recess or depression in the sheet support bar 693 is provided for cooperation with a unique sensing finger system for machine 600.

Sensing finger system

A means for sensing the presence or absence of a sheet of paper prior to its entry into the bite of the printing couple of the press, may best be understood from Figures 52, 53 and 54 of the drawings. The need for such

a sensing finger system is thought to be well understood and recognized by those familiar with the art, but briefly, the same is required to avoid the contact of the intermediate large and smaller cylinders of the printing couple in those instances where the feeding system has failed to function properly. By adequately sensing the absence of a sheet of paper in time to separate the cylinders of the printing couple, smearing or inking of the blanket surface involved at the couple is successfully avoided.

To best carry out this requirement I have devised a system believed to be unique in the art and presented as a marked improvement over previous devices of this class. This system, as in the sheet support system hereinabove described, is operated in conjunction with the cyclic operation of the printing couple and particularly from a plate cam means 712 mounted on shaft 605 adjacent the cam 705 and outwardly of the right-hand side plate 608. Cam 712 bears two peripheral depressions 712a and 712b at its periphery, which are engaged by roller member 713 (see Figure 53) rotatably mounted at one end of a follower rod 714 having pivotal connection at its opposite end to a crank arm 715. The lower end of crank arm 715 is fixed to a shaft 716 which extends transversely across the press through and between the side frame plates 608, 609. Crank 715 is compound in a sense that it comprises a double bell crank including a switch actuator arm portion 717 and a latch arm 718. Such arms 717 and 718 are substantially co-planar and related transversely to the crank arm 715. A spring member 719 is connected to the arm 715 intermediate its connection with the rod member 714 and shaft 716. This spring serves to normally bias the roller 713 into engagement with the peripheral edge of cam plate 712.

Mounted on shaft 716 and substantially over the gap or cut-out portion 710 of the undersheet support bar 693, is a sensing or feeler finger 720 designed to engage and ride across the upper surface of sheets of paper carried by the encircling gripper system as they approach the bite of the printing couple. A micro switch 721 is mounted adjacent the switch actuating finger or arm 717 of the compound crank 715 and such switch is electrically associated with a cylinder throw-out system as will hereinafter be described. Briefly, however, energization of switch 721 causes separation of the printing couple cylinders.

Associated with the cam operated sensing finger or linkage arrangement just described, which is capable of sensing the presence or absence of paper in the grippers of the encircling gripper system for energizing micro switch 721, is a second cam actuated system designed to energize a second micro switch 725 for returning the printing couple to its normal operation condition. Such two cam operated linkage means are interlocked as will be set forth presently and both are operated in timed relation to the cycling of the printing couple. The second linkage means includes a plate cam member 726 formed similarly to cam 712 with depression portions 726a and 726b located substantially 180° apart. Such plate cam 726 is contacted by roller 727 associated with a follower rod 728 located outwardly of side frame plate 608 and the similar, but shorter rod 714 associated with cam 712. Rod 728 is connected at its outer end intermediate the ends of a crank arm 729 pivotally supported at 730, by a support bracket 731 connected to the side frame plate 608. A finger portion 732 extends outwardly of the upper end of crank 729 beyond its pivot connection 730 for operating the second micro switch 725. The extension of crank 729 beyond or beneath the connection thereof with arm 728 is designed as an interlock latch mechanism for periodically engaging the arm portion 718 of the crank link 715 associated with the sensing finger operating linkage previously described. A spring member 733 connects to the crank 729 intermediate its connection with the rod 728 and the pivotal axis 730

therefor. Such spring serves to normally bias the rod 728 and roller 727 toward the cam member 726.

In operating the two linkage means described, namely, the sensing finger linkage for effecting cylinder separation and the linkage for operating the micro switch 725 to return the printing couple cylinders to their normal operating condition, it will be understood from Figure 52 in particular, that the sensing finger means 720 may assume three conditions of operation as illustrated. Such three conditions or positions are the fully raised condition, as shown in the uppermost dotted line illustration of the finger 720 in Figure 52, an intermediate position wherein such finger rests on top of a sheet of paper being carried by the encircling gripper system, and a fully lowered position wherein such finger has entered the recess 710 of the undersheet supporting bar 693. When the cam 712 is cycled so that the high points thereof intermediate the depressions 712a and 712b are engaged with roller 713, sensing finger member 720 is raised to its uppermost position as shown in Figure 52. As either depression 712a or 712b are approached by roller 713, the spring means 719, of course, tends to bias such roller into a following condition. However, if a sheet of paper is present on the encircling gripper system, or that is, lies intermediate the finger 720 and the undersupporting bar 693, then such finger 720 will assume its intermediate dotted line position, as shown in Figure 52. In such condition, the roller 713 will be held away from the cam portions 712a or 712b as the case may be.

If a sheet of paper is missing at the support bar 693, however, then finger 720 will drop into recess 710 to cause arm portion 717 to drop into energizing engagement with micro switch 721 thereby signalling for the separation of the printing couple cylinders. As arm 717 drops, the opposite arm 718 will be raised slightly to interfere with arcuate movement of the extending lower latch portion of crank link 729. Such interfering engagement of these two members effectively prevents rolls 727 from following the depressions 726a or 726b of the return actuating cam 726 and thus prevents finger 732 from engaging micro switch 725 which signals for the return movement of the separated cylinders.

As soon as the next depression 726a or 726b is cycled for engagement by roller 727, however, and providing finger 720 does not again signal the absence of a sheet in the encircling gripper means, the micro switch 725 will be contacted by finger 732 to restore the printing couple to operating conditions. It will be noted that both cam plates 726 and 712 bear two depression areas or nodes as specified, so that such automatic separation and return actuation of the cylinders may take place sequentially for approximately each 180° of the larger cylinder's rotation under normal circumstance and always at or in the gaps between work areas of the larger cylinder 602.

It will be recalled also that in certain conditions of operation for my new press, it is necessary that sheets of paper pass through the bite of the printing couple more than once and in the particular embodiment illustrated a double passage of such sheets is contemplated. In such multiple passage circumstances, the malfunction of the feeder system and the therefore consequential failure of such system to properly deliver paper to the encircling gripper system, again requires separation and return activities of the printing couple in either gap of the larger cylinder 602.

As thus far described, it will be seen that the cam 726, with its substantially diametrically opposed operating nodes 726a and 726b, causes the return of the printing couple cylinders for substantially each 180° of rotation of the larger cylinder and at the gaps or spacing between the work areas thereon. Such operational timing of the separating and return functions is satisfactory and required in all instances of operation for the

machine 600 except where perfection printing takes place. That is to say, in the instance of the perfection printing where images are transferred to both sides of the printed sheet simultaneously, one image from the larger cylinder 603 and one image from the smaller cylinder 602, substantially 180° of the larger cylinder's revolution is dedicated to the transfer of a plate image therefrom to the underlying blanket or smaller cylinder 603, according to familiar practice. Therefore, in the case of the malfunction of the feeder system wherein cylinder separation is required, such separation of the printing couple cylinders must be maintained for substantially 360° of the larger cylinder's rotation in order to avoid the transfer of a double image to the impression member on the underlying cylinder. It is well recognized that the double transfer of an image to the impression surface on the smaller cylinder should be avoided to achieve satisfactory copy. Obviously, therefore, if perfection work is to be accomplished the sensing finger and return finger systems for respectively energizing micro switch 725 must operate, not at each gap of the larger cylinder as thus far described, but only at one gap to permit separation for 360° of the larger cylinder's rotation. To carry out such a modified return activity of the printing couple, I have therefore provided a removable or shifting cam sector 735 for use with the cam plate 726.

Such sector 735 is mounted on a pair of spaced posts or rods 736, 736 so that such may be shifted inwardly to a position where it contacts the cam plate 726. This sector effectively serves to provide a continuation of the circular raised portion of the cam 726 at the position where the node 726a therein normally occurs. Roller member 727 correspondingly is formed of a width greater than the thickness of cam 726 so that when sector 735 is engaged by such roller, the latter will continue to ride over the high surface presented thereby. Such function effectively prevents the contact of micro switch 725 by the finger means 732 which normally occurs at the position of node 726a and thus premature return of the printing couple to its normal operating condition is avoided in those instances where such would be improper. Specifically in perfection work where every other gripper bar of the encircling gripper system is empty, the sensing finger 720 works on every other gripper bar and energization of micro switch 725 is correspondingly controlled, according to the cycling of the actuating cams 712 and 726 with added sector 735. In other instances of operation, where the blanket receives no impression, the sensing finger 720 works on every gripper bar since all gripper bars are full and therefore cylinder return and energization of switch 725 is thus required at each gap in the larger cylinder 602.

To better understand the workings and association of the sensing finger system just described, attention is now turned to the cylinder separating system or means which cooperates with the sensing finger system in separating and returning the printing couple cylinders.

Cylinder separating and variable pressure control system

To cooperate with the unique sensing finger system hereinabove described, I have also devised a new and improved cylinder separating and contact pressure control system which is best illustrated in Figures 55, 56, 57 and 58 of the drawings. This system is thought to be unique for it provides a means for automatically separating the axes of the printing couple cylinders to accommodate the thickness of paper fed through the bite of the two cylinders, thereby regulating contact pressure at the bite and assuring constant surface speed between the paper contacting areas of the intermediate and smaller cylinders during the printing operation. This feature is a marked advancement in this art, and affords elimination of ghost images and smearing of the printed characters. To my knowledge, no successful mechanism has

heretofore been provided for successfully accomplishing this feature.

Basically, as in other systems of the press where required, the cylinder separating system works in conjunction with and according to the timing and cyclic operation of the printing couple. As illustrated, I have located such separating mechanism at the left-hand side of the modified press 600, outwardly of the side frame plate 609. The mechanism is operated by and in direct response to the rotational cycling of a pair of cam members of the plate variety, indicated generally by numerals 740 and 741, which are mounted on shaft 605 associated with the intermediate larger cylinder 602. Cam 740 activates linkage means to throw the cylinder 603 away from and toward cylinder 602 when the gaps in such cylinders are opposed. Therefore I will first point out the particulars of such cam and its associated linkage means.

As viewed best in Figures 55 and 58 of the drawings, cam 740 bears two diametrically opposite nodes or high points 740a and 740b. The peripheral edge of such cam works against a roller 743 carried at the outer end of a bell crank 744 which is pivoted centrally on a mounting post 745 attached to side frame plate 609. A spring member 746 is attached to the bell crank 744 intermediate its pivotal axis and the outer end thereof remote from roller 743. Such outer end of the bell crank is pivotally attached to link 747 which leads downwardly to the outer end of throw-out lever 748 where pivot means 749 serves to attach such two members together. The throw-out lever 748 bears a suitable mounting collar 750 for receiving eccentric stub portion 607 of shaft 606 associated with the blanket or smaller cylinder 603. Lever 748 extends beyond its collar portion 750 to furnish an arm portion 751 which is formed as a cylindrical shaft and receives a stop collar 752 thereabout.

The stop collar 752, as shown best in Figures 56 and 57, bears a raised platform or portion 753 adjacent its one end for engagement by adjustable stop means, indicated generally at 754, as will be described presently. The collar member 752 is connected at its outer end to a symmetrical crank arm 755 which serves to rotate the collar 752 relative to the shaft or arm portion 751 of the throw-out lever 748. The outer ends of such symmetrical crank lever 755 are each provided with means for pivotal attachment with one end of a pair of connector rods 757, 758 which are pivotally joined, respectively, at their opposite ends to movable core members of a pair of solenoids 759 and 760. Such solenoids 759 and 760 are electrically energized and controlled in their energization by the micro switches 721 and 725 associated with the sensing finger system as hereinabove related.

In response to the cyclic operation of the printing couple, cam 740 is carried with the rotation of the intermediate larger cylinder 602. The cam is so arranged that the nodes or raised platform portions 740a and 740b thereof contact roller 743 immediately upon the entry of a gripper bar assembly 664 into the single gap in the blanket surface of the underlying smaller cylinder 603. The linkage comprising the bell crank 744 and link 747 thereupon serves to drive that end of the throwout lever 748 to which link 747 is attached upwardly, thus raising the axis of rotation for cylinder 603 and moving the periphery of such cylinder into one of the gaps between working areas on cylinder 602. This raising of cylinder 603 is temporary, however, as will be recognized by studying the design for cam 740. Consequently, the lower cylinder is thereafter dropped backwardly or lowered until collar 752 engages one of the stop bolts 762 or 763. Depending on the condition of the stop means and collar 752, the distance between the axes of the printing couple cylinders is thus set at any one of three distinct preselected values when printing on both sides of the paper sheets as in perfection work, or selec-

tively at two or three such preselected values when printing on one side of the paper sheets. This feature serves to control the contact pressure and full separation of the printing couple cylinders.

Specifically, it will be recalled that in perfection work substantially one-half of the 360° rotational cycle of cylinder 602 is dedicated to the transfer of an image from a plate member carried in one work area of such larger cylinder to an image receptive member carried at the periphery of the smaller cylinder 603. To accomplish such transfer successfully, a certain contacting pressure is required between the engaging surfaces at the bite of the printing couple and to that end a first distance between centers of the two cylinders is required.

During the next succeeding one-half revolution of the larger cylinder 602, printing of the paper takes place on both sides thereof, the upper face of the paper sheet receiving an impression from a printing medium carried in a second work area of the larger cylinder and the lower face area receiving the impression previously transferred to the underlying blanket cylinder. During such printing stage a second contacting pressure at the bite of the printing couple is desired. This second contacting pressure is desirably less than the first contacting pressure and partial separation of the cylinders is therefore desirable to accommodate the thickness of the paper sheet passing through the bite of the printing couple. Thus a second distance between the centers of the printing couple cylinders is required.

In the event of misfeeding or malfunction of the feeder system, it is of course necessary to completely separate the cylinders of the printing couple, as explained previously, and to that end a third distance between centers of the printing couple cylinders is required.

In contrast to such perfection operation, wherein images are printed on both sides of the paper sheet, printing on one side of the sheet normally necessitates the separation of the axes of the printing couple cylinders to only two distinct distances and possibly three distances as will appear hereinafter, the first distance to accommodate the travel of the paper through the printing couple for the transfer of images thereto and the second distance to accommodate the complete separation of the printing couple cylinders as in the case of malfunction of the feeder system in which event erroneously empty gripper appears at the bite of the printing couple. Such selective separation of the printing couple cylinders is carried out according to the concepts and features of my invention by the provisions and features of the stop mechanism and stop means 754 as will now be explained.

The stop means 754 comprises a crank 760 which is pivoted on post means 761 projecting from side frame plate 609. The pivoting of the stop means 754 is substantially central of its length and the lower end thereof is provided with a pair of threadingly adjustable stop bolts or members 762 and 763. Such stop members are each disposed adjacent to leaf spring members 764 which are designed to engage knurled or fluted surfaces of the stop members to maintain the latter in their threadingly adjusted positions. It will be understood that by threading either of the stop members 762 or 763 inwardly or outwardly, the distance between the pivotal axis defined by the post member 761 and the bottom of such stop members is correspondingly varied. Both stops 762 and 763 are aligned to engage either the outer surface of the raised platform portion 753 of the stop collar or the normal cylindrical surface thereof (see Figures 56 and 57 for example). The matter of which one of such surfaces on the stop collar is engaged by a particular stop member 762 or 763 depends on the rotational position of stop collar 752 with respect to the arm or cylindrical extension 751 of crank 748. This movement of collar 752 is regulated by energization of the solenoid members 759, 760.

In addition to the rotational shifting of collar 752, it

is also necessary that the stop members 762 and 763 be shifted with respect to such rotatable stop collar. In order to accomplish this function, I have provided a suitable linkage arrangement connecting the stop means 754 to cam 741. Specifically, a connecting link 765 is pivotally connected between the upper end of stop means 754 and the lower end of a bell crank 766. Crank 766 carries roller 767 at its upper end for engaging the camming periphery of the plate cam 741 and such is pivoted intermediate its ends on post member 768 attached to the side frame plate 609. Spring member 769 connects between the bell crank 756 and the side frame member 609 to normally bias roller 767 into engagement with the periphery of the plate cam 741.

Cam 741 is formed with a single raised portion 770 and a single depressed portion 771, each of which portions comprises substantially one-half of the circumference for such cam. When the raised portion 770 engages roller 767, the stop member 763 is disposed as illustrated in Figure 55, or that is in a position for engagement with the stop collar 752. When the depressed peripheral surface 771 of cam 741 is contacted by roller 767, however, the stop member 760 is shifted to its dotted line position as illustrated in Figure 55, so that stop bolt 762 thereof is positioned for engagement with the stop collar. This arcuate shifting of arm 760 occurs almost simultaneously, but slightly after the raising of the axis for the blanket cylinder 603 as previously described; such raising of the axis for cylinder 603 serving to relieve the engaging pressure or contact between the adjustable stop members 762 or 763 and stop collar 752. If at the time of the arcuate shifting of the stop means 754, the stop collar has been rotated from its Figure 56 position to its Figure 57 position, according to the energization of solenoid 759, then one of the adjustable stops 762 or 763 will be positioned to engage the cylindrical surface of the stop collar 752 adjacent to the raised platform portion 753 thereon. Such being the case, the throw-out lever or arm 748 will rotate counterclockwise when the roller 743 engages with the portions of cam 740 intermediate the raised nodes 740a and 740b thereon. This circumstance will serve to completely separate the cylinders of the printing couple as desired for the missed sheet situation. The distance of such separation, of course, is determined by the threaded adjustment of the particular stop bolt 762 or 763 so contacting the collar.

As will be recalled, energization of solenoid 759 takes place by the contact of the sensing finger 720 with the micro switch 721. However, if a sheet of paper is present over the undersheet supporting bar members 693, then the sensing finger 720 will not depress into the recess formed in such bar and instead, micro switch 725 will be engaged by the finger 732. Such energization of micro switch 725 serves to energize solenoid 760 to return or maintain the stop collar 752 into its Figure 56 position. In this event, shifting of the stop means 754 serves to bring one of the stops 762 or 763 into contact with raised portion 753 of the stop collar. The positional relationship of the printing couple which results is regulated for either paper thickness or for image transfer; such two instances requiring different spacings between the rotational axes of the printing couple cylinders.

In the case of perfection work, for example, one of the stop members can be adjusted to determine a first distance between axes of the printing couple cylinders, which distance will determine a first contact pressure at the bite as required for the successful transfer of image from plate to blanket. The other stop member would then be set at a second value to give a different axial spacing and thus a second contacting pressure for the printing couple cylinders. This second axial spacing accommodates the passage of paper through the bite of the printing couple without undue compression of the blanket

and pressure platen members between which the paper passes so that there is no difference in surface speed between such members.

In one sided printing, both stops 762 and 763 will normally be set at like projecting values to accommodate the passage of paper; there being no image transfer phase to be accommodated by a separate stop setting as in the case of perfection work.

In some instances of one sided printing, say in two color work where the paper passes through the bite twice before discharge, it may be desirable to have different contacting pressures between each work area of the larger cylinder and the underlying smaller cylinder to accommodate the characteristics of the ink, the heaviness of print etc. In such instance, the stops 762 and 763 may be accordingly adjusted to different settings as required to give the desired printing characteristic.

It will thus be recognized that the adjustable stop means 754 and related cylinder separating and pressure control system leads to improved versatility and control for this general class of press and that while I have related such to the modified press 600, such mechanisms may likewise be employed in the previously described forms of this invention, as well.

It will be also appreciated that the energization of the micro switches of the sensing finger system provides for a very efficient, accurate and positive means for signalling and energizing the cylinder separating operation. It will be recognized that the sensing finger system responds to the presence or absence of sheets of paper actually in the encircling gripper finger system and in advance of the bite of the printing couple so that required separation of such printing couple may occur in proper sequence and relation to the rotational cycle of the printing couple as desired. This system also may be applied in the previously described forms of my invention with modification as to location of the sensing finger to suit the particular gripper system employed.

So far I have considered the feeding, delivery and carrying of paper to and through the bite of the printing couple and the several linkages and mechanisms associated in accomplishing these functions. It is, of course, necessary that paper printed at the couple be discharged from the encircling gripper system and for such mechanism reference is now made to Figures 48, 49 and 58, wherein the discharge system and the means for activating the same according to certain desired circumstances of operation have been illustrated.

Discharge system

Mounted inwardly of the left-hand side frame plate 609 on a pivot axis or pin 775 is a discharge cam or shoe 776 adapted to move arcuately against the biasing effects of a spring member 777. The shoe 776 bears a suitable raised camming face for engaging the rollers 674 of the gripper finger actuating mechanism such that when a gripper assembly passes the shoe 776 and the same is disposed properly with respect thereto, opening and closing of the gripper fingers 666 will occur to transfer paper to the delivery mechanism 627 as shown in Figure 48. The operation of the discharge system, comprising essentially the operation of the shoe cam 776, is brought about by means of a crank 778 having connection with one end of shoe 776 substantially at its pivotal axis 775, the innerconnection of these two members serving to establish substantially a bell crank system. The outer end of crank 778 is joined pivotally to a push rod or link 779 supported on bracket means 780 inwardly of the side plate frame 609. The rod or link 779 carries a cam following roller 781 at its upper end for engaging a plate cam 782 carried on shaft 605 of the intermediate larger cylinder. Cam 782 bears a single depression or node in its otherwise circular circumference, indicated generally at 783. With this type of cam, rotational movement of the intermediate larger cylinder causes the shoe

cam 776 to be raised periodically to an interfering position with the rollers 674 of the gripper finger operating mechanism. Normally, this function occurs once for each 360° of rotation for cylinder 602.

Since in certain instances of operation the discharge phase must be shifted substantially 180° out of phase from the normal condition of the mechanism as illustrated in Figure 49, for example, means are provided to accomplish such purpose. Such means for changing the phase or cycle of operation for shoe cam 776 is brought about by providing a spring-loaded pin means 784 between the plate cam 782 and plate cam 651 immediately adjacent thereto on shaft 605. This relationship may best be understood by examining Figure 58 of the drawings. By withdrawing pin 784 from a suitable opening 785 in the plate cam 651 and rotating plate cam 782 substantially 180°, pin 784 may again be engaged with another opening 785 in plate cam 651. Thus, the phase of operation for the plate cam 782 may be altered to accommodate the phase shift of the discharge cycle.

Such phase change in the discharge cycle is required and necessary in those instances where the press is conditioned to operate for multiple passage of the paper through the bite of the printing couple. It will be helpful to understand and appreciate this requirement if it is remembered that the feeding operation takes place for each 360° of rotation for cylinder 602 and likewise as to the discharge operation. Since the spacing between grippers on the encircling gripper system is substantially equivalent to 180° or one half the circumference for the larger cylinder 602, the feed and discharge operations take place for every other gripper. Since there are three gripper assemblies 664 involved in the encircling gripper system, eventually all grippers are fed to and discharged from. Where the paper passes through the bite of the printing couple only once, it is essential that paper coming in on one side of the bite from the feeding station be discharged immediately after its passage through the printing couple by the discharge means. Such condition of operation is illustrated in the condition for the discharge mechanism as set forth in Figure 49. However, in those instances where a double passage of the paper through the printing couple is desired, as in multi-color work, then it is required that paper being fed in on one side of the bite of the printing couple, or that is, at the feeding station, bypass the discharge cam or station at least once so as to remain in the encircling gripper system for a second pass through the printing couple. While the requirement for feeding and discharging paper to every other gripper remains the same in the double passage situation, the phase of such cycles with respect to the operational phase of the rotational cycle for the printing couple shifts substantially 180° from the single passage condition of such mechanism. Therefore, the necessity for being able to shift the operating cycle of the discharge cam 776 is apparent.

Delivery system

In association with the shift of phase for the discharge cam 776, it is also essential that the delivery system be capable of such phase shift to accommodate release of paper from the encircling gripper system. One means by which such phase shift for the delivery system is accomplished is best illustrated in Figure 49 of the drawings, and comprises a very simple expedient. That is to say, the phase relationship between the grippers 634 of the delivery chain system and the grippers of the encircling gripper system or means, is determined by the positioning of the chains 631 and grippers with respect to the sprocket members 632 and the gear 630 which drives the same.

To shift the phase of the delivery chain system then, it is merely necessary to shift the chains with grippers 634 thereon with respect to the drive gear 630 which motivates such delivery system. It will be recalled that one

set of sprocket wheels 632 is fixed to driven shaft 663, but the drive gear 630 therefor is rotatable on such shaft 633. Interconnection between the drive gear 630 and the shaft 633 is accomplished by means of spring-loaded plunger mechanisms 786, as best shown in Figure 51.

Such plunger mechanisms are mounted on the gear 630 and project into diametrically opposite openings in adjacent sprocket wheel 632. By removing the plungers from such openings in the sprocket wheel and rotating shaft 633 and the sprocket wheels 180° relative to the gear 630, the plunger mechanisms 786 may again be engaged with the openings in the sprocket wheel, thus shifting the delivery system phase 180°.

The opening and closing of the grippers 634 on the delivery chain system is by conventional and known means, which comprises a stationary discharge cam 787 adapted to engage roller members 788 associated with the delivery system gripper bars (see Figure 49). A similar discharge cam is located adjacent the point of the delivery system where take-off therefrom is desired, all in a manner properly described hereinbefore in association with my first and second forms of the present invention.

Ink and dampening system

In order to accomplish printed copy with the press 600 herein described, it is essential that a suitable inking and dampening system be provided to properly transfer ink to the printing members of the printing couple.

Such inking and dampening system is best illustrated in Figure 59 of the drawings wherein such is schematically set forth. Basically, the system therein disclosed follows the teachings of individual ink and dampening units heretofore described with the uppermost larger cylinder 601 having two water units 790 and 791 comprising three rollers each, a first inking unit 792, supplied from fountain 793 and including a movable ductor 794 for selectively isolating such inking unit from the plates or working segments 795 and 796 carried by the upper cylinder 601.

A second ink unit 797 is also employed on the opposite side of cylinder 601 from ink unit 792, such also embodying a movable ductor 798 for isolating that ink unit from cylinder 601. With this arrangement, either or both of the work areas carried by cylinder 601 may be inked with the same or dissimilar colored inks as desired. The intermediate larger cylinder 602 likewise employs a single water unit 799 and an inking unit 800 common to the ink fountain 801 which supplies ink unit 797. In this latter regard, note that ink unit 800 also includes a movable ductor 802 for isolating the same from ink fountain 801. The system of course may be utilized according to the variations previously set forth herein.

Hand throw-out

In order to accommodate the cleaning of the plates or working members on cylinder 601 and to isolate such cylinder from the cylinders 602 and 603, a hand throw-out mechanism, indicated generally at 805, is provided comprising a throw-out lever 806, an adjustable stop 807, a latch plate 808 and spring means 809 (see Figure 59). By pivoting the latch plate 808 against the biasing forces of spring 809, throw-out lever 806 may be raised sufficiently to separate cylinders 601 and 602. This separation will accommodate the isolation of the two cylinders for purposes familiar in the art. The adjustable stop means 807, of course, serves to regulate the contacting pressure between the segments carried by cylinders 601 and 602, the same being illustrated as an adjustable threaded bolt member.

While the foregoing description for machine 600 serves to set forth the basic elements, requirements, functions and operational features of that machine, certain modifications are contemplated therein, as for example the modified support structure for the encircling ring mem-

bers 660 as found in press 600' of Figures 60 and 61 of the drawings.

Modified ring support

The modified ring support of Figures 60 and 61 is directed to the improvement of the encircling gripper system. As shown in these figures, instead of being supported on rollers 661 as shown in Figure 49 of the drawings, ring members 660' are carried on and by a plurality of rollers 810. Such rollers engage and ride in a track 811 formed in the periphery of a supporting ring 812 which is held or otherwise bolted to the supporting side frame members, such as frame plate 608 illustrated in Figure 61. This modified structure for supporting the ring members 660' is believed to provide a more adequate and positive support for such ring members and to insure their circular formation as is essential to the successful operation of this press. Basically, the modification of Figures 60 and 61 reverses the order of the roller supports in that the formerly described support for ring 660 included rollers supported directly from the side frame plates of the press with the ring members themselves riding on such rollers.

Also among the modifications for press 600 is that illustrated in Figure 62 of the drawings, wherein a press capable of producing four-color work is presented.

Four color modification

While the previously described presses of Figures 1 and 31, for example, contemplate the coupling of two or more presses in "tandem" to accomplish multi-color printing operations, machine 600 lends itself to a more adaptable version of a four color press having marked advantage as to compactness and size. These advantages may be recognized by inspecting the schematic representation of such a four color machine, indicated generally by numeral 815 in Figure 62.

Machine 815 includes side frame plates 816 which are suitably held in upright position and maintained in spaced parallelism by cross-connecting structures including a base plate member 817. The machine comprises a pair of printing couples each including two larger cylinders of like diameter and a smaller cylinder disposed beneath such larger cylinders. The cylinders for the two couples are indicated by numerals 818 through 823. Cylinders 818, 820, 821 and 823 are mounted on shafts 824, 825, 826 and 827, respectively, each of which shafts bears eccentric stub ends for accommodating separation of the associated cylinder from the intermediate larger cylinders 819 and 822 as illustrated. Throw-out of the upper cylinders 818 and 823 is by hand operation according to the concept set forth in Figure 59 and described previously. Separation of the smaller or blanket carrying cylinders 820 and 821 is automatic, as previously described and illustrated in Figures 55 through 58 of the drawings.

It will be recognized that the two printing couples, each comprising three cylinders, are disposed so that planes passing through or substantially through the axes of the three cylinders for each couple intersect in substantially V formation. This arrangement lends to the general compactness and efficiency of operation for this press.

The two couples are serviced by a common encircling gripper system 830 comprising a pair of spaced ring members 831 mounted and supported on rollers 632 and carrying suitable gripper bar assemblies of the order previously described and as shown, for example, in Figure 49 of the drawings.

A single motor 835 mounted on the bed plate 817 is connected by belt means 836 to a sheave wheel member 837 mounted on shaft 838 carrying a driving pinion 839. The pinion 839 drives an idler 840 which commonly engages suitable drive gear trains associated with the cylinders 818-823 to simultaneously activate the two couples of the press.

Paper at a stacking station 841 is delivered by conveyor means 842 to the grippers of the encircling gripper system 830 and suitable means of the order described previously in association with press 600 of Figure 48, causes the paper to be carried successively through the bites of the two printing couples once and/or more than once as desired to accomplish multiple operation printing.

A delivery means 845 receives paper discharged from the encircling gripper system 830 and deposits the same at a delivery stacking station 846; the delivery system 845 comprising a set of parallel spaced chain members 847 carrying suitable gripper bars 848 operating according to the concepts outlined for the delivery system 627 of the printing press 600.

Inking means (not shown), substantially paralleling the inking system set forth in Figure 59 of the drawings, are related to each of the two printing couples of machine 815 such that printing plates carried at the periphery of the larger cylinders 818, 819, 822 and 823 may be individually supplied with the same or different colored inks, selectively as desired.

It will be understood that the larger cylinders of press 815 are arranged to carry separated and individual work areas at their peripheries comprising either pressure-platen, letter press, offset and/or dry offset plate members to diversify the results and type of printing operations possible with this press according to the concepts outlined previously herein and as particularly described in association with the press of Figure 1 and diagrammed in Figures 31-33 of the drawings.

It is believed that the foregoing description of the basic and modified forms of my present invention serves to accurately set forth the concepts and inventive features involved therein. It is also believed that those cognizant with the art will readily recognize and appreciate the marked versatility and functional desirability of the invention herein disclosed, and that while various modifications, revisions and substitutions of equivalents may be made in the particular structures illustrated, such departures will not avoid the spirit and scope of the invention therein. As a consequence, it is not my intention to be limited to the particular structural features and aspects of the various forms and modified embodiments of the invention herein illustrated and described except as may appear in the following appended claims.

I claim:

1. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, sheet gripper means encompassing the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the arcuate distance between the centers of the said separated work areas and the spacing between adjacent gripper means being substantially equal.

2. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the large cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, plural sheet gripper means encompassing the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery

of the larger cylinder is divided into an even number of work areas, the arcuate extent of said work areas and the distance between adjacent gripper means normally being substantially equal, and means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once for selectively transferring one or more images thereto from a preselected number of said work areas.

3. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, sheet gripper means encompassing the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the arcuate extent of a work area and the spacing between adjacent gripper means being substantially equal, means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once for selectively transferring images thereto from a preselected number of said work areas, a platen pressure member carried in a work area of the larger cylinder, and means for mounting an ink receptive transfer member on the periphery of the smaller cylinder.

4. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, sheet gripper means encompassing the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the arcuate extent of a work area and the spacing between adjacent gripper means being substantially equal, means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once for selectively transferring images thereto from a preselected number of said work areas, and one or more ink receptive transfer members carried on one or more of the said separated work areas of the large cylinder.

5. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, sheet gripper means encompassing the smaller cylinder, an even number of said gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the arcuate extent of a work area and the spacing between adjacent gripper means being substantially equal, means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once for selectively transferring images thereto from a preselected number of said work areas, means for directly inking said printing members individually, and an ink receptive transfer

member mounted on the periphery of the smaller cylinder.

6. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried in certain of said work areas as selected, sheet gripper means encompassing the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the arcuate extent of a work area and the spacing between adjacent gripper means being substantially equal, means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once for performing corresponding single and multiple printing operations thereon, one or more of the said separated circumferential areas of the periphery of the large cylinder selectively carrying an ink receptive transfer member, means for directly inking said printing members individually, means for mounting an ink receptive transfer member on the periphery of the smaller cylinder, and means for advancing and feeding a sheet to said gripper means on one side of a vertical line extended through the point of tangency of the two said cylinders which is opposite that side of said vertical line on which the sheet emerges from the bite of the cylinders.

7. A printing machine as set forth in claim 6, including a third cylinder of a diameter equal to the said large cylinder and mounted in rotatable tangential relation to the latter, the periphery of said third cylinder being circumferentially divided into the same number of separated work areas as the cylinder adjacent thereto, one or more printing members each carried in one of said separated areas thereon, means for directly inking said printing members individually, and means for bringing the said inked printing members into contact with ink receptive transfer members carried on selected opposed work areas of the adjacent said large cylinder.

8. A printing machine as set forth in claim 6, in which the path of travel of the gripper means from the point at which a sheet is advanced thereto to the passage thereof through the bite of the cylinders is below the axial center of the larger of the two said cylinders.

9. A printing machine as set forth in claim 7 in which the one large cylinder, tangential to the other large cylinder and to the smaller cylinder, lies wholly between two horizontal planes, one passing through the axial center of said other large cylinder and the other passing through the axial center of said smaller cylinder.

10. In a printing machine, a cylinder in rotatable tangential relationship with another of the same diameter and with one other cylinder of smaller diameter, the two larger cylinders having plural spaced work areas correspondingly arranged for coextensive opposition during rotation of the printing couple, said areas carrying separate image producing and image transfer members selected and arranged to produce desired single and multiple printing operations on sheets passed through the bite of the printing couple, sheet gripper means in association with the smaller cylinder to carry a sheet to and through the bite of the small and adjacent larger cylinder once or more than once as selected, means for withdrawing sheets successively from a stack of sheets, means for advancing each sheet as withdrawn to the sheet gripper means, second gripper means in association with sheet conveyor means for withdrawing each sheet from the sheet gripper means after its final passage through said bite and for conveying it to a point of delivery, the said stack from which sheets are withdrawn

and the said point of delivery being on opposite sides of the two points of tangency of the three cylinders, the arrangement being such that the front edge of a sheet is engaged by and withdrawn from the sheet gripper means on opposite sides of said two points of tangency.

11. In a printing machine, a cylinder in rotatable tangential relationship with another of the same diameter and with one other cylinder of smaller diameter, the point of tangency of the two large cylinders being higher than the point of tangency of the small and adjacent large cylinder, the two larger cylinders having plural spaced work areas correspondingly arrayed for coextensive opposition during rotation of the printing couple, first sheet gripper means in association with the smaller cylinder to carry a sheet to and through the bite of the small and adjacent cylinder once or more than once as selected, means for withdrawing sheets successively from a stack of sheets, means for advancing each sheet as withdrawn to the sheet gripper means, second gripper means in association with sheet conveyor means for withdrawing each sheet from the sheet gripper means after its final passage through the bite of the cylinders and for conveying it to a point of delivery, the said stack from which sheets are withdrawn and the said point of delivery being on opposite sides of the two points of tangency of the three cylinders, the arrangement being such that the front edge of a sheet is engaged by and withdrawn from the sheet gripper means on opposite sides of said two points of tangency, and plural image producing and image transfer members arranged in said work areas in a manner selected to produce a desired sequence and arrangement of single and multiple printing operations on sheets passed through said bite.

12. In a printing machine, a cylinder in rotatable tangential relationship with another of the same diameter and with one other cylinder of smaller diameter, the larger cylinders having plural spaced work areas correspondingly arranged for opposition during rotation of the printing couple, sheet gripper means associated with the smaller cylinder to carry a sheet to and through the bite of the small and adjacent larger cylinder once or more than once as selected, means for withdrawing sheets successively from a stack of sheets, means for advancing each sheet as withdrawn to said sheet gripper means, second gripper means for withdrawing each sheet from the sheet gripper means after its final passage through the bite of the cylinders, means for conveying such withdrawn sheets to a point of delivery, the said stack from which sheets are withdrawn and the said point of delivery being on opposite sides of the two points of tangency of the three cylinders, the arrangement being such that the front edge of a sheet emerging from the bite of the cylinders for the final time is withdrawn from the sheet gripper means by said second gripper means before the succeeding sheet is advanced to the sheet gripper means and that the forward edge of a sheet is advanced to and withdrawn from said sheet gripper means from the opposite sides of a vertical line extended through the point of tangency of the small and adjacent large cylinder said work areas carrying separate image producing and image transfer members selected and arranged to produce desired single and multiple printing operations on sheets passed through said bite.

13. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the large cylinder being circumferentially divided into separated work areas, printing members carried in certain of said separated work areas as selected, sheet gripper means associated with the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery of the

larger cylinder is divided into an even number of work areas, the periphery of the smaller cylinder being circumferentially divided into separated areas each carrying an ink receptive transfer member, the arcuate extent between the centers of separated areas on both the large and the smaller cylinders being alike and equal to the distance between adjacent gripper means, the circumference of the smaller cylinder being equal to such arcuate extent multiplied by the number of separated areas into which the said smaller cylinder is divided, and one or more of the said separated circumferential areas at the periphery of the large cylinder being arranged to selectively carry an ink receptive transfer member.

14. In a printing machine, a pair of cylinders of unlike diameters rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried on selected work areas, sheet gripper means associated with the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the periphery of the smaller cylinder being circumferentially divided into separated areas to carry ink receptive transfer members, the arcuate extent between the centers of the separated areas on both the large and the smaller cylinders being alike and equal to the spacing between adjacent gripper means, and the circumference of the smaller cylinder being equal to such arcuate extent multiplied by the number of separated areas into which the said smaller cylinder is divided, one or more of the said separated circumferential areas of the large cylinder selectively carrying an ink receptive transfer member, means for directly inking said printing member individually, and means for mounting an ink receptive transfer member on one or more separated peripheral areas of the smaller cylinder.

15. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried on preselected work areas, sheet gripper means associated with the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an odd number of work areas, and an odd number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the periphery of the smaller cylinder being circumferentially divided into separated areas to accommodate ink receptive transfer members, the arcuate extent between centers of the separated areas on both the large and the smaller cylinders being alike and equal the distance between adjacent gripper means, and the circumference of the smaller cylinder being equal to that arcuate extent multiplied by the number of separated areas into which the said smaller cylinder is divided, and means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once.

16. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder, the periphery of the larger cylinder being circumferentially divided into separated work areas, printing members carried on certain of said separated work areas, plural sheet gripper means associated with the smaller cylinder, an even number of said sheet gripper means being provided when the periphery of the larger cylinder is divided into an

odd number of work areas and an odd number of said gripper means being provided when the periphery of the larger cylinder is divided into an even number of work areas, the periphery of the smaller cylinder being circumferentially divided into separated areas in which are carried ink receptive transfer members, the arcuate extent between centers of the separated areas on both the large and the smaller cylinders being coextensive and equal to the distance between adjacent gripper means, the circumference of the smaller cylinder being substantially equal to such arcuate extent multiplied by the number of separated areas into which its periphery is divided, at least one of the said separated work areas of the large cylinder being arranged to selectively carry an ink receptive transfer member, means selectively operable to cause a sheet to be carried by said gripper means through the bite of the said cylinders once or more than once, and means for advancing and feeding a sheet to a said gripper means from one side of a vertical line extended through the point of tangency of the two said cylinders and opposite from the side of said vertical line at which the sheet emerges from the bite of the cylinders.

17. A printing machine as set forth in claim 16, including a third cylinder of a diameter equal to the said large cylinder and mounted in rotatable tangential relation thereto, the periphery of said third cylinder being circumferentially divided into the same number of separated areas as the cylinder adjacent thereto, one or more printing members, each carried in one of said separated areas of said third cylinders, means for directly inking such printing members individually, and means for bringing the said inked printing members into contact with ink receptive members carried on opposed areas of the adjacent large cylinder.

18. A printing machine as set forth in claim 16, in which the path of travel of the gripper means from the point at which a sheet is advanced thereto to the passage thereof through the bite of the cylinders is beneath the axial center of the larger of the two said cylinders.

19. A printing machine as set forth in claim 17, in which the one large cylinder lies tangential to the other large cylinder and to the smaller cylinder within an area between two horizontal planes, one of which passes through the axial center of the said other large cylinder to which it is tangential and the other of which passes through the axial center of the said smaller cylinder.

20. A printing machine, as set forth in claim 6, comprising, means for conveying a sheet from the bite of the cylinders thereof, after having passed through said bite selectively once or more than once, to a second printing machine and through the bite of the cylinders thereof once or more than once, said conveying means comprising a unit rotatably co-acting with the smaller cylinders of both printing machines and carrying a plurality of sheet gripper members, the space between each such gripper members being equal to the circumference of a said smaller cylinder, and the number of said gripper members being an odd number when the periphery of said large cylinder is divided into an even number of separated areas and an even number when the periphery of said large cylinder is divided into an odd number of such separated areas.

21. In a printing machine, as described in claim 20, means for conveying a sheet, after it has passed through the bite of the cylinders of the first said printing machine once and through the bite of the cylinders of the said second printing machine once, to and through the bite of the cylinders of the first said printing machine a second time and thereafter to and through the bite of the cylinders of the said second said printing machine a second time.

22. In a printing machine, as described in claim 6, revolvable sheet gripper carrier means for conveying sheets from the bite of the cylinders thereof to a second printing machine and encompassing the smaller cylinders of

the first and second printing machines, said revolvable sheet gripper means supporting and carrying an odd number of sheet grippers if the peripheries of the large cylinders are divided into an even number of separated areas, and supporting and carrying an even number of sheet grippers if the peripheries of the large cylinders are divided into an odd number of separated areas, means for feeding and advancing a sheet to every other sheet gripper supported on the said revolvable sheet gripper carrier means, means for holding a sheet in said sheet gripper while it passes to and through the bite of the cylinders of the first printing machine for the first time and for retaining such hold on the said sheet in the same gripper to an into the bite of the cylinders of the said second printing machine for the first time, selective means for releasing the said gripper hold on the same said sheet after the said gripper has passed through the bite of the cylinders of the said second printing machine for the first time or for retaining the said hold on the same said sheet in the same said gripper and conveying the said sheet back to and through the bite of the cylinders of the first and second said printing machine for a second time, and means for releasing the said gripper hold on the said sheet after the said gripper has passed through the bite of the cylinders of the second printing machine for the second time.

23. In a printing machine as set forth in claim 6, gripper conveyor delivery means having means associated therewith to cause a sheet to be released from the sheet gripper means after the same has passed through the bite of the cylinders once and more than once as selected, means on said gripper conveyor delivery means to grip the sheet so released, said gripper conveyor delivery means serving to carry such sheet toward a point of discharge, and means to release the sheet from the said gripper conveyor delivery means.

24. In a printing machine as described in claim 16, gripper conveyor delivery means having means associated therewith to cause a sheet to be released from the sheet gripper means after the same has passed through the bite of the cylinders once or more than once as selected, means associated with the said gripper conveyor delivery means to grip the sheet so released, said gripper conveyor delivery means being arranged to carry the sheet toward the point of discharge, and additional means to discharge the sheet from the said gripper conveyor delivery means.

25. In a printing machine as set forth in claim 6, sheet gripper carrier means revolvable in a path substantially encompassing the area in which the smaller cylinder of the printing machine is contained and arranged to support and carry an odd number of said sheet gripper means if the periphery of the large cylinder adjacent to the smaller cylinder is divided into an even number of separated areas or an even number of said sheet gripper means if the periphery of the large cylinder is divided into an odd number of separated areas, the distance between adjacent sheet gripper means being substantially equal to the circumference of the said large cylinder divided by the number of separated areas into which the periphery of the said large cylinder is divided, means for holding a sheet advanced to said gripper means, and for carrying the said sheet so held into the bite of the said cylinders once or more than once, and selective means for releasing the said sheet from the said sheet gripper means after the sheet therein has passed through the bite of the cylinders once or more than once.

26. In a printing machine as set forth in claim 7, means for inking two of said printing members from a common source, one of such printing members being carried on the periphery of one of said two named large cylinders and the other of such printing members being carried on the periphery of the other of said large cylinders.

27. In a printing machine as described in claim 7, means for inking two of said printing members from a common

source, one of which members is carried on the periphery of one of the two named large cylinders and the other of which members is carried on the periphery of the other of said large cylinder, and selective means for inking said printing members individually or simultaneously from said source during the rotation of the said cylinders.

28. In a printing machine as described in claim 17, means for inking two of said printing members from a common source, one of which members is carried on the periphery of one of the two named large cylinders and the other of which members is carried on the periphery of the other of said large cylinders.

29. In a printing machine as described in claim 17, means for inking two of said printing members from a common source, one of which members is carried on the periphery of one of the two named large cylinders and the other of which members is carried on the periphery of the other large cylinder, and selective means for inking either or both of said printing members from said common source during the rotation of the said cylinders.

30. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger being wholly divisible by the diameter of the smaller, the periphery of the larger cylinder being circumferentially divided into separated work areas, plural sheet gripper means supported on endless means encircling said smaller cylinder and arranged to pass through the bite of the said cylinders and to selectively carry a sheet therethrough once or more than once, an even number of said sheet gripper means being provided when the large cylinder bears an odd number of work areas and an odd number when the large cylinder bears an even number of work areas, sheet stop means, means for advancing a sheet to said sheet stop means, means for opening said sheet gripper means, means for closing said sheet gripper means, the said means for closing the said sheet gripper means being operative after the sheet's advancement to the said sheet stop means and before the said sheet gripper means reaches the bite of the cylinders, the path of sheet travel from the said sheet stop means to the bite of the cylinders being substantially horizontal and spaced outwardly from the periphery of the smaller cylinder, the endless gripper supporting means causing a sheet traveling to the bite of the cylinders more than once to pass beneath the path of sheet advancement to the said sheet stop means.

31. In a printing machine, two rotatable cylinders mounted in tangential relationship, the diameter of one of which is less than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, two rotatable endless ring members whose path encompasses the smaller cylinder, two or more sheet gripper bar members extending between said ring members, the arcuate distance between each two sheet gripper bar members being equal to the circumference of the smaller cylinder, two or more work areas on the periphery of the large cylinder circumferentially separated by lateral gaps which during rotation of the two cylinders oppose one or more lateral gaps in the periphery of the smaller cylinder and through which gaps the said sheet gripper bars pass during said cylinder rotation, sheet guide and end stop members which members are positioned intersectingly across the travel path of said gripper bar members, sheet gripper means on each sheet gripper bar member, means for closing said gripper means to seize a sheet advanced to said sheet end stop members for carrying said sheet to the bite of said cylinders, means for opening said sheet gripper means after the sheet has emerged from said bite and before the said sheet gripper means again pass the said sheet guide and end stop means, means for withdrawing the said sheet guide and end stop means from their position intersecting the travel path of said sheet gripper bar members, and means for restoring the said sheet guide and end stop means to their position intersecting the said

travel path once during each revolution of the large cylinder.

32. In a printing machine, two rotatable cylinders mounted in tangential relationship, the diameter of one of which is less than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, two rotatable endless ring members whose path encompasses the smaller cylinder and which are spaced apart, two or more sheet gripper bar members extending between the two endless ring members, the arcuate distance between adjacent said sheet gripper bar members being equal to the circumference of the smaller cylinder, two or more work areas on the periphery of the large cylinder circumferentially separated by lateral gaps which during rotation of the two cylinders oppose one or more lateral gaps in the periphery of the smaller cylinder and through which gaps the said sheet gripper bars pass during said cylinder rotation, sheet guide and sheet end stop members having laterally spaced open spaces at their forward edges and which intersect the travel path of said sheet gripper bar members, the latter being provided with laterally spaced open spaces positioned to pass by and through the portions of the sheet guide and end stop members between the said laterally spaced open spaces therein, sheet gripper means mounted on each sheet gripper bar, means for closing said gripper means to seize a sheet advanced to said stop members and to carry said sheet therefrom to the bite of said cylinders, means for opening said gripper means after said sheet has emerged from said bite and before said sheet gripper means again pass the said sheet guide and end stop means, means for withdrawing the said sheet guide and end stop means from their position intersecting the travel path of said bar members, means for restoring the said sheet guide and end stop means to their position intersecting the travel path of said gripper bar members at each revolution of the large cylinder, and means for moving the said sheet guide and end stop members forwardly in the general direction of travel for a said gripper bar member next to reach the bite of the two cylinders, said forward movement of the sheet guide and end stop members being timed to start when a sheet gripper means has first seized the sheet therefrom.

33. In a printing machine, two rotatable cylinders mounted in tangential relationship, the diameter of one of which is less than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, two rotatable endless ring members whose path encompasses the smaller cylinder and which are spaced apart by two or more sheet gripper bar members whose ends are attached to the two rotatable endless ring members, the arcuate distance between adjacent sheet gripper bar members being equal to the circumference of the smaller cylinder, two or more work areas on the periphery of the large cylinder circumferentially separated by lateral gaps which during rotation of the two cylinders oppose one or more lateral gaps in the periphery of the smaller cylinder and through which gaps the said sheet gripper bars pass during said cylinder rotation, sheet gripper members mounted on the said sheet gripper bar members, means to open said sheet gripper members after they have passed through the point of tangency of the two cylinders, means for first advancing a sheet to stop members, means to thereafter advance a sheet to the said open sheet gripper members, and means to thereafter close the said sheet gripper members and remove the sheet from said stop members before said gripper members reach the point of tangency of the said two cylinders.

34. A printing machine as set forth in claim 2, comprising means for detecting the absence of a sheet next intended to pass through the bite of the cylinders, means coacting with said detector means for separating the said cylinders, such separation taking place when a space between separated areas on the large cylinder is opposed

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to a similar space on the smaller cylinder, and means for returning such separated cylinders to tangency when such spaces are later opposed during cylinder rotation.

35. In a printing machine as set forth in claim 13, means for detecting the absence of a sheet next intended to pass through the bite of the cylinders, means coacting with said detector means for separating the said cylinders, such separation taking place when a space between separated areas on said larger cylinder is opposed to a similar space on the smaller cylinder, and means for returning such separated cylinders to tangency when such spaces are later opposed during cylinder rotation.

36. In a printing machine as set forth in claim 33, a pivoted extended member related to the axis of the smaller cylinder, means for urging the axis of the smaller cylinder away from the axis of the large cylinder, means whereby the movement of said pivoted member effects the movement of the smaller cylinder toward or away from the axis of the large cylinder, a member rotatably mounted on said extended member, a stop member positioned to engage said rotatable member, a first surface on said rotatable member which when engaged with the said stop member limits the withdrawal of the axis of the smaller cylinder from the axis of the large cylinder to define an operative printing position therefor, a second surface on the said rotatable member offset from said first surface, sheet detector means arranged to detect the presence or absence of a sheet after the means for advancing the first sheet to the said stop fingers has so operated, a first microswitch including means for its energization when the sheet detector means detects the presence of a sheet, means in association with the said rotatable member which is movable upon the energization of said first microswitch to present the said first surface thereon to said stop member, a second microswitch having means for its energization when the sheet detector means fails to detect the presence of a sheet, means in association with the said rotatable member which is movable upon the energization of the said second microswitch to withdraw the said first surface of the said rotatable member and present its said second surface to the said stop member thereby permitting movement of the axis of the smaller cylinder away from the axis of the large cylinder to a non-operative printing position, and means for limiting the last said movement.

37. A printing machine as described in claim 36, including means whereby the sheet detector means is selectively operable at each revolution of the large cylinder or at each half revolution thereof.

38. In a printing machine, two rotatable printing couple cylinders mounted in tangential relationship, the diameter of one being less than and wholly divisible into the diameter of the other, two or more work areas on the periphery of the larger cylinder circumferentially separated by lateral gaps which during rotation of the two cylinders oppose one or more lateral gaps in the periphery of the small cylinder, sheet gripper means and means for advancing a sheet thereto, means for moving said sheet gripper means and for causing it to pass through the point of tangency of the two cylinders when a gap in the larger cylinder is opposed to a gap in the smaller cylinder, means for opening the said sheet gripper means before a sheet is advanced thereto, means for closing said sheet gripper means before such reaches the point of tangency of the two cylinders, means for maintaining a first predetermined distance between the axes of the two cylinders during the rotational opposition of one work area on the periphery of the large cylinder to a peripheral area on the smaller cylinder, and additional means for maintaining a second different predetermined distance between the axes of the two cylinders during the rotational opposition of another work area on the periphery of the large cylinder to the same or different peripheral area on the smaller cylinder

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thereby to provide distinctly different printing pressures over said separated work areas.

39. In a printing machine, two rotatable cylinders mounted in tangential relationship, the diameter of one being less than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, two or more work areas on the periphery of the larger cylinder circumferentially separated by lateral gaps which during rotation of the two cylinders oppose one or more lateral gaps in the periphery of the small cylinder, plural sheet gripper members and means for advancing a sheet thereto, means for moving said sheet gripper members along an endless path encircling said smaller cylinder and causing the same to pass through the point of tangency of the two cylinders when a gap in the larger cylinder is opposed to a gap in the small cylinder, means for opening each sheet gripper member before a sheet is advanced thereto, means for closing each sheet gripper means before it reaches the point of tangency of the two cylinders, means for maintaining a first predetermined distance between the axes of the two cylinders during the rotational opposition of one work area on the periphery of the large cylinder to a peripheral area on the small cylinder, means for maintaining a second different predetermined distance between the axes of the two cylinders during the rotational opposition of another work area on the periphery of the large cylinder to the same or different peripheral area on the smaller cylinder, and means for maintaining the same distance between the axes of the two cylinders during the rotational opposition of both said two work areas on the periphery of the large cylinder to the same or different peripheral area on the smaller cylinder.

40. A printing machine, as set forth in claim 38, in which means are provided for urging the axis of the smaller cylinder away from the axis of the large cylinder and in which the said means for maintaining one distance between the two said areas during the rotational opposition of one work area on the periphery of the large cylinder to a peripheral area on the smaller cylinder and for maintaining a different distance during the rotational opposition of another work area on the periphery of the large cylinder to the same or different peripheral areas on the smaller cylinder comprise separately adjustable stop members which are alternately presented to and brought into contact with a member associated with the smaller cylinder, thereby to limit the movement of the axis of the smaller cylinder away from the axis of the large cylinder.

41. A printing machine as set forth in claim 38, in which means are provided for urging the axis of the smaller cylinder away from the axis of the large cylinder and in which the means for maintaining one distance between the two said areas during the rotational opposition of one work area on the periphery of the large cylinder to a peripheral area on the smaller cylinder and for maintaining a different distance during the rotational opposition of another work area on the periphery of the large cylinder to the same or different peripheral areas on the smaller cylinder comprise separately adjustable stop members which are alternately presented to and brought into contact with a member associated with the smaller cylinder thereby to limit the movement of the axis of the smaller cylinder away from the axis of the large cylinder, and means operative during the rotational opposition of a gap in the large cylinder to a gap in the smaller cylinder to effect the separation of the said member associated with the smaller cylinder and one of said stop members, means operative during the same rotational opposition of the same gaps to effect the positional presentation of said alternate separately adjustable stop member to the said member in association with the smaller cylinder, such presentation of said alternate stop member being effected during the separation of said one stop

member and the member in association with the smaller cylinder, and means effective after presentation of the said alternate stop member to end said separation, said last means being operative during the same rotational opposition of the same said gaps.

42. In a printing machine, two cylinders of unlike diameter, the diameter of the large cylinder being wholly divisible by the diameter of the smaller, the two printing couple cylinders being mounted in rotatable tangential relation, the periphery of the larger cylinder being circumferentially divided into two or more work areas separated by lateral gaps, one or more lateral gaps in the periphery of the smaller cylinder, each gap in the larger cylinder rotationally opposing a gap in the smaller cylinder during each revolution of the larger cylinder, means for separating the axes of the two cylinders, two or more adjustable stop members, one of which limits the separation of the axes of the two cylinders to a first distance during the rotational opposition of one work area on the large cylinder to an area on the smaller cylinder and the other of which limits separation of the axes of the cylinders to a second distance during the rotational opposition of another work area on the large cylinder to the same or different area on the smaller cylinder, said distances being regulated by adjustment of said stop members.

43. In a printing machine as described in claim 42, means operative during the rotational opposition of a gap in the large cylinder to a gap in the smaller cylinder to position said one stop member for limiting separation of the two cylinders, means operative during the rotational opposition of another gap in the large cylinder to a gap in the smaller cylinder to retract the said one stop member from its limiting position, and means to position the other stop member to limit the separation of the axes of the two cylinders, said last means being operative during the rotational opposition of the same said gaps in the large and small cylinders which are opposed during the retraction of the said one stop member.

44. In a printing machine as set forth in claim 43, means operative during the first portion of the rotational opposition of each gap in the large cylinder to a gap in the smaller cylinder for decreasing the distance between the axes of the two said cylinders, means for maintaining said decreased distance during the retraction of said one stop member and the positioning of said other stop member to its position for limiting the separation of said cylinders, and means for thereafter separating the axes of the said cylinders a distance defined by the said other stop member, the last said means being operative during the latter portion of the rotational opposition of the same gaps in the large and small cylinders which were opposed when the said decrease of the distance between the axes of the two said cylinders, the retraction of one said stop member and the positioning of the other stop member were effected.

45. A printing machine as described in claim 44, in which means are provided to selectively advance a sheet to and through the bite of the two cylinders once or more than once.

46. In a printing machine as described in claim 44 including means to detect the presence of a sheet at a predetermined point of its advancement toward the bite of the two said cylinders and at a predetermined time during the revolution of the large cylinder, and means operative upon such detection to limit the separation of the axes of the two said cylinders to a predetermined operative printing position.

47. In a printing machine as described in claim 44, means to detect the absence of a sheet at a predetermined point and at a predetermined time during the revolution of the large cylinder, and means operative upon the detection of such sheet absence to initiate the separation of the axes of the two cylinders to a non-operative printing position.

48. In a printing machine as described in claim 45, means for the detection of the presence of a sheet at a predetermined point and at more than one predetermined time during the revolution of the large cylinder, and means operative upon each such detection to limit the separation of the two said cylinders to a predetermined operative printing position.

49. In a printing machine as described in claim 45, means to detect the absence of a sheet at a predetermined point and at more than one predetermined time during the revolution of the large cylinder, and means operative upon each such detection to initiate the separation of the axes of the said two cylinders to a non-operative printing position.

50. In a printing machine two cylinders mounted in rotatable tangential relationship, the diameter of one being larger than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, sheet gripper means associated with the smaller cylinder, a lateral gap in the smaller cylinder, two or more lateral gaps in the larger cylinder each of which opposes the said gap in the smaller cylinder during revolution of such cylinders, a member arranged to extend into the gap of the smaller cylinder, lateral openings between the said sheet grippers so arranged that during rotation of said cylinders the sheet grippers pass by and through the said member, means to advance the forward edge of a sheet into the said sheet grippers and register the same against said member positioned in the small cylinder's gap, and means for periodically moving said member into and out of its sheet registering position.

51. In a printing machine, two cylinders in rotational tangential relationship, the diameter of one being larger than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the other, sheet gripper means associated with the smaller cylinder and arranged to pass through lateral gaps provided in each cylinder, such gaps being in rotational opposition during revolution of the cylinders, stop members, means for advancing a sheet to said stop members, a cross bar member disposed under the forward portion of a sheet when advanced to said stop members, one or more openings in the upper face of said cross bar member connecting with suction means, means for causing said suction means to become operative after the advancement of a sheet to said stop members, one or more sheet contact members arranged above the sheet so advanced and above the suction openings in the upper face of the said cross bar member, means for causing the said contact members to come into pressure contact with the sheet when the suction means first becomes operative, means for moving the said stop members, the said cross bar member and the sheet contacting members forwardly to the leading edge of said sheet into said sheet gripper members, means to move the stop members out of the path of the said sheet's forward movement, means to close the sheet grippers on the forward edge of the sheet at the end of said forward movement, means to thereupon disrupt said suction means and lift the said contact members and means to return the cross bar member, the contact members and the stop members rearwardly to their first position.

52. In a printing machine, two rotatable cylinders in tangential relationship, the diameter of one of which is less than the diameter of the other, the diameter of the larger being wholly divisible by the diameter of the smaller, two rotatable endless ring members whose path encircles the smaller cylinder and which ring members are spaced apart by two or more gripper bar members attached thereto, the arcuate distance between adjacent gripper bar members being equal to the circumference of the smaller cylinder, means for opening and closing said gripper bar members, two or more work areas on the periphery of the larger cylinder circumferentially separated by lateral gaps, one or more lateral gaps in the

periphery of the smaller cylinder, the number of gripper bars provided being an odd number when an even number of said work areas are provided on the large cylinder and an even number when an odd number of said work areas are provided, an undersheet support member positioned between said rotatable endless ring members and pivoted axially with the smaller cylinder, means for maintaining said cross support member radially inward of the path of travel of the said sheet gripper bar members, means operative after the passage of each said sheet gripper bar member past said support member to pivot said support member to a stationary position substantially adjacent said path of travel of said gripper bar member and between the point at which closing of the sheet gripper members is effected and the point of tangency of the two cylinders, means for maintaining said cross bar member in said stationary position until after the closed sheet gripper member has emerged from the bite of the two cylinders, and means for thereafter returning said cross bar member to its first said position radially inward of the path of travel of the said sheet gripper bar members and before the next sheet gripper bar member has reached the position at which closure thereof is effected.

53. In a printing machine, two cylinders mounted in rotatable tangential relationship, the diameter of one being larger than the diameter of the other and the diameter of the smaller being wholly divisible into the diameter of the larger, two or more work areas on the periphery of the larger cylinder circumferentially separated by equally spaced lateral gaps, a lateral gap in the smaller cylinder arranged to oppose each gap on the larger cylinder during rotation, sheet gripper bar means associated with the smaller cylinder, a pair of parallel spaced endless members, said sheet gripper bar members being mounted to and between said two endless members and spaced apart a distance equal to the circumference of the smaller cylinder, an even number of said gripper bar members being provided if the larger cylinder's periphery is provided with an odd number of gaps and an odd number of said gripper bar members being provided if the larger cylinder periphery is provided with an even number of gaps, means for advancing a sheet to a sheet gripper bar member at each revolution of the large cylinder, means for motivating said endless members to pass the said sheet gripper bar members through the opposed gaps in the cylinders during cylinder rotation, means to detect the absence of a sheet during its approach to a sheet gripper bar member, actuator members mounted on said endless members adjacent each gripper bar member and in advance thereof, each actuator member having an operative and a non-operative position, means for retaining said actuator members in a non-operative position, means operative upon the detection of the absence of a sheet to position said actuator members into an operative position before the next following gripper bar member enters the opposed gaps of the rotating cylinders, means activated by said operatively positioned actuator member to separate the cylinders, and means to restore the said operatively positioned actuator member to a non-operative position after the said next following gripper bar member has passed through the opposed gaps in the cylinders twice and subsequent to the operative positioning of the said actuator member.

54. In a printing machine, two cylinders in rotatable tangential relation, one of which is larger than the other, the diameter of the larger being wholly divisible by the diameter of the smaller, the periphery of the larger being divided into two or more work areas circumferentially separated by lateral gaps, sheet gripper means, an odd number of sheet gripper means being provided if an even number of said work areas are provided and an even number thereof being provided if an odd number of said work areas are provided, means for maintaining a predetermined distance between the axial centers of the

two cylinders during the rotational opposition of one work area on the large cylinder to a surface on the small cylinder, means for maintaining a different predetermined distance between the axial centers of the two cylinders during the rotational opposition of another work area on the large cylinder to a surface on the small cylinder, means for advancing a sheet to the sheet grippers, means in association with the sheet gripper means for carrying a sheet to and through the bite of the cylinders and between a work area on the large cylinder and a surface on the small cylinder, selective means for either thereupon discharging the sheet from the sheet gripper means or for again carrying it to and through the bite of the cylinders and between another work area on the large cylinder and a surface on the small cylinder, means for increasing the distance between the axial centers of the cylinders before a sheet gripper means to which a sheet has not been advanced passes through the bite of the cylinders, and means for maintaining such increased distance during a full revolution of the large cylinder.

55. In a printing machine, two cylinders in rotatable tangential relation, one of which is larger than the other, the diameter of the larger being wholly divisible by the diameter of the smaller, the periphery of the larger being divided into two or more work areas circumferentially separated by lateral gaps, sheet gripper means, an odd number of sheet gripper means being provided if an even number of said work areas are provided and an even number of sheet gripper means being provided if an odd number of said work areas are provided, means for maintaining a predetermined distance between the axial centers of the two cylinders during the rotational opposition of one work area on the large cylinder to a surface on the small cylinder, means for maintaining a different predetermined distance between the axial centers of the two cylinders during the rotational opposition of another work area on the large cylinder to a surface on the small cylinder, means for advancing a sheet to the sheet grippers, means in association with the sheet gripper means for carrying a sheet to and through the bite of the cylinders and between a work area on the large cylinder and a surface on the small cylinder, selective means for either thereupon discharging the sheet from the sheet gripper means or for again carrying it to and through the bite of the cylinders and between another work area on the large cylinder and a surface on the small cylinder, means for increasing the distance between the axial centers of the cylinders before a sheet gripper means to which a sheet has not been advanced passes through the bite of the cylinders and means for maintaining such increased distance during the rotational opposition of one work area on the large cylinder to a surface on the small cylinder.

56. In a printing machine, a first cylinder in rotatable tangential relation to a second cylinder, the diameter of the said first cylinder being greater than and wholly divisible by the diameter of the said second cylinder, the periphery of the said first cylinder being circumferentially divided into three or more equal work areas and the periphery of the said second cylinder comprising at least one work area substantially equal in arcuate extent to a work area on the said first cylinder, a third cylinder in rotatable tangential relation to and of equal diameter with the said first cylinder and having at least one work area on its periphery, the arcuate extent of which is substantially equal to a work area on the said first cylinder, means for mounting an ink receptive medium on a work area of said third cylinder, means for mounting an ink receptive medium on a work area of the said second cylinder, means for mounting ink receptive mediums on at least two of the work areas of the said first cylinder, means for directly transferring one ink image from an ink receptive medium mounted on one of the work areas of the said first cylinder to an ink receptive medium

mounted on the periphery of the said second cylinder, means for directly transferring an ink image from an ink receptive medium mounted on the periphery of the said third cylinder to an ink receptive medium mounted on a work area of the said first cylinder, means for rotatably opposing the transferred ink image on the periphery of the said second cylinder to the transferred ink image on the periphery of the said first cylinder, and means for passing a sheet to the bite of the said first cylinder and the said second cylinder and between the said two opposed ink images.

57. A printing machine as in claim 56, in which the operational work areas into which the periphery of the said cylinders are circumferentially divided are separated by lateral gaps.

58. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder; plural printing members carried at separated areas of the periphery of the larger cylinder, plural sheet gripper means movable with endless means encircling said smaller cylinder, means selectively operable to cause a sheet to be carried by each said gripper means through the bite of said two cylinders once and more than once, the number of said gripper means differing from the number of said printing members by at least one, means for advancing and feeding a sheet to said gripper means from one side of a vertical line extending through the bite of said cylinders, and means for receiving a sheet from said gripper means on the other side of said line.

59. In a printing machine, a pair of cylinders of unlike diameter rotatably mounted in tangential relation, the diameter of the larger cylinder being wholly divisible by the diameter of the smaller cylinder; sheet gripper means movable with endless means encircling the smaller cylinder, means for advancing and feeding a sheet to said gripper means from one side of a vertical line extending through the point of tangent contact between said smaller cylinder and the larger cylinder, and means for receiving a sheet from said gripper means on the other side of said line, means selectively operable to cause said gripper means to carry a sheet to be printed through the bite of said two cylinders once and more than once, means for mounting a plurality of printing members at separated circumferential areas of said larger cylinder, the arcuate extent of each of such areas being substantially coextensive with the circumference of said smaller cylinder, and means for directly inking said printing members.

60. In a printing machine, a pair of rotatable cylinders of equal diameter, a third cylinder of smaller diameter, the diameter of each larger cylinder being wholly divisible by the diameter of the smaller cylinder, each of said cylinders being in tangent contact with one other cylinder; said larger cylinders having plural separated work areas correspondingly arrayed for opposition during rotation of the printing couple, said areas carrying separate image producing and image transferring members selected and arranged to produce desired single and multiple printing operations on sheets carried through the bite of said printing couple, gripper means encompassing the smaller cylinder, means selectively operable to condition said gripper means to carry a sheet to be printed through the bite between the smaller and its next adjacent cylinder once and more than once, means for advancing and feeding a sheet to said gripper means from one side of a line extending through the axial center of said smaller cylinder and its point of tangent contact with the next adjacent cylinder, and means for receiving a sheet from said gripper means on the other side of said line.

61. In a printing mechanism, a pair of cylinders having like diameters, a third cylinder of smaller diameter, the diameter of each of said cylinders of like diameter

being wholly divisible by the diameter of said smaller cylinder, each of said cylinders being in tangential engagement with one other cylinder, said larger cylinders having plural separated work areas correspondingly arrayed for opposition during rotation of the printing couple, said work areas carrying separate image producing and image transferring members selected and arranged to impart desired single and multiple printing operations to sheets passed through the bite of the printing couple, the arrangement of said cylinders being such that a vertical line extending through the point of tangency of said smaller cylinder and its next adjacent cylinder intersects all three of said cylinders, gripper means movable with said smaller cylinder, feeder means for delivering sheets to be printed to said gripper means at a point located on one side of said line, and delivery means for receiving sheets from said gripper means on the opposite side of said line.

62. In a printing machine, a pair of cylinders having like diameters, a third cylinder of smaller diameter, each of said cylinders tangentially contacting one other of said cylinders, the diameters of the first named cylinders being wholly divisible by the diameter of the smaller cylinder, plural printing members carried at separated areas on the periphery of each of said first named cylinders, said printing members being arranged and selected in opposed pairs to produce desired single and multiple printing operations on sheets carried through the bite of the printing couple, plural sheet gripper means movable with said smaller cylinder and arranged to carry sheets to be printed to and through the bite between said smaller and next adjacent cylinder once and more than once as selected, the number of said gripper means differing from the number of said printing members by at least one; each of said pairs of opposed printing members causing a transfer of an image to said sheets.

63. In a printing machine, a pair of cylinders of like diameter rotatably mounted in tangential relation, a third cylinder in tangential contact with one of said cylinders, the diameter of each cylinder of said pair being a whole multiple of the diameter of said third cylinder, sheet gripper means movable with said third cylinder, the two larger cylinders having plural spaced work areas correspondingly paired for image transferring opposition during rotation of the printing coupling, means selectively operable to cause said gripper means to carry a sheet through the point of contacting tangency of said third cylinder with one cylinder of said pair, once and more than once as selected; means for advancing a sheet to said gripper means, conveyor means for receiving a sheet from said gripper means, after it has passed through said point of tangency for the final time, to convey the same to a delivery point; and means for transferring said sheet from said gripper means to said conveyor means.

64. In a printing machine, a pair of rotatable tangentially contacting cylinders of like diameter, a third cylinder related in tangential engagement with one cylinder of said pair, the diameter of each cylinder of said pair being a whole multiple of the diameter of said third cylinder, the axial center of said third cylinder being below the axial center of both cylinders of said pair, sheet gripper means movable about the axis of said third cylinder, means for advancing a sheet to said sheet gripper means, means selectively operable to cause said gripper means to carry a sheet to and through the point of contacting tangency of said third cylinder with one cylinder of said pair, once and more than once; conveyor means for receiving a sheet from said gripper means after the same is passed through said point of tangency for the final time, means for transferring said sheet from said gripper means to said conveyor means, and means for mounting printing members at separated peripheral areas of said pair of cylinders, the said peripheral areas corresponding substantially to the circumferential surface of said third

cylinder and opposing one another during rotation of the printing couple cylinders to produce desired single and multiple image transfer to sheets carried through said point of tangency.

65. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through the said lateral gap during a rotation of the smaller cylinder, a third cylinder mounted in rotatable tangential relation to the large cylinder, means for carrying a primary printing member on the periphery of the said third cylinder, means for carrying a printing transfer member on a portion of the periphery of the said large cylinder, and means for selectively controlling the number of times each gripper member carries the same sheet through said lateral gap.

66. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable ring members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a first lateral gap in the smaller cylinder, means for carrying a sheet gripper member through said lateral gap during rotation of the smaller cylinder, means for mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a second lateral gap through which a sheet gripper member is arranged to pass during a rotation of the said second smaller cylinder, a second large cylinder mounted in rotatable tangential relation to the said second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, and means selectively controlling the number of times each gripper member carries the same sheet through said first and second gaps.

67. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through the said lateral gap during rotation of the smaller cylinder, a third cylinder mounted in rotatable tangential relation to the large cylinder, means for carrying a primary printing member on the periphery of the said third cylinder, means for carrying a printing transfer member on a portion of the periphery of the said large cylinder, means mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a lateral gap through which a sheet gripper member is arranged to pass dur-

ing rotation of the said second smaller cylinder, a second large cylinder mounted in rotatable tangential relation to the second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, means for carrying a primary printing plate on a portion of the periphery of the said second large cylinder, and means selectively controlling the number of times each gripper member carries the same sheet through the gap of each of said two smaller cylinders.

68. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable ring members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through the said lateral gap during rotation of the smaller cylinder, a third cylinder mounted in rotatable tangential relation to the large cylinder, means for carrying a primary printing member on the periphery of the said third cylinder, means for carrying a printing transfer member on a portion of the periphery of the said large cylinder, means mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a lateral gap through which a sheet gripper member is arranged to pass during rotation of the said second smaller cylinder, and a second large cylinder mounted in rotatable tangential relation to the second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, means for carrying a primary printing plate on a portion of the periphery of the said second large cylinder, means mounting a fourth cylinder in rotatable tangential relation to the said second large cylinder, means for carrying a primary printing member on the periphery of the said fourth cylinder, means for carrying a printing transfer member on a portion of the said second large cylinder, and means selectively controlling the number of times each gripper means carries the same sheet through the two-named gaps in order to provide selected single and multiple image transfers on one or both sides of the sheet.

69. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable ring members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper members carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through the said lateral gap during a rotation of the smaller cylinder, means mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a lateral gap through which a sheet gripper member is arranged to pass during a rotation of the said second smaller cylinder, means mounting a second large cylinder in rotatable tangential relation to the said second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, means for carrying a primary printing member on a portion of the periphery of each of the said large cylinders, and means selectively controlling the

number of times each gripper member carries each sheet through the gaps of the two-named smaller cylinders thereby to provide for the transfer of single and multiple images to one or both sides of the sheet.

70. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable ring members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper members carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through the said lateral gap during a rotation of the smaller cylinder, means for mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a lateral gap through which a sheet gripper member is arranged to pass during a rotation of the said second smaller cylinder, means mounting a second large cylinder in rotatable tangential relation to the said second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, means for carrying a primary printing member on a portion of the periphery of each of the said large cylinders, means for carrying a printing transfer member on the periphery of either or both of the said smaller cylinders, means for carrying an impression member on a portion of the periphery of either or both of the large cylinders, and means for selectively controlling the passage of each gripper member through the lateral gap of each of said smaller cylinders once and more than once to provide corresponding selected single and multiple image transfer to one and both sides of the sheet carried therein.

71. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, three or more sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper through said gap during a rotation of the smaller cylinder, means mounting a third cylinder in rotatable tangential relation to the large cylinder, means for carrying a primary printing member on the periphery of the said third cylinder, means for carrying a printing transfer member on a portion of the periphery of the said large cylinder, means for carrying a printing transfer

member on the periphery of the smaller cylinder, means for carrying a primary printing member on a portion of the periphery of the large cylinder, and means selectively controlling the number of times each gripper means carries each sheet through said gap to provide a corresponding selected single and multiple image transfer to one or both sides thereof.

72. In a printing mechanism, two cylinders of unlike diameter mounted in rotatable tangential relation, the diameter of one being less than the diameter of the other and the diameter of the larger being wholly divisible by the diameter of the smaller, endless rotatable members in association with the smaller cylinder, the path of travel of said endless members substantially encompassing the circumferential area occupied by the smaller cylinder, plural sheet gripper means carried by said endless members and spaced apart a distance wholly divisible by the circumference of the smaller cylinder, a lateral gap in the smaller cylinder, means for carrying a sheet gripper member through said gap during a rotation of the smaller cylinder, a third cylinder mounted in rotatable tangential relation to the large cylinder, means for carrying a primary printing member on the periphery of the said third cylinder, means for carrying a printing transfer member on a portion of the periphery of the said large cylinder, means mounting a second rotatable smaller cylinder in association with the said rotatable endless members and substantially within their path of travel, said second smaller cylinder having a lateral gap through which a sheet gripper member is arranged to pass during rotation of the said second smaller cylinder, a second large cylinder mounted in rotatable tangential relation to the second smaller cylinder, the diameter of the second large cylinder being wholly divisible by the diameter of the second smaller cylinder, means for carrying a primary printing plate on a portion of the periphery of the said second large cylinder, means for carrying a primary printing plate on a portion of the periphery of the first said large cylinder, means for carrying a printing transfer member on the periphery of the said smaller cylinder tangential thereto, and means controlling the number of times each sheet gripper member carries a sheet through the said gaps of both said smaller cylinders thereby to perform single and multiple printing operations on one or both sides of the sheet as selected.

References Cited in the file of this patent

UNITED STATES PATENTS

503,391	Toye	Aug. 15, 1893
533,186	Toye	Jan. 29, 1895
1,105,965	Cornwall	Aug. 4, 1914
2,046,189	Shultz	June 30, 1936
2,374,668	Davidson	May 1, 1945
2,542,073	Aberle	Feb. 20, 1951
2,753,791	Thurmann	July 10, 1956

FOREIGN PATENTS

345,872	Germany	Dec. 19, 1921
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,911,907

November 10, 1959

William Ward Davidson

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 56, line 66, for "large" read -- larger --; column 59, line 68, for "large" read -- larger --; column 60, line 38, for "member" read -- members --; column 61, line 30, for "cylinders" read -- cylinder --; column 62, line 35, for "release" read -- discharge --; column 65, line 13, for the claim reference numeral "33" read -- 31 --; column 74, line 54, for "diameter or" read -- diameter of --.

Signed and sealed this 12th day of April 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents