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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

Filed Aug. 20, 1947 24 Sheets-Sheet 1

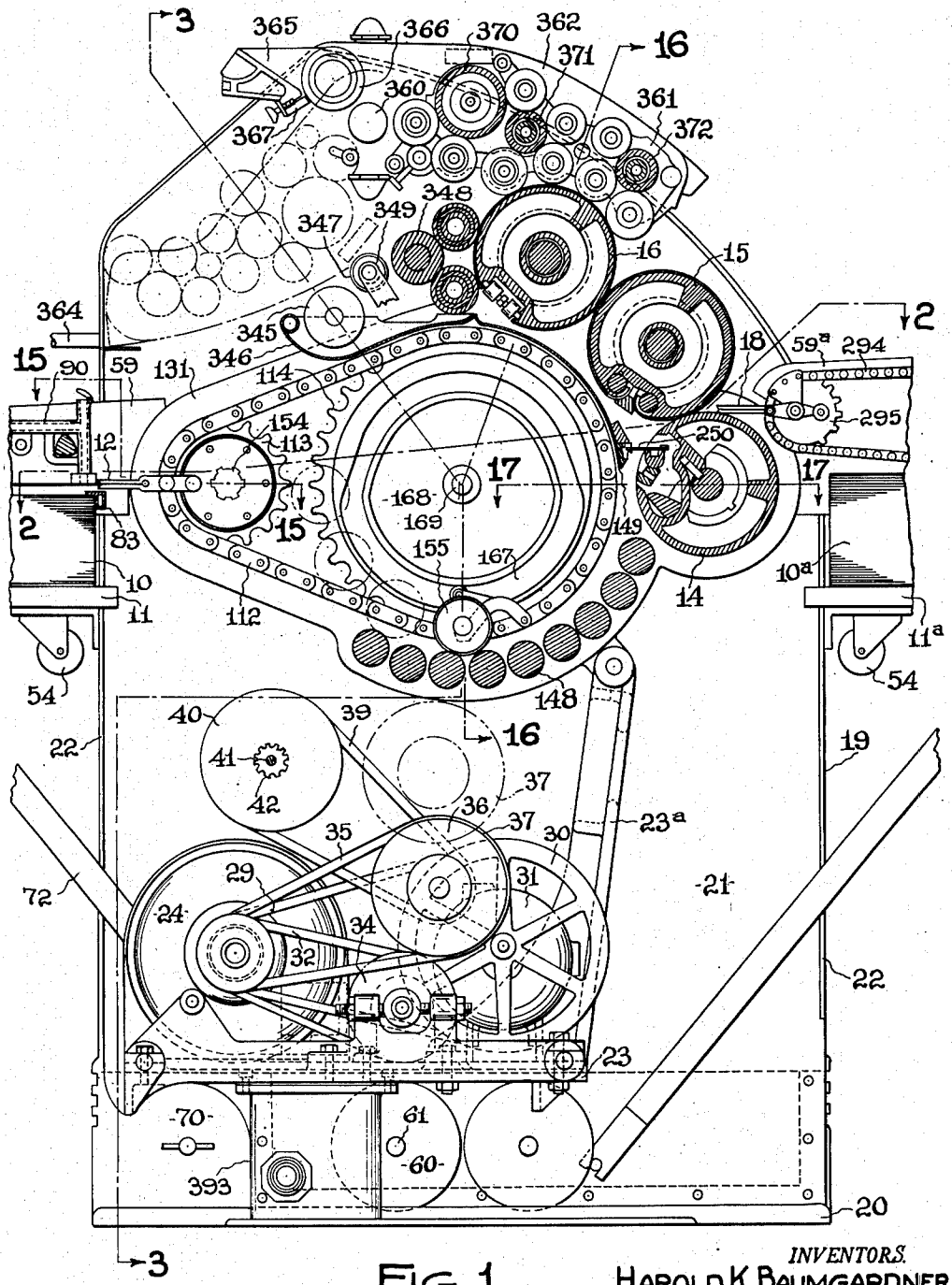

FIG. 1

INVENTORS.
HAROLD K. BAUMGARDNER
BY JOSEPH D. KREIS

Hyde, Meyer, Baldwin & Doran
ATTORNEYS

Feb. 24, 1953 H. K. BAUMGARDNER ET AL 2,629,323

SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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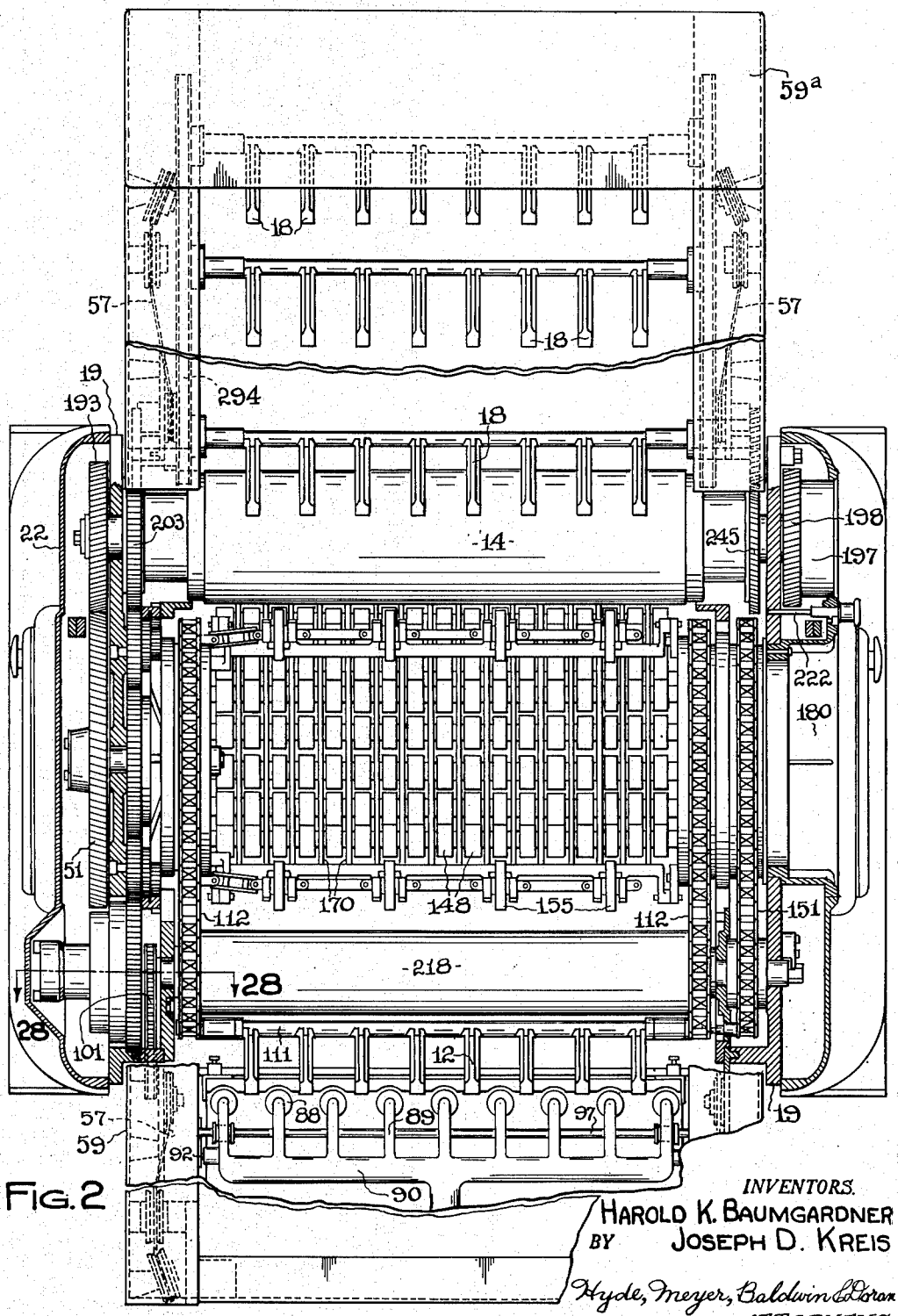

FIG. 2

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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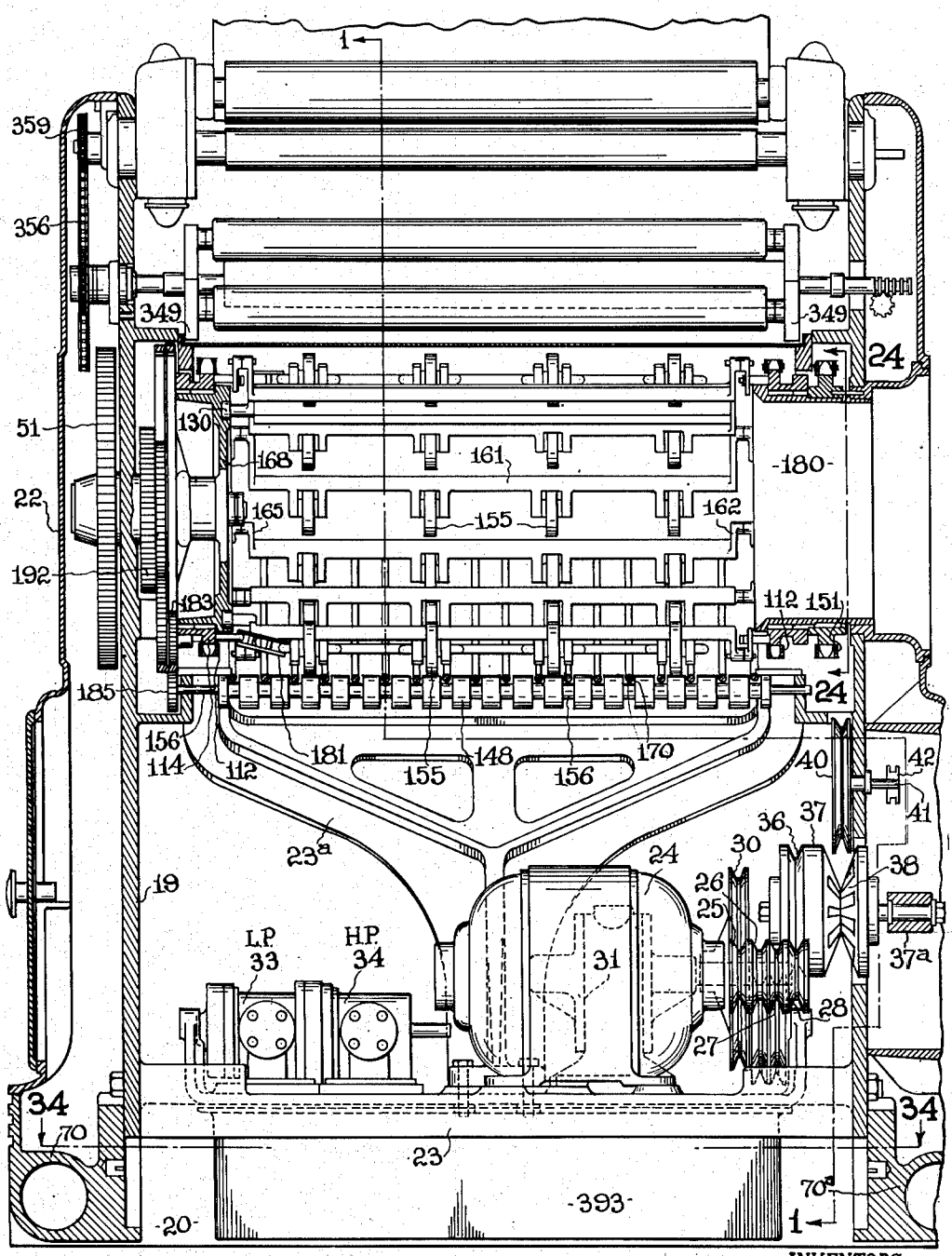

FIG. 3

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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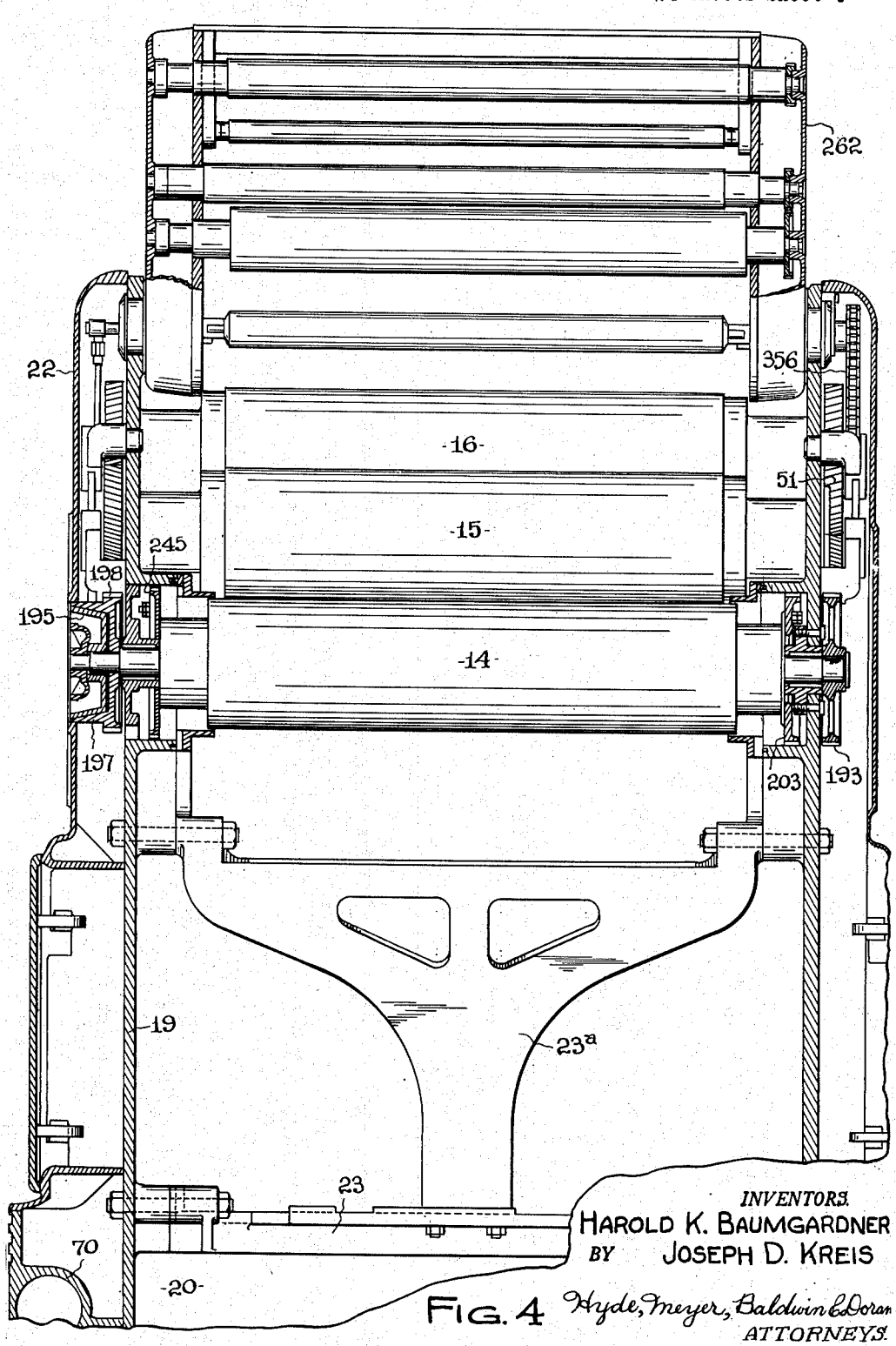

INVENTORS.
HAROLD K. BAUMGARDNER
BY JOSEPH D. KREIS

FIG. 4

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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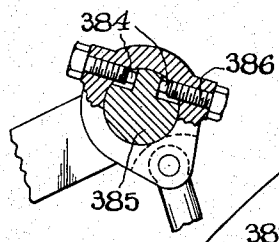

FIG. 5a

FIG. 5

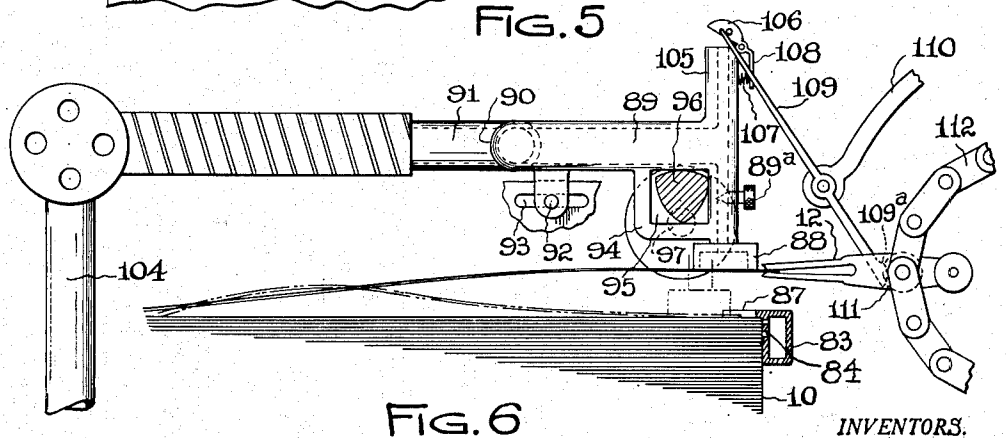

FIG. 6

INVENTORS.
HAROLD K. BAUMGARDNER
BY JOSEPH D. KREIS

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ATTORNEYS.

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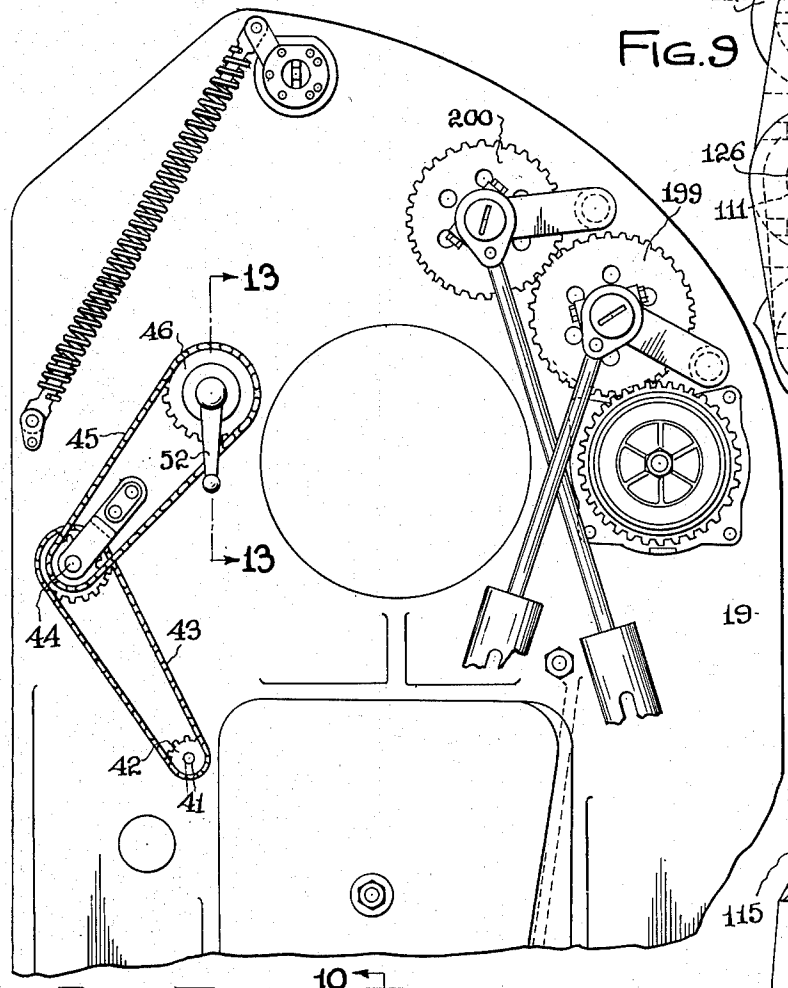

FIG. 7

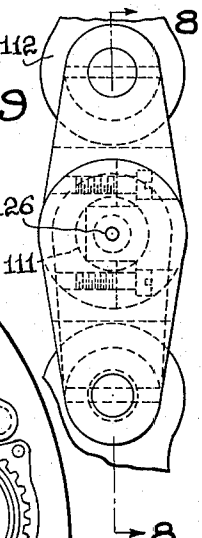

FIG. 9

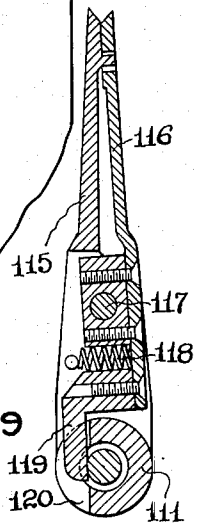

FIG. 10

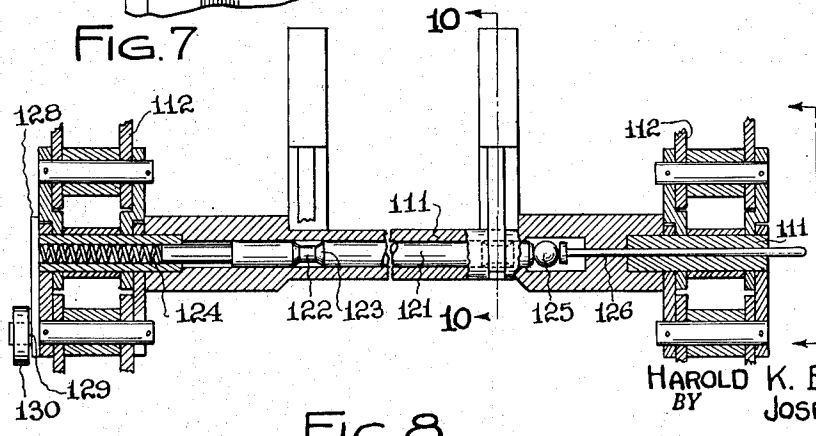

FIG. 8

INVENTORS.
HAROLD K. BAUMGARDNER
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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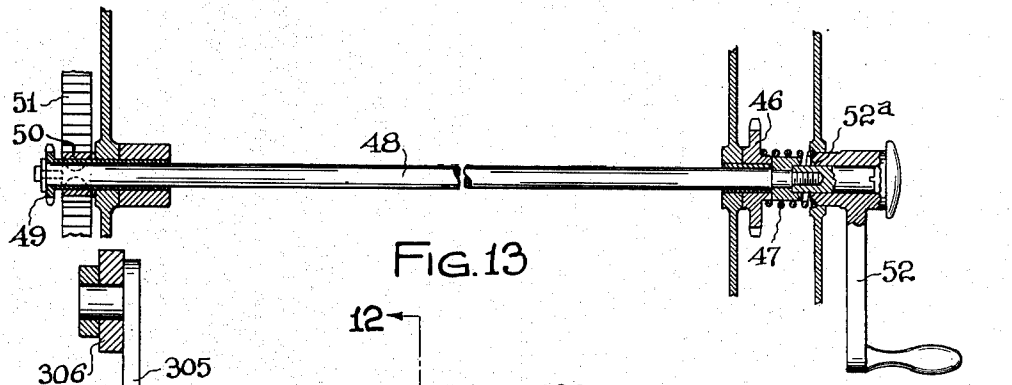

FIG. 13

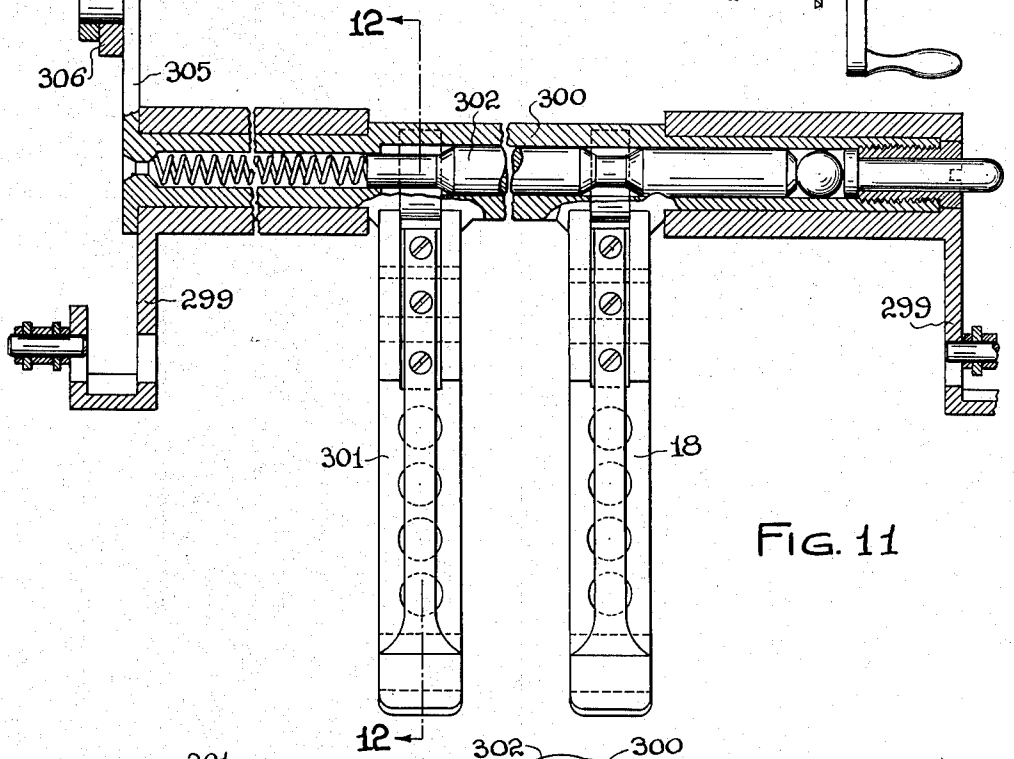

FIG. 11

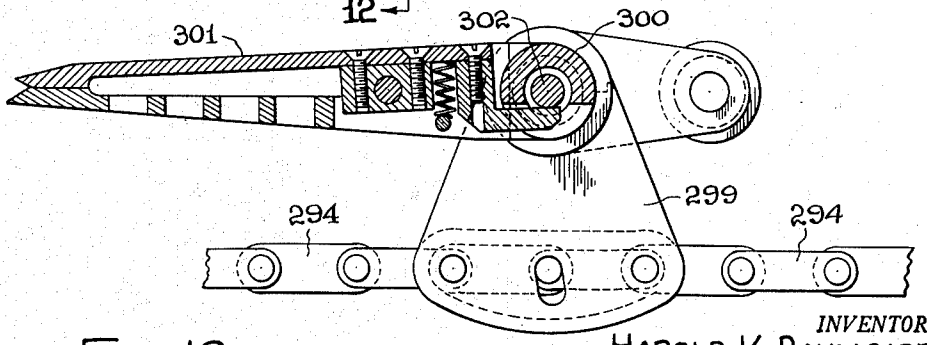

FIG. 12

INVENTORS.
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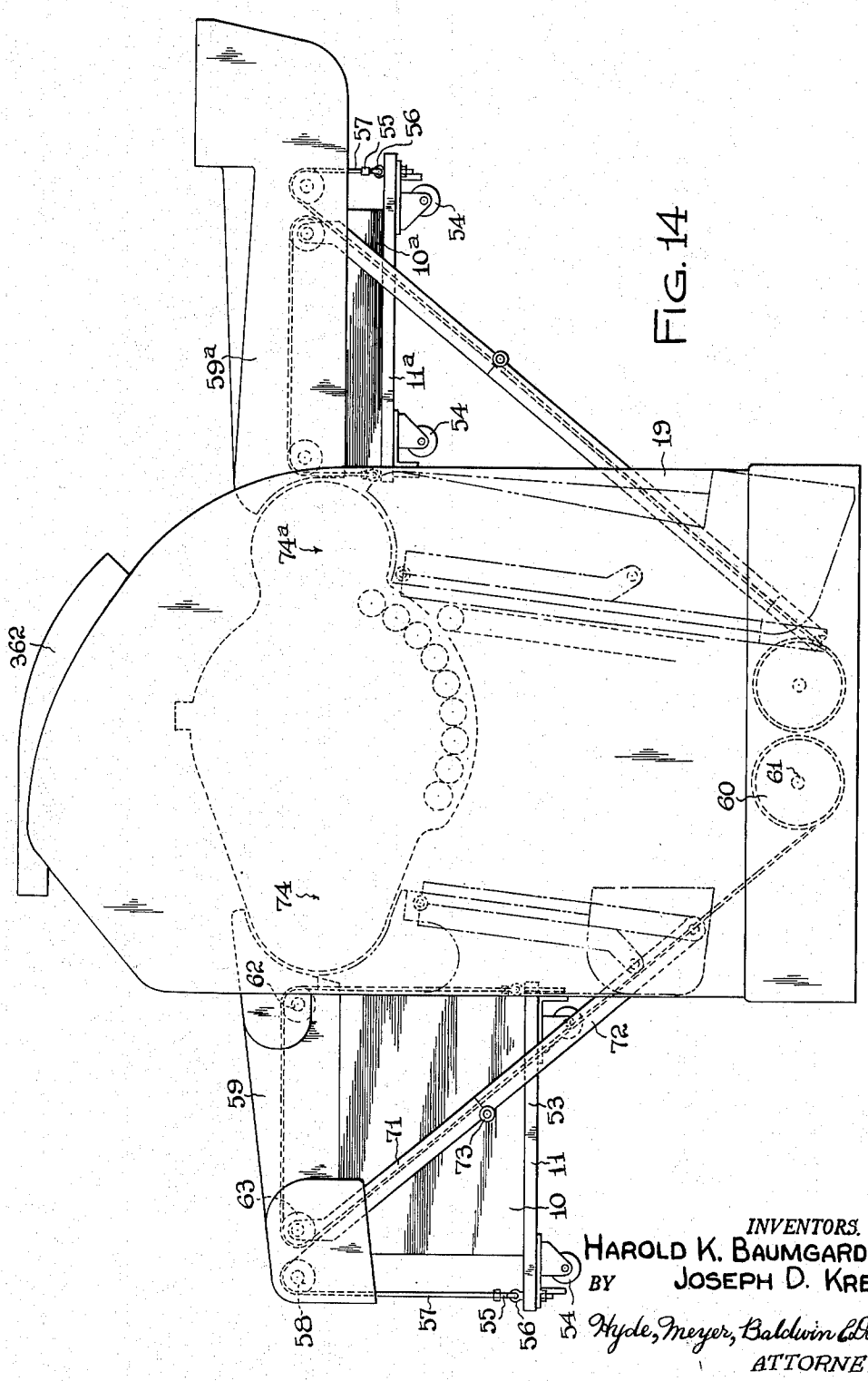

FIG. 14

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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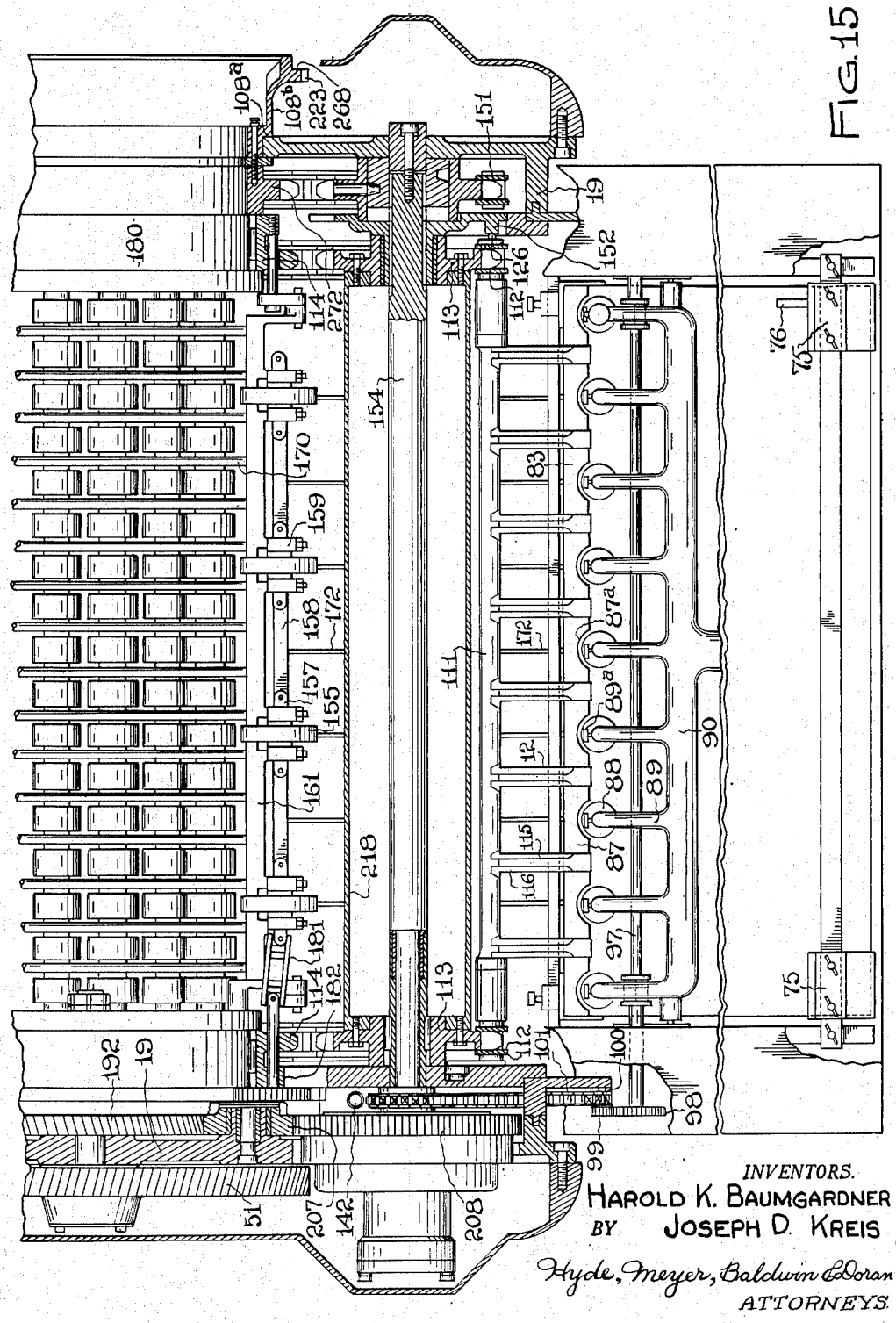
FIG. 15



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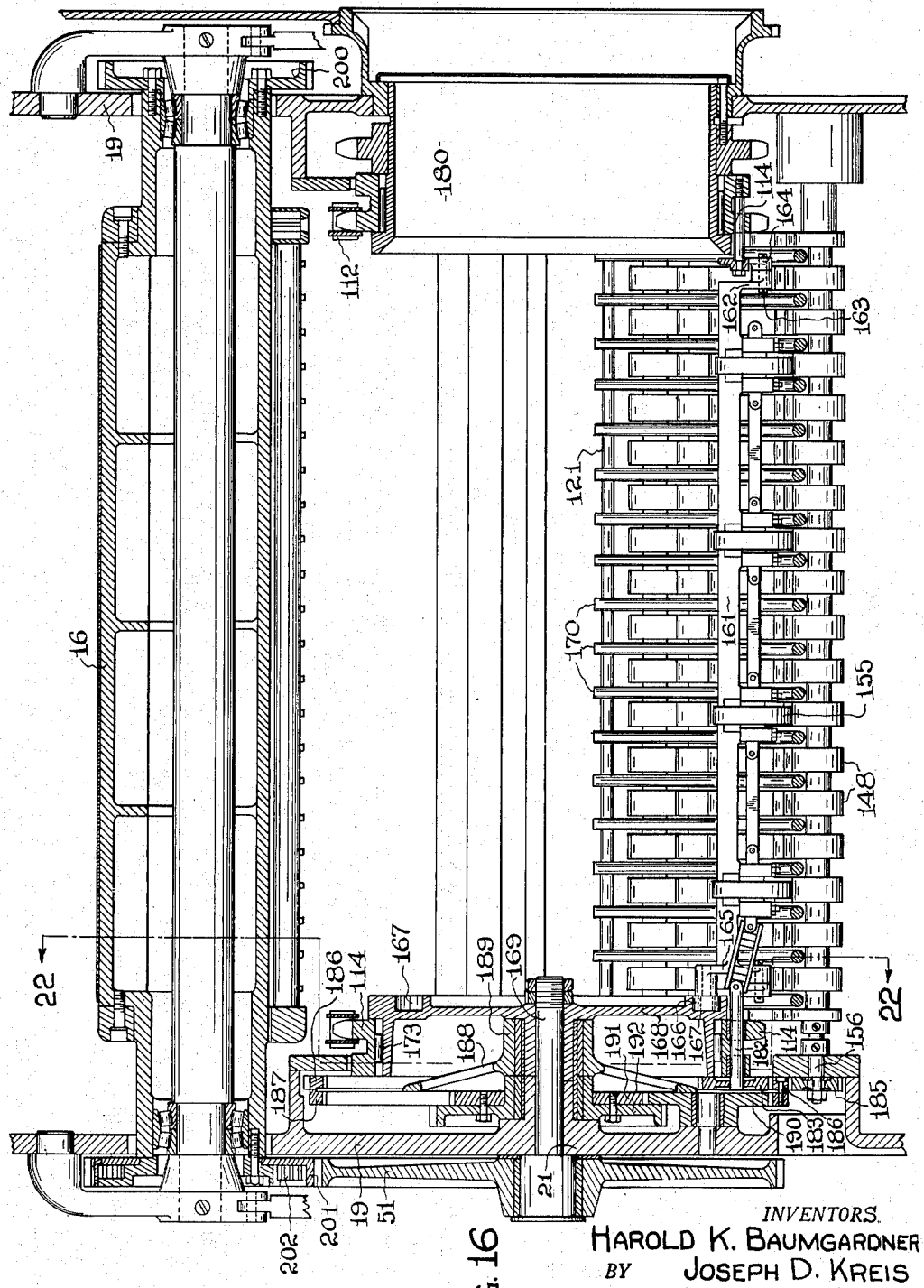

FIG. 16

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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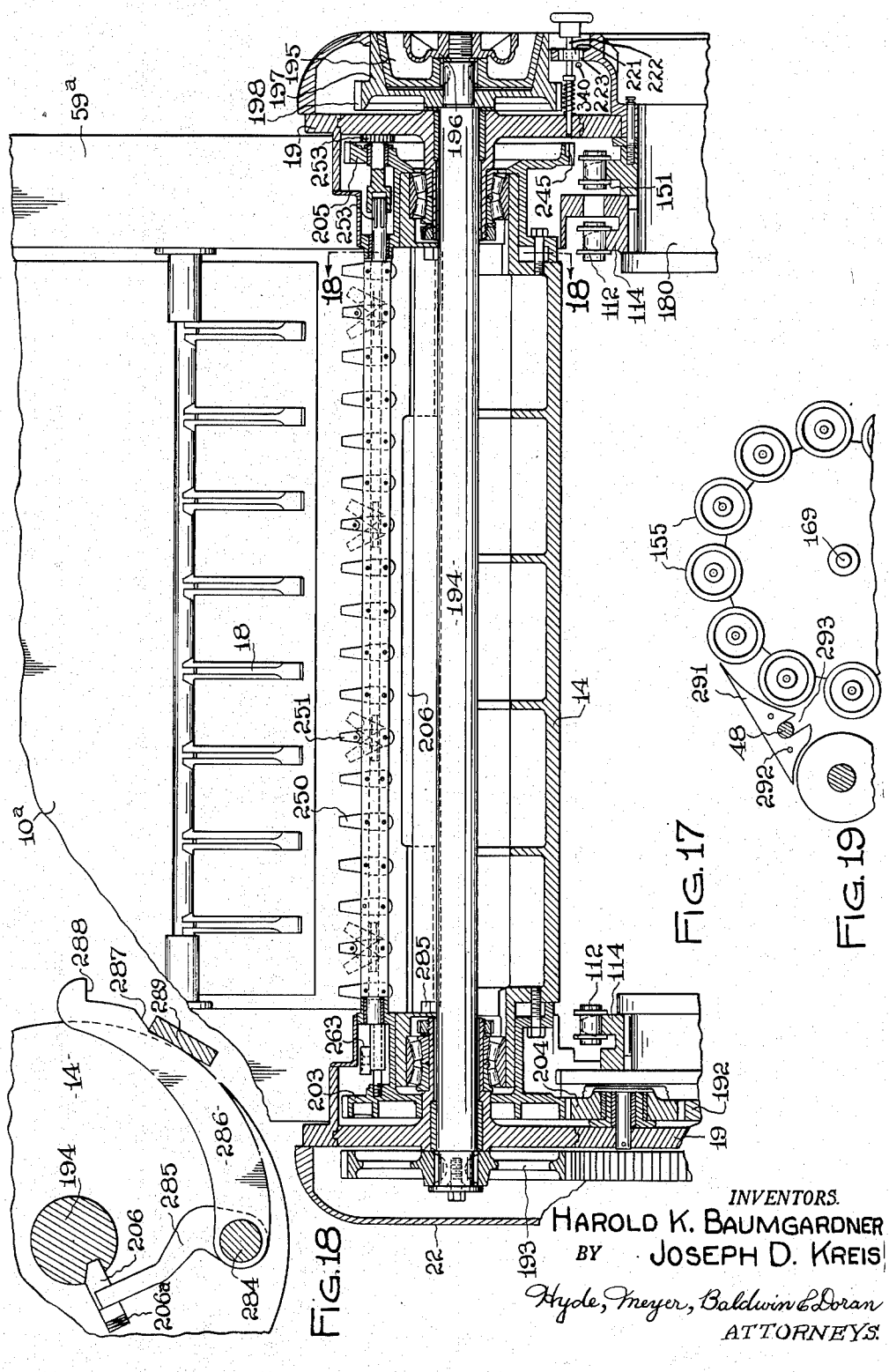

FIG. 18

FIG. 19

FIG. 17

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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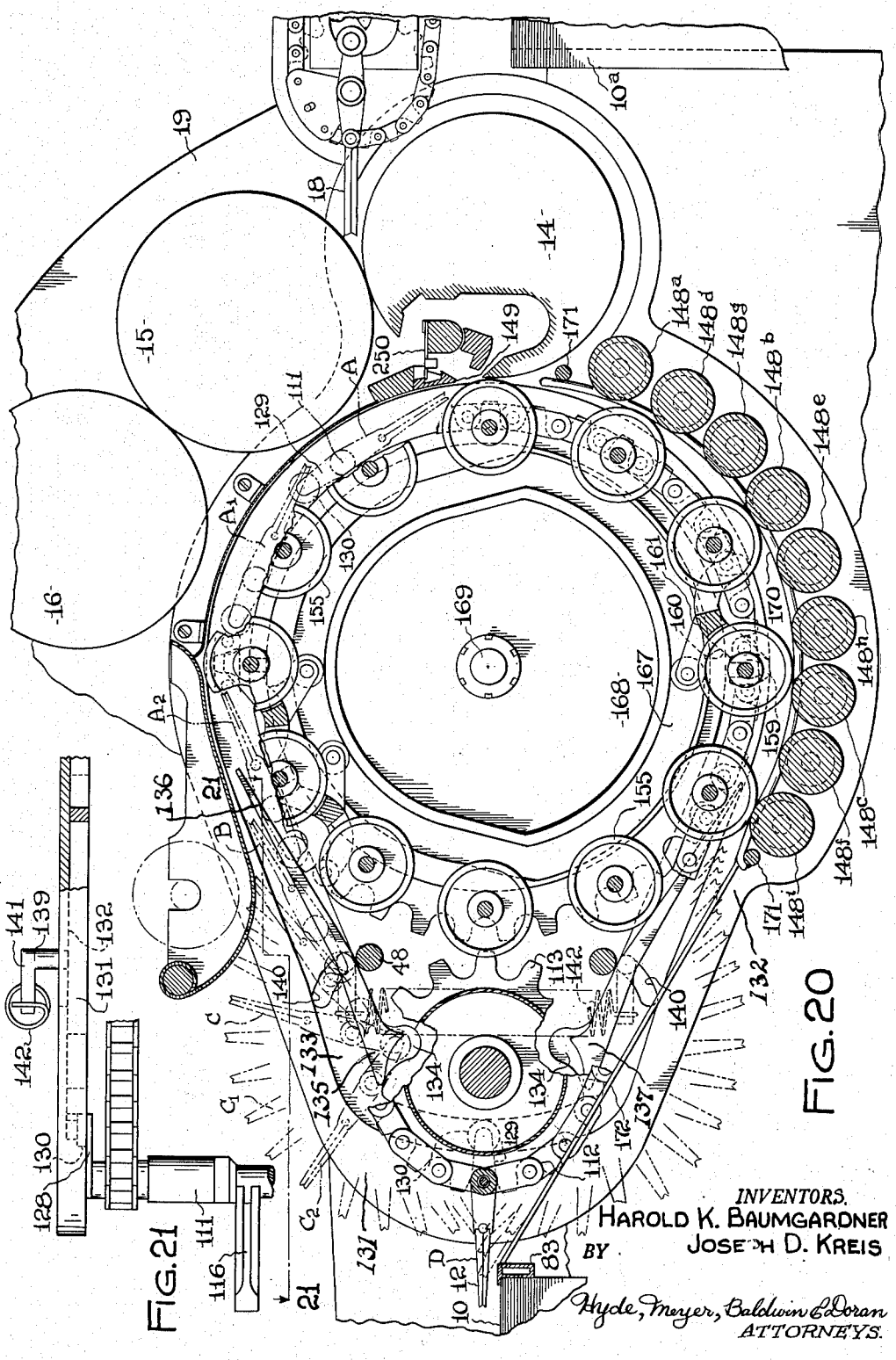

FIG. 20

FIG. 21

INVENTORS.
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JOSEPH D. KREIS
BY
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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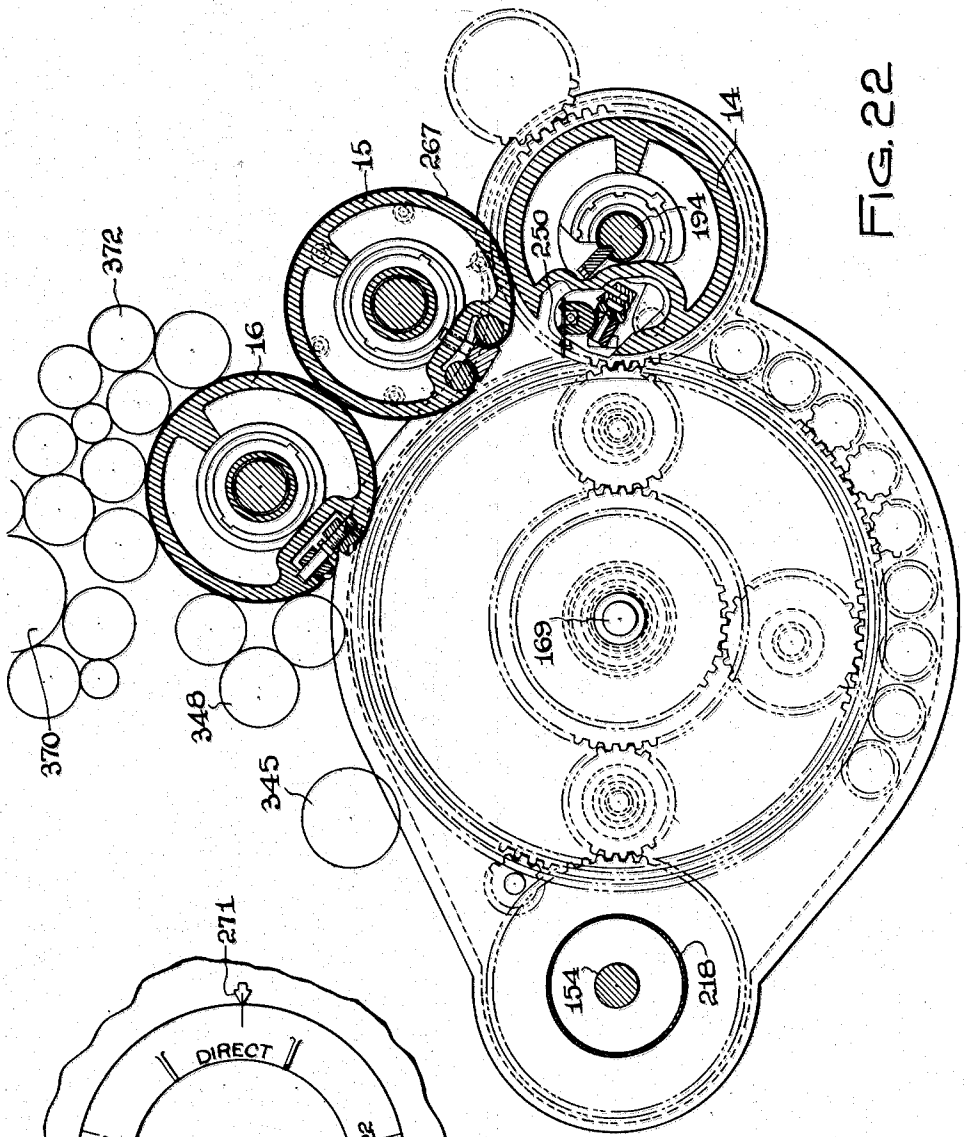

FIG. 22

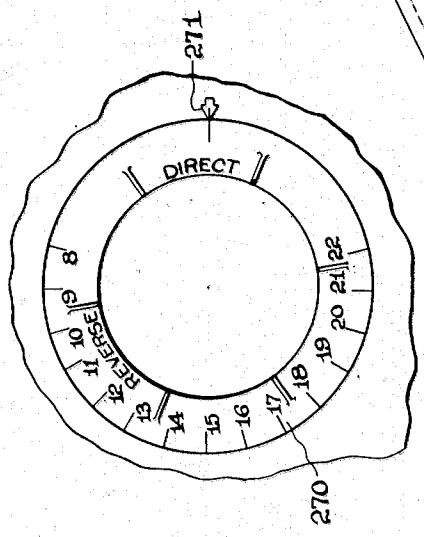

FIG. 23

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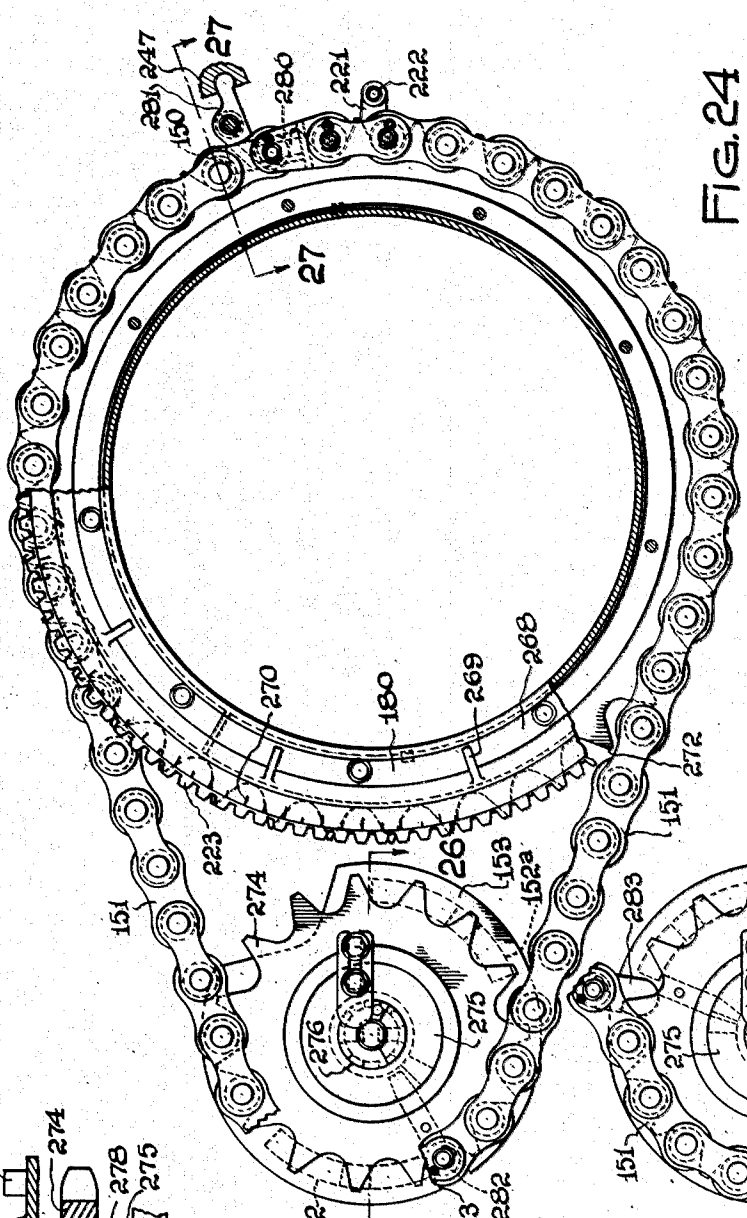

FIG. 24

FIG. 25

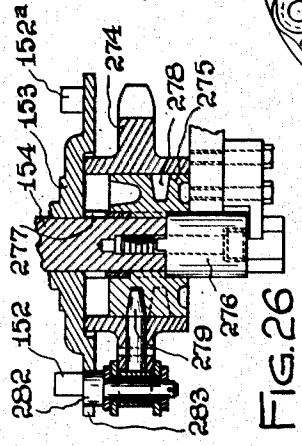

FIG. 26

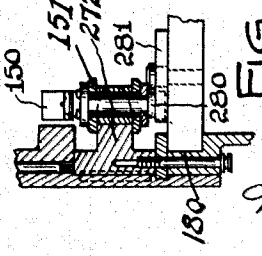

FIG. 27

INVENTORS
HAROLD K. BAUMGARDNER
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ATTORNEYS.

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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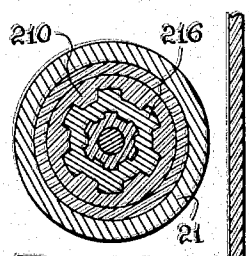

FIG. 30

FIG. 28

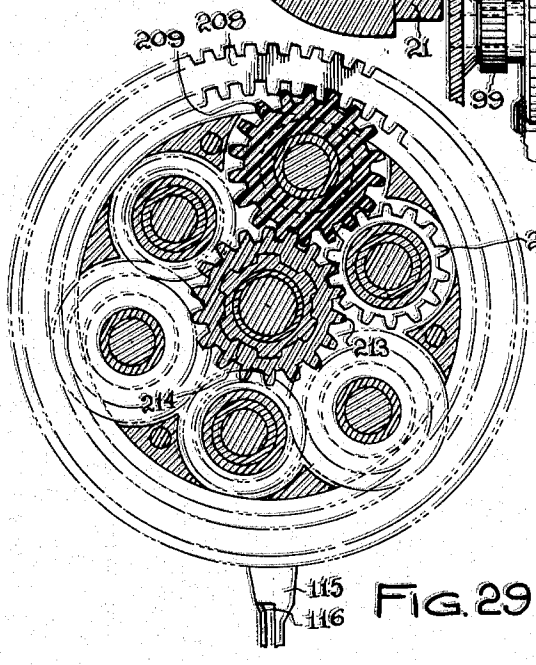

FIG. 29

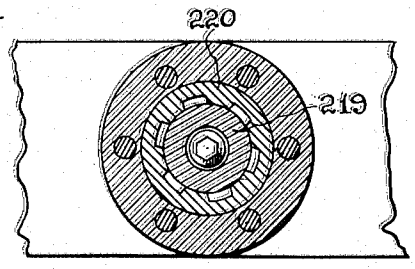

FIG. 31

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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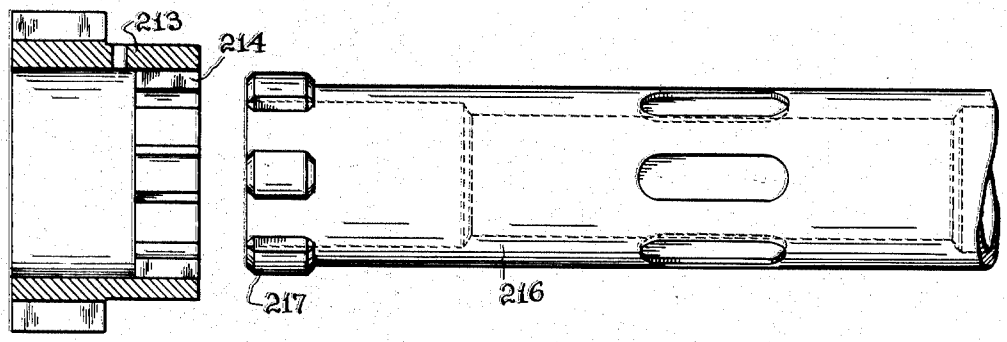

FIG. 33

FIG. 32

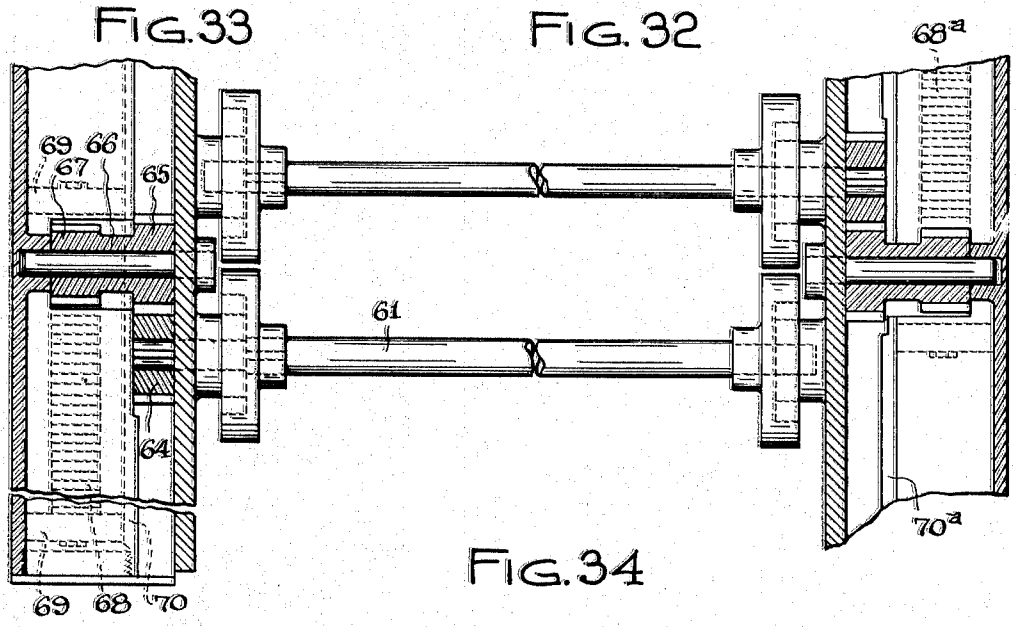

FIG. 34

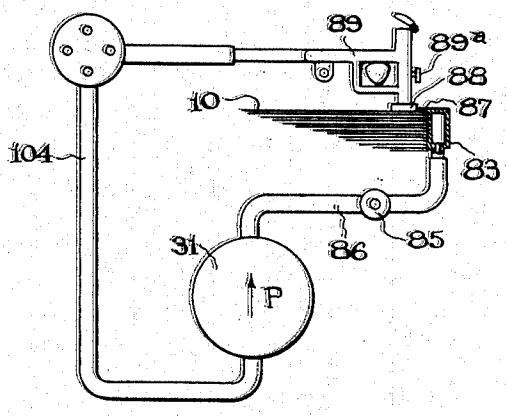

FIG. 35

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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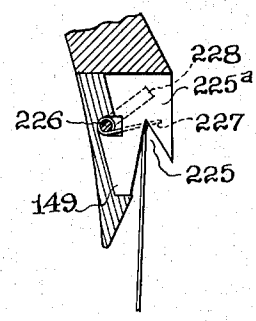

FIG. 40a

FIG. 36

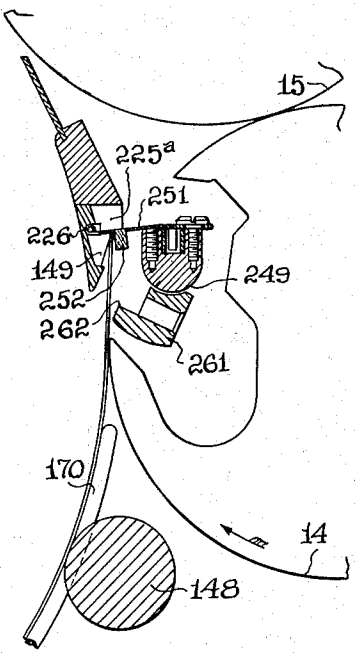

FIG. 37

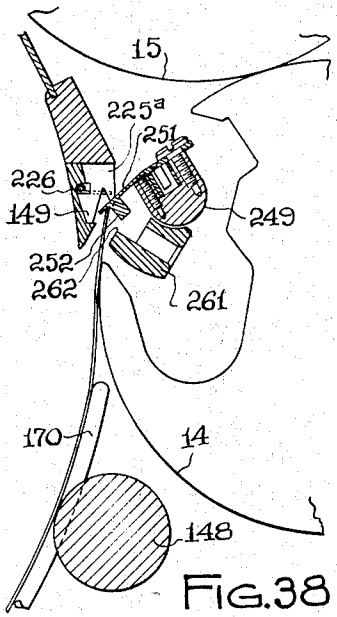

FIG. 38

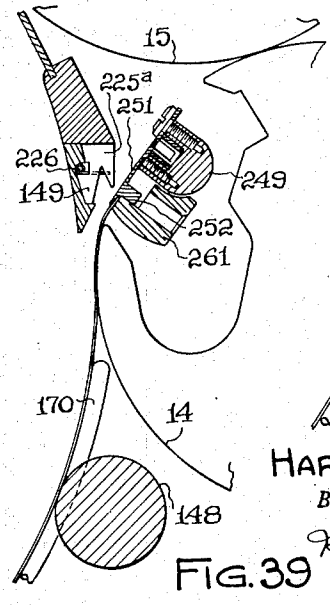

FIG. 39

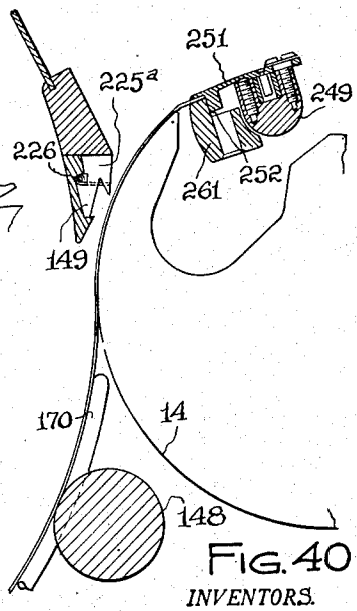

FIG. 40

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

Filed Aug. 20, 1947 24 Sheets-Sheet 18

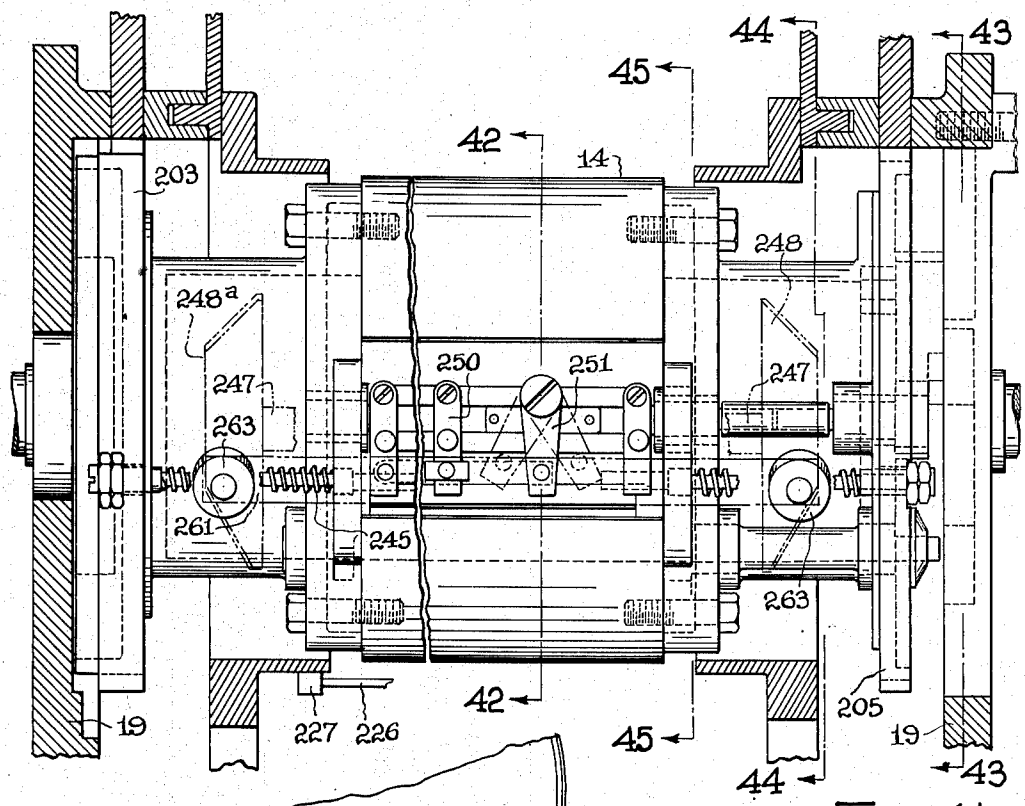

FIG. 41

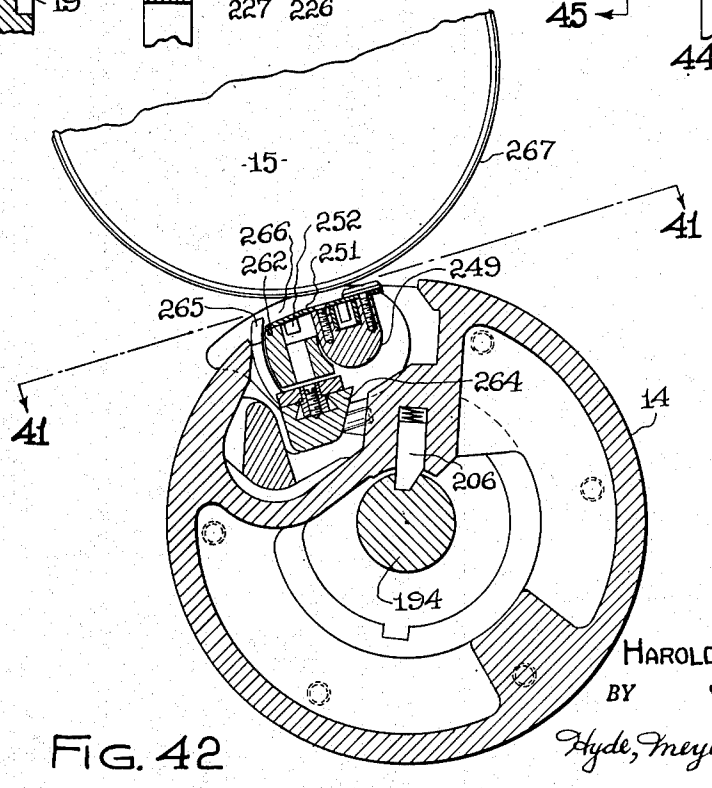

FIG. 42

INVENTORS.
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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

Filed Aug. 20, 1947 24 Sheets-Sheet 19

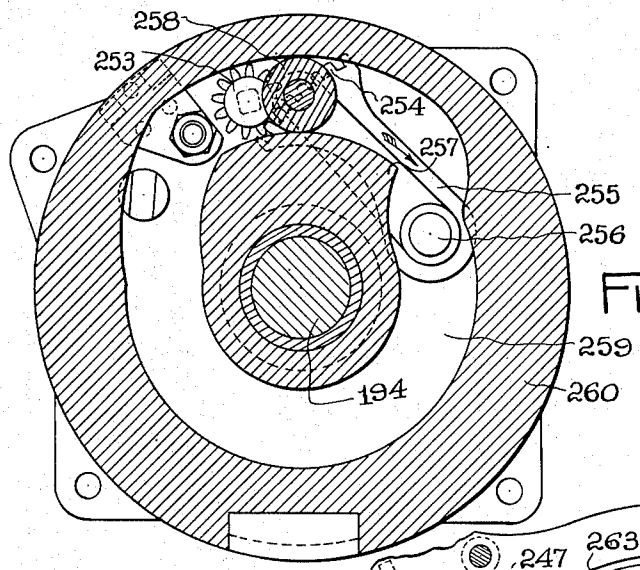

FIG. 43

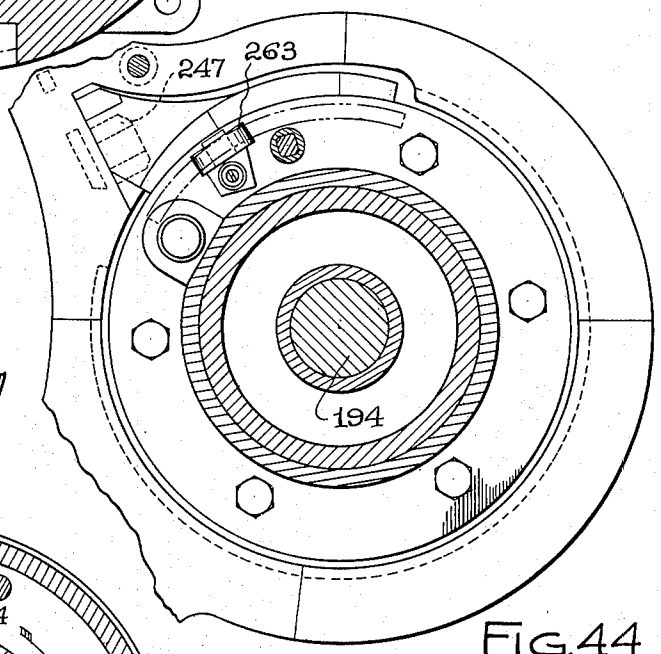

FIG. 44

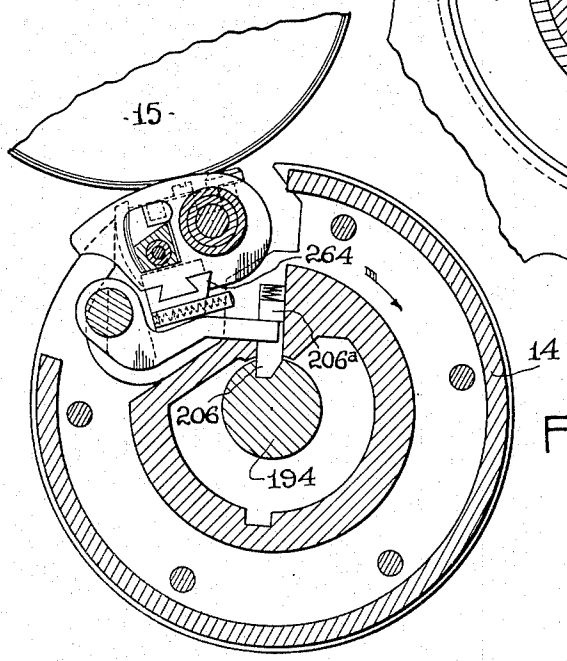

FIG. 45

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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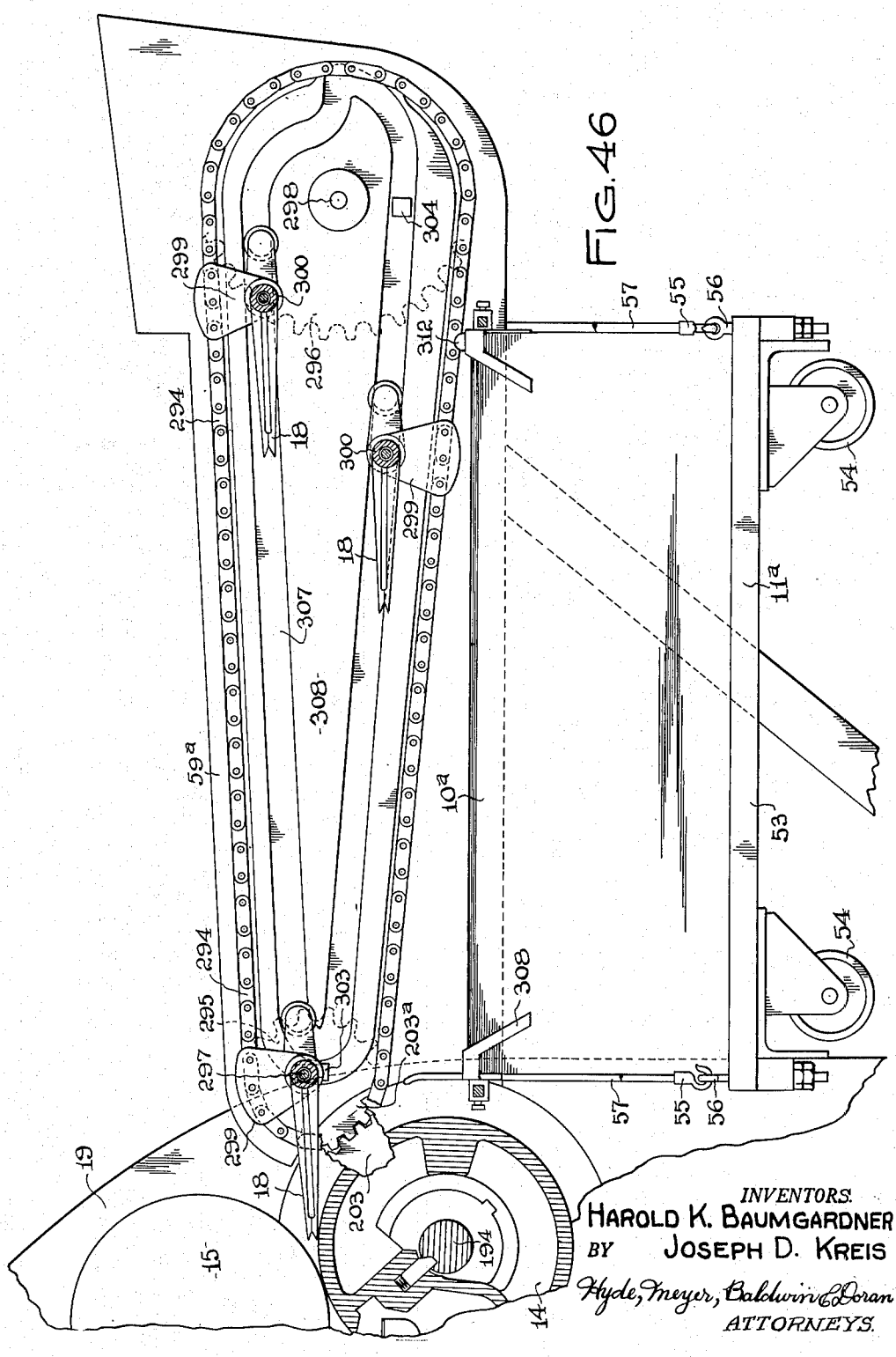

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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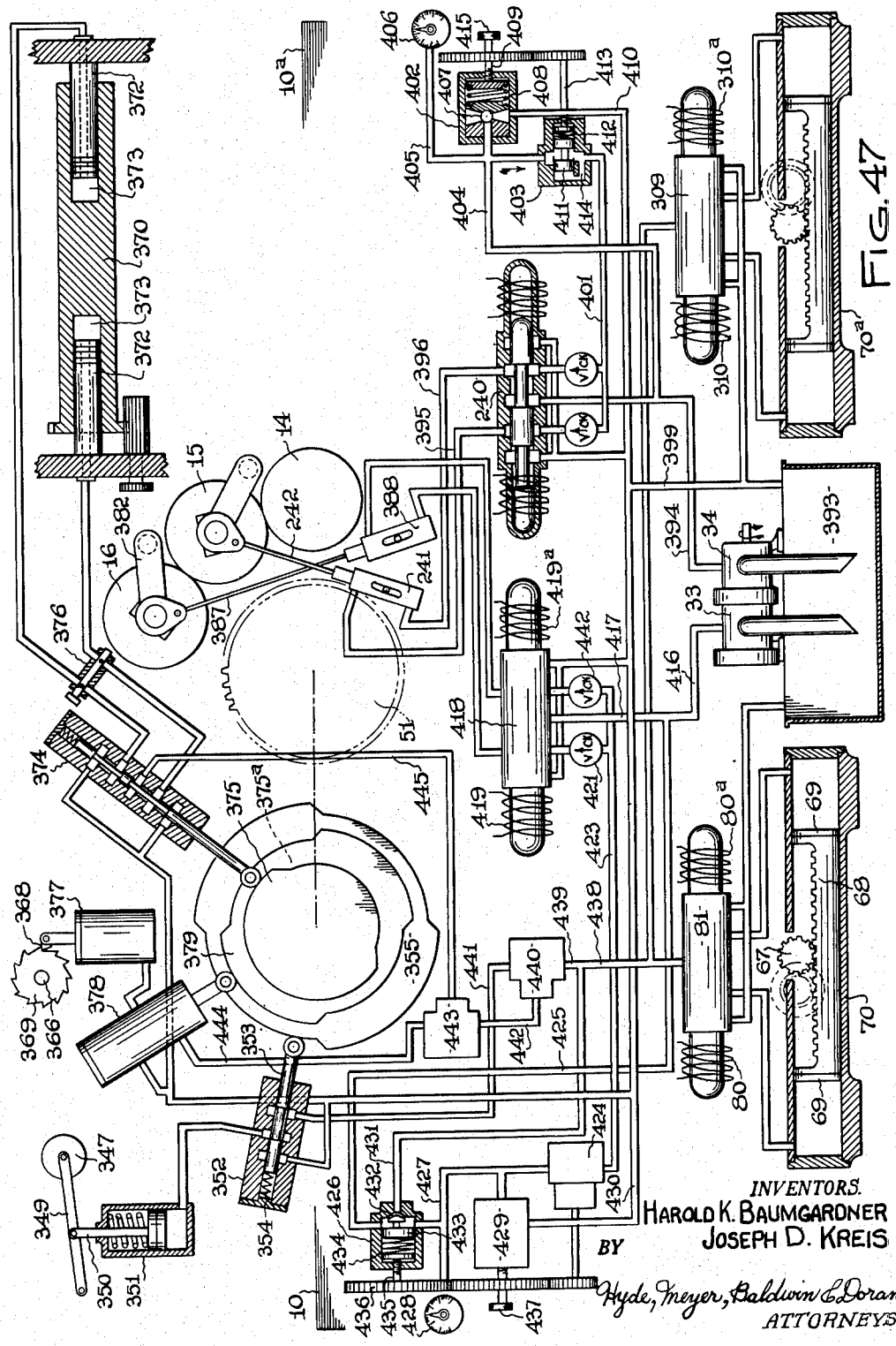

FIG. 47

INVENTORS.
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BY
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Filed Aug. 20, 1947 24 Sheets-Sheet 22

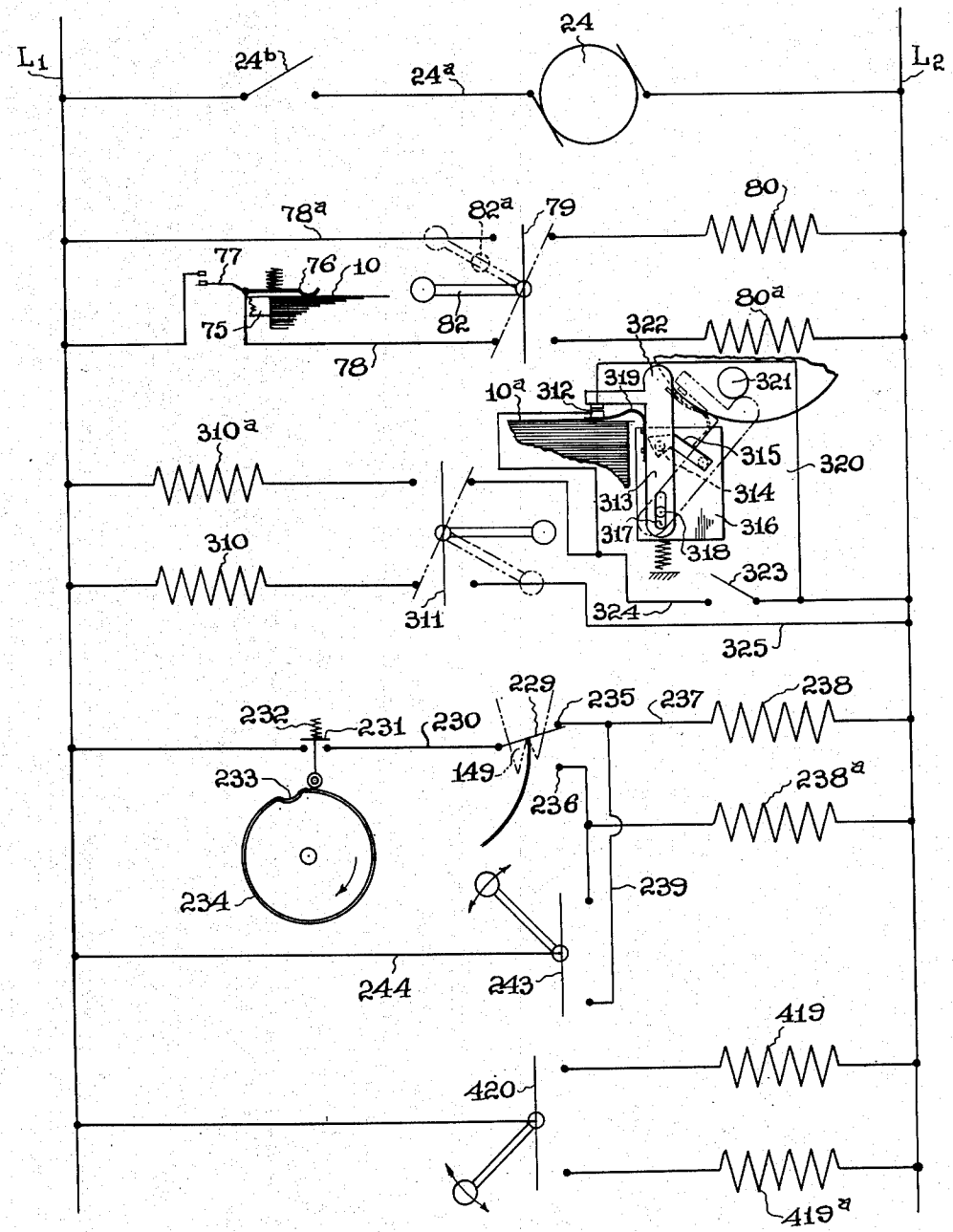

FIG. 48

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

Filed Aug. 20, 1947 24 Sheets-Sheet 23

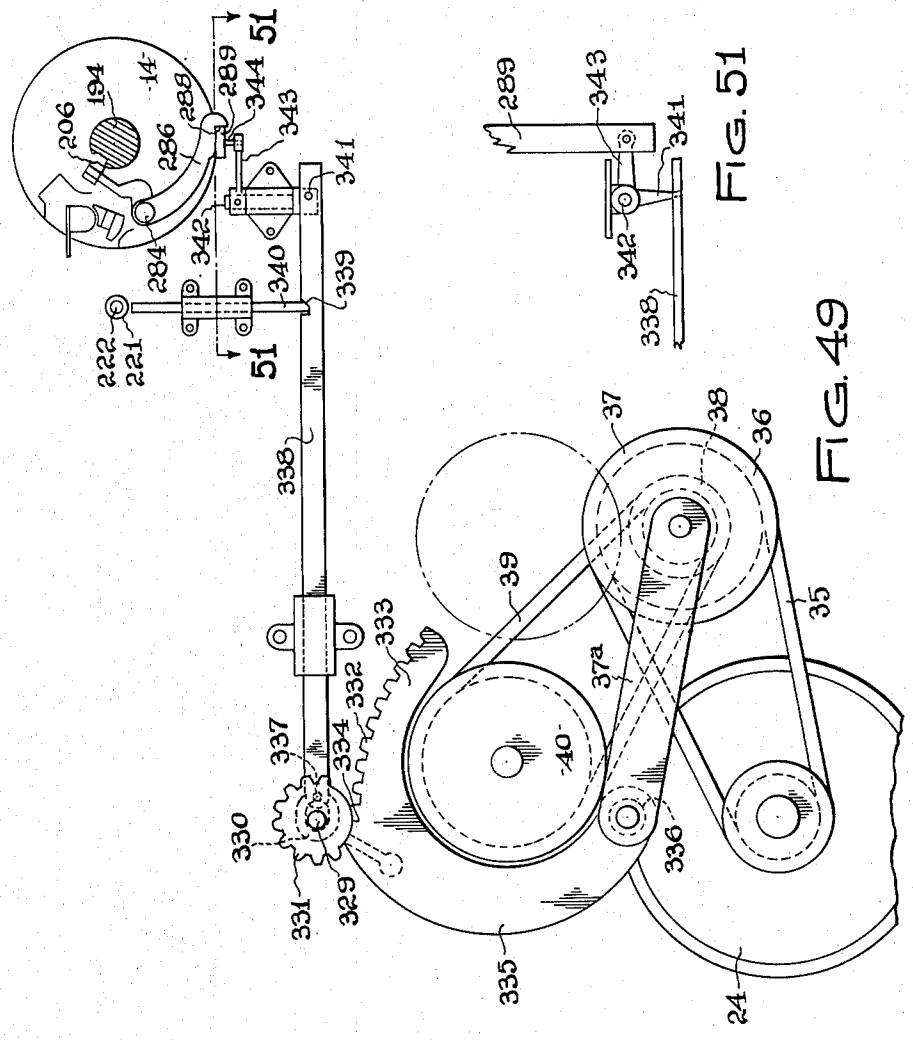

FIG. 49

FIG. 51

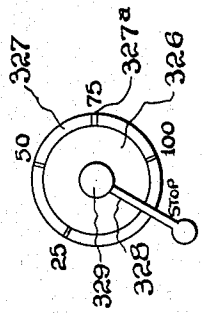

FIG. 50

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Feb. 24, 1953 H. K. BAUMGARDNER ET AL 2,629,323

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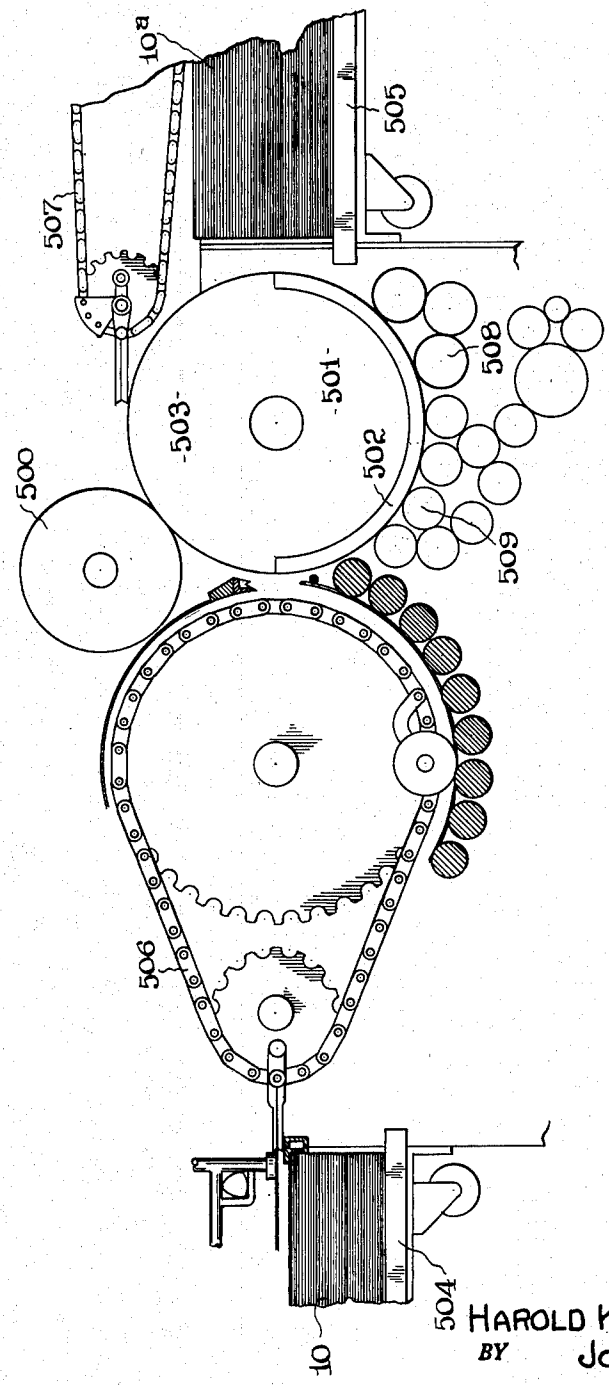

FIG. 52

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SHEET HANDLING MECHANISM FOR ROTARY PRINTING PRESSES

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45 Claims. (Cl. 101—232)

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This invention relates to offset printing presses such as are used in the printing of many copies upon sheets from type, stereotype, or electrotype, or from plates made of rubber, metal or other materials.

One object of the invention is to provide an improved offset printing press arranged in such manner that it may be utilized for either direct or reverse printing, or, as the trade puts it, for either "work" or "turn and work," thus enabling a stack of sheets to be fed one by one through the machine and printed on one face and piled in a stack, and then, without reversing the stack, again feeding the sheets through the machine and printing each upon its reverse face and again piling them in a stack, all without special manipulation or turning of the sheets or stack between printings.

A further object is to provide an improved press of the character described, in which the same sheet selecting, feeding and conveying devices are utilized for either direct or reverse printing, or for "work" or "turn and work," by simple adjustments readily performed by the ordinary operator and requiring no special skill.

Another object of the invention is to provide an improved printing press, including improved mechanism for securing proper registry or position of the sheet while in motion toward the bite of the impression roll, or, in other words, for securing sheet registration while the sheet is "on the fly."

A further object is to provide an improved printing press in which the sheet registering mechanism operates both fore and aft, or in the direction of sheet advance movement, and also laterally, and is equally effective during either direct or reverse printing.

A further object is to provide an improved press in which the sheet registering mechanism is so arranged that during both direct and reverse printing the sheet is registered on the fly, but always with reference to the same base points or edges of the sheet itself.

Still another object is to provide an improved printing press in which longitudinal registry is accomplished by a series of repeated light wiping or "kiss" impulses administered to the sheet while it lies in a zone ahead of that position where it is seized by grippers which carry it between the blanket and impression cylinders for printing, to which position it is thus urged by the registering mechanism.

A further object is to provide an improved printing press in which the sheet registering

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mechanism includes a series of "kiss" rollers which produce advance movement of the sheet, and which rollers operate correctly and while the sheet is on the fly, regardless of whether they are traveling bodily with or contrary to the direction of movement of the sheet along its path.

Another object is to provide sheet registering means which is fully effective upon a leading sheet even though a following sheet overtakes and is laid upon it, thus reducing cylinder size and increasing the rate of output.

Another object of the invention is to provide improved sheet feeding mechanism, including grippers for transferring a sheet from its position at the top of a supply stack to a feeding position at the entrance to the printing space between the impression and blanket cylinders, and in which said grippers may be caused to present either the leading or the trailing edge of the sheet to said entrance, thus adapting the transfer mechanism either to direct or to reverse printing.

Still another object of the invention is to provide sheet feeding mechanism including improved means for separating a sheet from the top of the stack and presenting it to the transfer grippers, such mechanism being arranged to insure separation of a single sheet and advance of the pile as sheets are removed therefrom.

Another object is to provide a printing press including sheet handling mechanism embodying improved means for handling sheets at the delivery end of the machine, such means including improved means for lowering the stack as sheets are added thereto.

Still another object of the invention is to provide a machine including improved means for adapting its mechanism to operate upon sheets of various sizes, during either direct or reverse printing.

Another object of the invention is to provide improved inking mechanism, including a pan shaped member in which the inking rolls are mounted or contained, and which member is capable of being moved to either of two positions, in one of which it serves as a cover, as when the machine is in operation, and in the other of which it serves as a collecting pan for cleaning fluid used to clean the inking rolls and mechanism.

Still another object is to provide improved means for producing or controlling the pressure between the operating cylinders, such as between the blanket and impression cylinders, to compensate for variations in density of image, and variations in thickness, texture or composition

of paper, or between the blanket cylinder and plate or form cylinder, to produce various densities of image.

Still another object is to provide improved means for relieving the pressure between cylinders, or preventing contact between them, when a sheet is "missed."

Another object is to provide improved means for operating upon stacks of sheets, by the use of dollies, without any necessity for reversing piles upon the dollies, such as for reverve printing.

Another object is to provide an improved printing press of very compact form, but capable of use in several different ways and for different purposes, and in which all parts which extend beyond the frame or casing lines when the machine is in operation, such as stack or sheet holding or operating devices, operating means therefor, inking mechanism or the like, may be turned or folded to positions within those lines, thus enabling the entire machine to be enclosed within a cover and thus protecting all parts against dirt or injury, and confining the machine, when idle, to small space or volume.

Another object is to provide improved control mechanism, including interlocks between the starting and stopping devices, the speed control mechanism, the mechanism for coupling and uncoupling the impression cylinder, the control drum lock, and the reversing mechanism, for safety and other purposes.

Further objects of the invention in part are obvious and in part will appear more in detail hereinafter.

Before describing the drawings, it may be stated that as a general rule, or with few exceptions, in the description of the views, as well as throughout the specification, the positions of all parts are stated or defined as they would appear to an operator either facing the front of the machine, where the sheets are fed into it, and looking toward its delivery end, or standing at its right-hand side.

With that understanding, Fig. 1 is a longitudinal sectional elevation on approximately the line 1—1, Fig. 3, looking in the direction of the arrows, some parts being shown more or less conventionally and others being omitted for simplicity in illustration;

Fig. 2 is in part a plan view and in part a sectional plan view on the line 2—2, Fig. 1, some parts being omitted;

Fig. 3 is a transverse sectional elevation on approximately the line 3—3, Fig. 1, some parts being again omitted or shown somewhat conventionally;

Fig. 4 is a rear elevation, partly in section, the delivery mechanism and some other parts being omitted;

Fig. 5 is a left side elevation, outside of the frame, of the upper portion of the machine, but with the outer casing omitted.

Fig. 5a is a detail end view, partly broken out, of the mounting means for one of the rolls;

Fig. 6 is a detail side elevation, on a larger scale, showing certain of the sheet separating and feeding devices;

Fig. 7 is a right side elevation, corresponding to Fig. 5, with the outer casing again omitted;

Fig. 8 is a detail section plan view, partly in section on the line 8—8, Fig. 9, showing the transfer grippers;

Fig. 9 is an end view from the right, on the line 9—9, Fig. 8;

Fig. 10 is a detail sectional view on approximately the line 10—10, Fig. 8;

Fig. 11 is a detail plan view, partly in section, corresponding somewhat to Fig. 8, but showing the delivery grippers, some parts being omitted;

Fig. 12 is a sectional view on the line 12—12, Fig. 11;

Fig. 13 is a detail sectional elevation on the line 13—13, Fig. 7;

Fig. 14 is an outside elevation, from the right, somewhat diagrammatic, showing how the feeding and delivering mechanisms are folded in the casing;

Fig. 15 is a detail plan view, partly in section on the line 15—15, Fig. 1;

Fig. 16 is a detail sectional elevation, on approximately the line 16—16, Fig. 1;

Fig. 17 is a detail sectional plan view, on approximately the line 17—17, Fig. 1; showing the impression cylinder, with its grippers in sheet releasing position;

Fig. 18 is in part an end elevation and in part a sectional elevation on the line 18—18, Fig. 17, showing the mechanism for operating the impression cylinder key;

Fig. 19 is a detail sectional elevation, corresponding somewhat to the section plane of Fig. 1, illustrating a bridge for supporting the sheet during reverse printing;

Fig. 20 is a detail sectional elevation, corresponding to Fig. 1, but somewhat diagrammatic, illustrating the operation of both the transfer grippers and the longitudinal registering rolls;

Fig. 21 is a detail sectional view on approximately the line 21—21, Fig. 20;

Fig. 22 is a diagram, generally in section on approximately the line 22—22, Fig. 16, showing some of the driving gearing;

Fig. 23 is a detail outside elevation, on a reduced scale, illustrating the end of the control drum and the indicia thereon;

Fig. 24 is a detail sectional elevation, on a larger scale, on approximately the line 24—24, Fig. 3, and also showing part of the indicating and adjusting dial;

Fig. 25 is a detail view, showing another position of parts illustrated in Fig. 24;

Fig. 26 is a detail sectional plan view on the line 26—26, Fig. 24;

Fig. 27 is a detail sectional view on the line 27—27, Fig. 24;

Fig. 28 is a detail section, on a larger scale, on the line 28—28, Fig. 2;

Fig. 29 is a detail sectional elevation on the line 29—29, Fig. 28;

Fig. 30 is a detail section on the line 30—30, Fig. 28;

Fig. 31 is a detail section on the line 31—31, Fig. 28;

Fig. 32 is a detail elevation, on a larger scale, of a clutch sleeve;

Fig. 33 is a detail longitudinal sectional view of a combined sun gear and clutch member;

Fig. 34 is a detail sectional plan view on approximately the line 34—34, Fig. 3;

Fig. 35 is a diagram illustrating the air flow system;

Figs. 36 to 40 inclusive are detail sectional views illustrating a V-bar and a portion of the impression cylinder and its grippers, the several views illustrating different positions of the parts;

Fig. 40a is a detail sectional view of the V-bar;

Fig. 41 is a detail plan view, taken on the line 41—41, Fig. 42, showing the operating mechanism for the impression cylinder grippers;

Fig. 42 is a cross section on the line 42—42, Fig. 41;

Figs. 43, 44 and 45 are cross sections on the corresponding section lines in Fig. 42;

Fig. 46 is a detail side elevation, partly in section, showing the sheet delivery mechanism;

Fig. 47 is a diagram, illustrating the fluid pressure control and operating system, certain parts being shown in section;

Fig. 48 is an across-the-line diagram, illustrating the electrical control and operating system;

Fig. 49 is an elevation, somewhat diagrammatic, showing certain interlocks in the starting, stopping, speed control and other control devices;

Fig. 50 is a detail elevation showing the control handle;

Fig. 51 is a detail plan view, on the line 51—51, Fig. 50, and

Fig. 52 is a diagrammatic view, illustrating another arrangement of plate, blanket and impression cylinders, with which our invention may be employed.

General organization

Referring first to Fig. 14, which illustrates the machine as viewed from the right, the sheets to be printed are fed, one by one, from the top of a stack **10** supported by one of a series of interchangeable duplicate dollies **11** to transfer grippers **12**, Fig. 1, which carry them through the body of the machine and present them for registration in proper position to pass through the bite between an impression cylinder **14** and a blanket cylinder **15**, to the latter of which an ink image is applied from the plate cylinder **16**. Arriving there, and with proper registration, the now leading edge of the sheet (whichever it may be) is transferred to grippers mounted on the impression cylinder, which in turn carry it through the bite between the impression and blanket cylinders, beyond which the leading edge of the sheet is transferred to delivery grippers **18**. These carry the sheet to a position above the delivery stack **10***a* on dolly **11***a*, and release it, thus adding it to the stack and completing one cycle of machine operations.

General description

The machine includes a suitable frame **19**, including a base **20** adapted to rest upon the floor or other support, opposite side walls **21** suitably cross-connected by brace rods and tie members to which no detailed reference is necessary, and on which frame most of the working parts are supported. The whole machine is enclosed within an outer casing or jacket **22**, which covers all mechanism when the machine is not in use and presents a neat and attractive outer appearance.

In the base, upon a suitable horizontal shelf **23** supported by hanger **23***a*, is mounted a driving or operating electric motor **24**, in a circuit **24***a*, Fig. 48, from L_1 to L_2, the shaft of which motor is provided with a number of operating pulleys, marked **25**, **26**, **27**, **28**, Fig. 3, said motor being controlled by switch **24***b*.

Pulley **25** is connected by belt **29**, Fig. 1, to a pulley **30** for operating the shaft of an air pump **31** shown in dotted lines, Fig. 3.

Pulleys **26**, **27** are connected by belts **32** to the operating shaft of two pumps **33**, **34**, Fig. 3, mounted in tandem, pump **33** being adapted to circulate an operating fluid, such as oil, in large quantity and at relatively low pressure, while pump **34** circulates similar fluid in small quantity and at high pressure. The fluid pressure or hydraulic system will be described more fully hereinafter.

Pulley **26** is connected by belt **35** to the driving pulley **36** of a well-known form of change speed mechanism, such as that commercially known as the Speedmaster, marked generally **37** (Figs. 1 and 49) and having another pulley **38** connected by belt **39** to a driven pulley **40**. Pulleys **36**, **38** automatically vary in effective diameter. Member **37** is mounted upon a swinging arm **37***a* by means of which it may be moved from the full line position to the position shown in dotted lines, Fig. 1, to thereby adjust the pulleys and change the speed ratio as between the driving pulley **36** and pulley **38**, thus varying the speed of operation of all parts driven by pulley **40**. These include the sheet feeding, transferring and delivery mechanisms and the several operating cylinders, thus varying the rate of production of all finished work. The means and manner of operating arm **37***a* will be described hereafter.

Pulley **40** is on a shaft **41** having a sprocket **42** (Figs. 1, 3, 7 and 13) connected by chain **43** to a sprocket on shaft **44** which, through chain **45** drives sprocket **46** connected by a releasable coil spring clutch **47** to shaft **48**. This extends across the machine to its left side (Fig. 13) where it is provided with a sprocket **49** and a pinion **50**, the latter meshing with a large main driving or bull gear **51**, later to be referred to. A hand crank **52** may be releasably coupled to the shaft by clutch teeth **52***a*, with simultaneous release of power clutch **47**, for manually driving the parts, such as when setting up or adjusting the mechanism for a particular job, as will later more fully appear.

Supply stack elevation

The dollies **11**, **11***a*, serve not only as trucks, by means of which stacks of up to ten thousand sheets or more may be rolled from the supply room to the printing press, or from one end to the other of the press for reverse printing, but also as elevators forming a part of the machine itself, one rising as sheets are taken off from the top of its pile, and the other descending as sheets are laid upon its pile. Each dolly consists (Figs. 14 and 46) of a simple platform **53** mounted upon caster wheels **54** and provided at each of its four corners with suitable means, shown conventionally as adjustable hooks **55** and eyes **56**, by means of which belts or cables **57** may be detachably connected to it and adjusted for stack leveling purposes. Of the four cables **57** for the dolly **11** at the feed end of the machine, the two nearest to an operator standing there are led up over pulleys **58** mounted in a hinged frame or apron **59** and then down to pulleys **60** mounted on a shaft **61** journalled in the base of the machine frame. The two cables **57** remote from the operator are led up over pulleys **62**, then forwardly to and over pulleys **63** and down to the same pulleys **60** upon shaft **61**. Shaft **61**, on the left-hand side of the machine is provided with a pinion **64** (Fig. 34) meshing with a gear **65** on a stub shaft **66** and coupled to a pinion **67** in engagement with a rack **68** connecting two pistons **69** traveling in the chambers of a double acting servomotor cylinder **70** actuated by fluid pressure, such as hydraulic pressure, supplied by the flow of oil through the hydraulic system to be later described.

For convenience it may be here noted that the dolly **11***a* at the discharge end of the machine is actuated by a corresponding double acting cylinder **70***a*, the pistons of which, by means of rack **68***a*, and a corresponding set of cables and pulleys, are releasably and operatively connected to the

dolly 11a. However, as shown in Fig. 3, cylinders 70 and 70a, while parallel, are located on opposite sides of the machine.

Referring again to Fig. 14, the hinged frame 59 before referred to is shown in full lines in operating position, in which it is supported by diagonal braces, each including two members 71, 72, pivoted together at 73, the former connected to the swinging frame 59 and the latter to the stationary machine frame 21. By breaking the pivotal joint 73 and folding the brace members inwardly, frame 59 may be swung down to the position shown in dot-dash lines, bringing all of its parts within the boundary of the machine casing, thus reducing bulk when the machine is not in use. To so fold the frame 59 into the machine, the dolly of course is disconnected from its cables.

A similar arrangement, requiring no special description, supports the swinging frame or apron 59a at the discharge end of the machine. Frames 59 and 59a, of course, are pivotally mounted at the points marked 74, 74a, respectively, in the main frame.

Four members 75, shown more or less conventionally in Fig. 15, confine and guide the corners of the rising stack and hold the sheets in proper position to be seized and advanced to the transfer grippers. These guide members preferably are conveniently adjustable in any conventional manner (not shown) both longitudinally and laterally of the machine so as to receive between them rectangular sheets of any desirable shape and size and properly located for feeding purposes.

A feeler finger or lever 76, shown more or less conventionally in Fig. 15, is mounted upon a suitable support, such as one of the members 75, and is biased by a light spring downwardly, or toward the rising stack. Said finger actuates a single-pole single-throw electric switch 77, Fig. 48, biased to closed position, in a circuit wire 78 connected in parallel with wire 78a to a double-pole double-throw switch 79, connected to control circuits including the two actuating coils 80, 80a of a suitable solenoid operated four-way distributing valve 81, Fig. 47, the purpose of which is to control the flow of oil to and from the double acting servomotor 70. Valve 81 is suitably biased to neutral position and the switch 79 has a manually operatable handle 82 convenient for use in setting up the machine, and by operation of which the dolly may be either raised or lowered. Normally, when the machine is in operation, switch arm 82 is releasably held in the dotted line position, Fig. 48, by a suitable spring latch conventionally indicated at 82a.

It may be well here to remark that all control or distributing valves in the hydraulic system, including the valve 81, are of the same general form, each having a slidable distributing plunger-form valve member provided with one or two iron cores for cooperation with an operating coil or coils, and with appropriate biasing springs, where necessary. Such valves are of common construction and require no detailed illustration.

Valve 81 has three positions. It is biased to neutral lapped position, with all passages closed, and may be moved to either of two operating positions, in each of which it supplies pressure fluid to one end of cylinder 70 and evacuates the other.

Assuming the machine in operation, with a stack of sheets being fed, switch 79 is placed in its dotted line position, Fig. 48, in which it is stable. Feeler 76 is held in light contact with the uppermost sheet by its biasing spring. Switch 77 is open. Coils 80, 80a are deenergized and valve 81 is closed. No fluid flows to or from either of the pistons 69. Thus the dolly 11 and stack are stationary.

As sheets are removed one by one from the stack and are fed to the machine, the level of the stack lowers and feeler 76 swings slowly downwardly until finally it closes switch 77 and thus momentarily energizes coil 80 and cracks or opens valve 81. Immediately a small charge of fluid is admitted from the large volume hydraulic pump 33 to the appropriate piston of cylinder 70, moving over the rack, and causing the shaft 61 to rotate in the proper direction to elevate dolly 11 and the stack which it carries. Fluid evacuated from the other end of the cylinder is returned to the storage reservoir. Upward motion of the stack promptly raises the feeler 76, and permits switch 77 to open. Valve 81 returns to neutral closed position. Fluid flow and upward stack movement thereupon cease.

The feeler is in very light contact with the uppermost sheet and all control parts are delicate and are delicately adjusted, operating with a sort of governor action within fairly close limits. Only a small quantity of oil is moved, and very little motion is required, so that, in effect, the top of the stack always is maintained at substantially uniform level.

In setting up the machine for operation upon a fresh stack, the hand switch 79 is used to move valve 81 over to its reverse position, by energizing coil 80a, thus returning the pistons 69 to the other end of the cylinder, and lowering the cable ends, as will be readily understood.

Generally similar mechanism is provided for handling the stack of printed sheets at the delivery end of the machine, although here, of course, the dolly moves downwardly as the stack builds up.

Sheet separating and feeding mechanism

Further referring to Figs. 1, 6, 15 and 35, the frame 59 supports a transversely extending hollow tubular member 83 (usually of generally rectangular cross section) extending along the advance face of the stack near its top and provided with a series of small ports 84 opening toward the stack and toward an operator standing in front of it, said tube being closed at both ends and communicating at its middle point by way of regulating valve 85 with a conduit 86 connected to a suitable source of compressed air, such as the outlet side of the air pump 31 before referred to (Fig. 35). With that pump in operation, jets of compressed air blow continuously from the openings against the edges of the uppermost sheets of the stack, constantly agitating them and tending to lift the extreme uppermost sheets and partially separate them from each other and from the stack. However, a lip 87 on the tube, having recesses 87a, extends over the edge of the topmost sheet and controls its escape. The final effect is to separate the uppermost sheet from those below it, thus presenting forwardly the leading edge portion of but a single sheet for seizure by suction devices and advance to transfer grippers, as will now appear.

To remove a sheet or cause its escape from the top of the stack, several suction cups 88 communicate at intervals by pipes 89 with a hollow suction manifold 90 of pipe form extending across the machine, in frame 59, slightly above the

uppermost sheet and adjacent the leading edge thereof. In each pipe 89 is a regulating valve 89a. This sheet lifting manifold 90 is given special bodily movement.

Viewed endwise, or from the right side of the machine, as in Fig. 6, the manifold moves in a rectangular path, first downwardly a half inch or more, to bring the suction cups into contact with and thereby seize the uppermost sheet, then rearwardly or toward an operator standing in front of the machine, then upwardly, and then forwardly to its original position, where the advance edge of the sheet is grasped by transfer grippers for conveyance into and through the machine.

To effect such movements of the sheet carrying manifold 90, it is suitably mounted for the purpose. Although any suitable arrangement may be employed, the drawings show member 90 more or less conventionally, for purposes of illustration. Its closed ends are each supported upon an arm 91 pivoted at 92 in frame 59, the pivots 92 traveling in horizontal slots 93 in the side frame members, thus enabling the entire sheet lifting device, including both side arms 91 and manifold 90, to have limited longitudinal or fore and aft movement in the frame, and member 90 to have up and down swinging motion about the pivots 92 with respect to the stack of sheets. Part of each of the arms 91 is of rectangular open form, as indicated at 94, providing a square opening or space 95 in which rotates a three lobe cam 96 on a cross shaft 97 journalled in frame 55. Shaft 97 of course extends clear across the machine with similar cams on its opposite ends, one for each of the arms 91.

Cam shaft 97 which actuates the suction cups, is provided with a large pinion 98 driven by a smaller pinion 99 coupled to sprocket 100 connected by chain 101 to sprocket teeth 102 on constantly driven pinion 103, Figs. 2, 15 and 28, forming part of a reversing mechanism later referred to. The arrangement provides three to one reduction in the gearing, for timing purposes.

Continuous rotation of shaft 97 produces motion of member 90 of that kind before described, i. e., in a rectangular path. As it moves rearwardly, or toward the operator, with the suction cups down on the stack, the effect is to first pull the edge of the sheet out from beneath lip 87 and then bow, arch or buckle the middle portion of the uppermost sheet upwardly, as shown in dotted lines, Fig. 6, thus completely separating it from those beneath it, and facilitating its advance without frictional drag or tendency to cling to the pile. Upward motion of the cups lifts the sheet to a level above lip 87, the full line position, Fig. 6.

The space within pipe 90 communicates by way of a conduit 104 with a suitable source of suction, such as the suction side of the air pump 31 before referred to.

The air control system, Figs. 6 and 35, includes a lateral branch 105, open to the atmosphere but normally held closed by a hinged cap 106 biased by tension spring 107. Assuming that fan 31 is in constant operation, with suction continually produced in conduit 90, it is apparent that when cap 106 is closed the suction is effective at the suction cups 88, to cause a sheet to cling to them. However, whenever, cap 106 is opened, the suction effect is dissipated by flow from atmosphere into the branch pipe 105, and becomes ineffective at the cups.

The control system for these suction cups includes means for operating the cap 106 in such manner as to render the suction cups effective prior to their engagement with the uppermost sheet, and to relieve or dissipate the suction effect just as the leading edge of the sheet being fed enters the transfer grippers and is seized by them. As shown in Fig. 6, cap 106 is provided with a projection 108 lying opposite one end of a lever 109 pivotally mounted in a fixed frame arm 110. The opposite end of lever 109 is provided with a curved cam lug 109a which lies in the same horizontal plane as the top sheet, and also in the path of movement of a cross rod 111 (or a part attached thereto) upon which the transfer grippers are mounted, and later referred to. Each time the transfer grippers come around and are presented to the pile for receiving a sheet, the rod 111 engages cam lug 109a, tilts lever 109 and momentarily opens cap 106, thus relieving the suction and releasing the sheet from the suction cups, at the instant when it is seized by the grippers, and allowing it to be advanced by them. In operation the trailing end of one sheet passes beyond the suction cups before suction can again build up and become effective upon the next sheet.

Lip 87 is provided at intervals with the notches or recesses 87a referred to, to provide space through which the suction cups move into engagement with the sheet.

Sheet transfer mechanism

The sheet transfer mechanism accepts or receives the sheet from the suction cups and transfers it to a position with its then front or leading edge approaching the entrance to the space between the impression and blanket cylinders, where it is seized by a set of grippers later to be described mounted upon and forming part of the impression cylinder mechanism.

The transfer mechanism includes a set of sheet transfer grippers shown in detail in Figs. 8, 9, 10 and 20. These grippers, of which any number may be employed, are spaced at intervals along the cross rod 11 before referred to. This is mounted at its opposite ends in two endless conveyor chains 112, each running over and connecting a small sprocket 113 and a large sprocket 114, the latter forming the driving means for the chain, as will later appear.

Cross rod 111 is of generally tubular form, its reduced end portions actually forming pins at joints in the chains 112. Each gripper includes two jaw members, one marked 115 being fixed or rigid with the tubular rod, as by brazing or welding, while the other, marked 116, is pivoted thereto on an axis 117. A compression spring 118 biases the jaws of each gripper pair toward closed position. Each movable jaw is provided with a tail 119, the end portion of which lies in a recess 120 of the rod opposite a portion of an actuating spindle 121 slidable in the bore of the tube 111 and provided, in a zone adjacent each gripper pair, with a reduced portion 122 terminating in tapered or inclined cam portions 123. At one end the spindle 121 abuts a compression spring 124 housed within the tube and tending to move rod 121 to the right in Fig. 8 or to a position in which the reduced portion 122 of the spindle is opposite tail 119, with the jaws of the grippers closed. At its opposite end the spindle abuts a steel ball 125, beyond which is the head of a push rod 126, the extreme end of which extends outwardly from the tube 111, beyond the links of chain 112.

By pushing in the exposed end portion of the push rod, the entire spindle 121 is moved to the left, advancing the inclined cam shoulders 123, to thereby open the jaws of all grippers. Upon release of the push rod, spring 124 returns the spindle to its original jaw-enclosing position.

At its opposite end, rod 111 has secured thereto an arm 128 provided with an operating pin or crank 129 and a roller 130.

In the form shown, chains 112 are provided with but a single set of transfer grippers, although two or more might be employed, if desirable. That is merely a matter of timing of the parts, the present arrangement being of one-cycle form in the sense that the transfer grippers and chains make but one complete circuit for each sheet printed.

On the left-hand side of the machine, a portion of the main frame supports in fixed position a cam plate 131, Figs. 1, 15 and 20. This cam plate is provided with a groove form track 132, symmetrical about a horizontal axis, as in Fig. 20, and provided at two opposite points with gradually widening portions 133 each including an inwardly extending bay 134. In each widened portion of the groove is mounted a mechanical switch member 135 having a narrow tongue or arm 136 at one end and a wider head portion 137 at the other end, the latter having a prong extending partially into the bay 134.

Referring now to Figs. 20 and 21, each switch member, intermediate its ends, is provided with a pin 139 on its back face, extending through an elongated curved slot 140 in the cam plate, and on the other face of the cam plate, in a recess of the frame, said pin carries a fixed arm 141. The two arms 141 of the two switch members are cross connected by a tension spring 142, which normally maintains said switch members in the positions shown.

Crank 129 and roller 130 on the arm 128 of the gripper carrying rod extend into and travel along the cam groove 132.

Sheet transfer during direct printing

When the machine is printing "direct," i. e., to print or impress the image on that side of the sheet which lies uppermost as it is removed from the stack, chains 112 move or travel in the counterclockwise direction, Figs. 1 and 20. Fig. 20 illustrates diagrammatically, various positions of the transfer gripper during one complete cycle of operations.

The reduced end portions of the rod 111, as stated, form pins and constitute parts of the transfer chains 112, and hence follow exactly their path of movement with the same speed. The position of the several sets of jaws, which project outwardly from rod 111, depends of course upon the crank 129 and its position, at any given instant, in the cam groove 132 and with reference to the position of the rod 111.

At position A the grippers are moving away from the entrance to the space between the impression and blanket cylinders, having transferred a sheet to its position on the registering table, as will later appear. Consequently, the crank 129 is ahead of the rod 111, and the grippers are trailing, as it were. As the chain moves on, the grippers move through several positions indicated at A_1, A_2, and then to position B, where the roller 130 has moved in between the narrow tongue 136 of the uppermost switch and the inner wall or surface of the cam groove. As the chain advances, the roller continues along said wall, swinging the switch 135 upwardly, against the tension of spring 142, and opening a path below the switch along which the roller travels down into the bay or pocket 134. As the switch moves upwardly its pin 139 travels toward the upper end of the slot 140.

When the crank 129 reaches the bottom of the bay 134 it becomes a fulcrum about which the rod and grippers are turned, as it were, through several positions indicated at C, C_1, etc. until finally the grippers are ahead of or leading the rod and roller. The roller then rides out of the pocket 134 in the space between the head portion 137 of switch 135 and the inner wall of the groove and then down along a curved part of the groove to its lower half.

In the meantime, the ends of the jaws have traveled horizontally along an acute V-shaped path, in front of the paper stack, thus advancing and retracting them with very accurate registration with respect to the edge of the sheet being registered. While the jaws are in their most advanced position, with respect to the sheet, shown in full lines and marked D, they are momentarily opened by a cam (as will later appear) and the edge of the sheet enters between them.

Now, as the result of further chain movement, the crank 129 travels ahead of the rod 111, with the grippers trailing behind the rod and closed upon and holding the edge portion of the sheet. The upper switch member 137, of course has been returned by spring 143 to its original position, shown in full lines. The lower switch, shown in full lines, is in position to permit the roller 130 to pass between its head 137 and the outer edge of the cam groove, the roller raising the narrow arm 136 of the switch as it passes. Thus, along the lower half of the cam groove, the roller passes the switch without entering the bay 134, and the grippers continue to trail behind rod 111.

The chain proceeds, advancing the rod, the grippers, and the sheet seized by the gripper jaws, toward the impression cylinder. During such travel the sheet moves above and across a series of any suitable number, nine being shown, of cross rollers 148, distributed at intervals along the path of sheet movement and fairly close together, but not in contact with each other. These rollers form a sort of concave pocket, table or floor upon which the sheet is supported in concave shape to stiffen and strengthen it during lateral registration, later described.

In this manner the transfer grippers convey the sheet to a position on said table with its leading edge ready to move to and enter the V-shaped recess of a stationary transversely extending V bar 149, mounted upon the side frame members.

At the same instant, or even just a little earlier, the actuating rod 126, within the gripper bar 111, engages a cam (later described) and is moved endwise to open the jaws, which release the sheet. Thereupon they move forward, with the chain, to and through positions A, B, etc., repeating the same cycle of operations for the next sheet.

The transfer gripper jaws are therefore closed practically all of the time, during each cycle, being opened and closed momentarily twice, once when they receive and grip a sheet delivered to them from the suction cups, and a second time when the leading edge of the sheet approaches or enters the V-shaped recess in the V bar. Opening movement of the jaws in each case is produced by engagement of the projecting end of the push rod 126 with a cam.

One of these cams, 150, is shown in dotted lines, Fig. 24, and in Fig. 27. It is a shiftable but rel-

atively fixed cam, because at this point in the path of travel of the sheet, where it is released and laid upon the registering table, the sheet must always lie in the same position, regardless of whether the machine is printing directly or reversely. Therefore, this cam is mounted in definite position upon a portion of an adjustable control chain 151, but is shiftable with the chain along its path of movement, for timing and reverse printing purposes, as will later appear.

The other cam is effective to open the grippers where they receive a sheet from the suction cups. Two cams are required for this purpose. The cam so operative during direct printing is marked 152 and is shown in full lines in Fig. 24. It is mounted on or forms part of a disc or plate 153, splined to the shaft 154 which supports sprockets 113 (Figs. 1 and 15), but which plate is nonrotatable or stationary while the machine is in operation. The same plate also is provided with a second and corresponding cam 152*a*, Fig. 24, which serves as an alternate for cam 152 and operates in exactly the same manner when the machine is adjusted for and is operating for reverse printing, as will later appear. In other words, the same selective adjustment of other parts, effective to cause the machine to print either directly or reversely, also shifts the cam plate 153 selectively to either of two positions, in which one or the other of the pair of cams 152, 152*a*, is effective, the other cam of the pair at that time being idle or ineffective, because out of range of the path of movement of pin 126, as will be apparent from Figs. 15, 24 and 25.

Advance of sheet on registering table

The two large sprockets 114, over which chains 112 travel, serve as carriers to support and operate a series of small sheet registering or "kiss" rollers 155. Rollers 148, before referred to, are short plain cylinders, or sections of cylinders, usually made of stainless steel or other metal, distributed at intervals along and fixed to rods 156 journalled in the frame, to present smooth surfaces along which the sheet can easily slide where it contacts with or rests upon them. The rollers 155 also are short or narrow, but a little larger in diameter than rollers 148, at least the outer or peripheral portions thereof being made of suitable friction material, such as sponge rubber or a rubber-like composition, so that where they contact with a sheet they tend to slide it along.

"Kiss" rollers 155 are arranged in groups of any suitable number (four being shown in Fig. 15) lying in coaxial relation, opposite ends of the pins 157 upon which the rollers are mounted being connected end to end by fairly strong flexible straps 158, made, for example, of heavy leather, and which so connect the rollers as to enable them to be driven in groups, but with some freedom of relative movement of each relative to the others of its group.

Any number of groups of rollers 155 may be employed, twelve groups being shown in Fig. 20, distributed at uniform intervals around the axis of the sprockets 114. The mountings for the rollers of all groups are alike, those for one group being illustrated in Figs. 15, 16 and 20, the remaining sets of rolls being indicated conventionally and they or their mountings at times being omitted to avoid confusion of lines.

Each roller pin or axle 157 is loosely supported in but locked against escape from a pair of U-shaped hangers 159, Fig. 20, mounted on the ends of arms 160 projecting from a long bar 161 extending across the machine and provided at its opposite ends with arms 162 pivotally mounted by pins 163 on blocks 164 mounted in the two sprockets 114. An arm 165 (Fig. 16) on bar 161 supports a roller 166 which travels in a cam track or groove 167 in a stationary wheel or drum 168 locked to a shaft 169 supported in the left-hand frame member 21 and upon which the bull gear 51 is rotatably supported. Cam groove 167 is so shaped (Fig. 20) as to permit the "kiss" rolls to drop into contact with the rolls 148, or a sheet lying on them, as they move past rolls 148, and to withdraw the kiss rolls while they are moving past the impression, blanket and plate cylinders and across the top of the machine. Engagement of the kiss rolls with the bar on which they are mounted locks them and their supporting shafts in place and prevents them from dropping or otherwise escaping from their hangers, but without interfering with their freedom of self-accommodation as they travel along.

As shown in Figs. 15 and 20, additional support for the sheet may be supplied by a series of curved rods 170 extending longitudinally in the gaps between the rows or lanes of rollers 148, the surfaces of said rods lying very slightly below the roller surfaces, said rods being supported at their ends upon one or more cross bars 171. Other rods 172 may extend from the blower tube 83 at the edge of the stack to the first cross bar 171 and serve as a bridge to support the trailing portions of the sheets as they advance to the registering table.

A cylindrical flange or wall 173 of drum 168 serves as a bearing upon which one sprocket 114 rotates, while at the opposite side of the machine the other sprocket 114 is journalled upon a control drum 180, later to be referred to.

The pin or axle of one of the end rollers 155 of each set is operatably connected, by universal joint member 181, to a shaft 182 extending through the sprocket wheel 114 and provided beyond it with a pinion 183, by means of which the rollers 155 may be rotated. Rollers 148, at the same side of the machine are also provided with shaft members 156 equipped with pinions 185, by means of which they may be rotated. As shown in Fig. 16, the pinions 183, 185, for the two sets of rollers, mesh respectively with internal and external teeth on a ring gear 186 fixed with another internal ring gear 187 connected by spokes 188 to a hub 189 mounted to rotate on the hub of the stationary drum 168.

Ring gear 187 meshes with and is driven by a pinion 190 actuated by a small gear 191 coupled to a larger gear 192, the drive for which will be later referred to.

Bull gear 51, Fig. 16, meshes with and drives two pinions. One, marked 193, Fig. 17, is on the left-hand end of the shaft 194 of the impression cylinder 14. At its opposite end, shaft 194 has splined thereto a cone clutch member 195 which may be adjusted by a hand wheel nut 196 into clutching engagement with its cooperating clutch member 197 fast with a gear 198 rotatable on the shaft and coupled to gear 199 (Fig. 7) on the blanket cylinder, which in turn drives gear 200 on the plate cylinder 16.

The plate cylinder, at its opposite end (Fig. 16) carries a gear 201, connected to it by a coil spring take-up device, marked generally 202, gear 201 being the second of the two gears earlier said to mesh with the bull gear 51. The spring take-up mechanism is provided solely for the

purpose of taking up back lash or slack in the gear system just described.

Referring again to Fig. 17, the impression cylinder, at the left-hand side of the machine carries a pinion 203 which meshes with an intermediate pinion 204, which meshes with and drives the gear 192, before referred to and shown in Fig. 16.

Gear 203 and a corresponding gear 205 at the opposite end of the impression roller, serve as the driving gears for the delivery gripper chains 294 shown in Fig. 46 and later to be referred to, and the grippers and jaws of which seize a printed sheet delivered to them by the impression roll grippers and convey it to its position on top of the finished stack. The impression cylinder is operatively connected to shaft 194 by a long key 206, capable of cylinder release operation, as will later appear.

As before stated, the drive for the rollers 148, which with rods 170, support a sheet in concave form on the registration table, ready for seizure by the grippers of the impression cylinder, and of the sets of kiss rollers 155, is by way of the external and internal teeth on the ring gear 186 to gears 185 and 183, respectively. The parts are so proportioned, and the gear ratios are so chosen or selected, that the surfaces of all of these rollers, presented to and contacting a sheet lying between the two sets, travel in the same direction as the sheet and at the same speed. Rollers 155 are loosely mounted in their supports, and they also travel planetwise with the sprockets 114, as the latter turn in one direction or the other, according to the setup.

Taking into consideration the length of the transfer grippers, which always are trailing when the sheet is released, the sheet is released and laid upon the registering table with its leading edge somewhat short of the V-groove which it should enter, say an inch or so. Without pause, the "kiss" rollers apply to it a series of rapidly repeated kiss impulses, one as each kiss roller 155 passes each roller 148 in the lane along which it travels, thus gently, but firmly and positively, coaxing the sheet forwardly and insuring full advance of its leading edge into the V-groove, and accurate fore and aft registry by impact thereof with feelers in the bottom of the groove, preparatory to final registry on the impression cylinder itself.

Due to the flexible connections 158 between rollers 155 in the same group, and their loose mountings, rollers 155 act more or less individually, each accommodating itself to the rollers 148 with which it coacts.

The action of these kiss rollers is to apply a localized frictional brushing effect to the sheet wherever a roller 155 passes a roller 148, applying positive feeding advance to the sheet wherever it is pinched between rollers, but the positive advance is not continuous, but intermittent, because the planetary motion of rollers 155, at a speed higher than their peripheral speed, carries them away from rollers 148. Thus, while the sheet is being continually subjected to repeated localized advancing impulses, there is never any tendency to buckle it.

It will also be observed that the circumferential spacing of the two sets of rollers 155, 148 is different. Rollers 148 are shown 12° apart and rollers 155 30° apart. Due to that spacing, regardless of whether sprockets 114 are turning clockwise of counterclockwise, Fig. 20, only the rollers 155, of one group can have full contact with a group of rollers 148 at any one instant. The ultimate effect is to cause the repeated sheet advancing kiss contacts to occur serially, at spaced rolls 148, always in order in a direction contrary to that of normal sheet travel toward the V-groove. That is, kiss contacts occur at the several rolls 148 in the order of their subscript lettering *a, b, c* in Fig. 20 and so on. This mode of operation distributes the localized kiss impulses along the sheet in such manner as to further avoid any tendency to arch or buckle it.

Further, due to planetary travel of the kiss rollers and identity of the effective peripheral speeds of the two sets of rollers, the kiss effect is exactly the same, regardless of either the direction or the rate of planetary travel.

Also, by distributing a series of individual localized impulses serially over the entire sheet area, the mechanism straightens up any sheet which is laid upon the registering table aslant or in askew position, advancing which ever side lags, when the leading side reaches the groove in the V-bar. Thus, longitudinal registration on the table is complete from every standpoint.

Again, and intentionally, the kiss rollers are equally effective when, because the sheet is long, or for any other reason, two sheets become superposed on the registering table at the same time. When that occurs, the second sheet is above but somewhat behind the first, and the two are "kissed" forwardly together until the leading edge of the first enters the V-bar recess and is grasped by the impression cylinder grippers, whereupon it is whisked away from its position beneath the second sheet, the latter still advancing, and so on. Engagement of the leading edge of the following sheet with the feelers in the V-groove does not interfere with advance of the leading sheet by the kiss rollers beneath it and the following sheet goes ahead, in its turn, just like any other. That manner of operation is peculiarly advantageous because it enables this machine to accommodate longer sheets than usual without unduly increasing cylinder sizes and total machine bulk. Indeed, when the present machine is designed to accept sheets up to, say, 21 inches in length, the circumference of the impression cylinder is only 22.8 inches, whereas in prior machines it is usually about twice the maximum sheet length, or 42 inches or more.

Going back, now, to the drive for transfer chains 112, Figs. 15, 22 and 29 to 32, the gear 192 also meshes directly with a pinion 207, which in turn meshes with external teeth upon a gear 208 having internal teeth which mesh with a series of three pinions 209, mounted upon spider 210, and which pinions mesh directly with external teeth on the gear 103 having internal clutch teeth 211. Pinions 209 also drive a set of smaller intermediate pinions 212 (Fig. 29) which drive the teeth of another pinion 213, coaxial with and similar to pinion 103 and also having internal clutch teeth 214. Obviously pinions 103 and 213, which are coaxial, rotate in opposite directions. These two pinions are mounted upon bushings on the central supporting shaft 154, upon which is journalled a sleeve 216 (Figs. 28 and 32) provided with external clutch teeth 217 adapted, by longitudinal movement of the shaft and sleeve, to be moved selectively into engagement with either of the two sets of clutch teeth 211, 214, thereby to rotate the sleeve in either direction. The sleeve also has slidably secured thereto, as by a key, one of the two small sprockets 113 over which the

two chains 112 travel, said sprockets being connected by the tubular shaft 218.

Spider 210 is keyed to shaft 154, but the shaft is slidable in the spider. A rigid part of shaft 154, at its left-hand end, Fig. 28, forms a clutch member 219 provided with external clutch teeth adapted for interlock, by longitudinal movement of said shaft, with cooperating stationary internal clutch teeth on a member 220 mounted upon a part of the stationary frame 21, and which clutch, when the teeth are interlocked, serves to hold the shaft 154 and the spider 210 stationary during reverse printing.

A toothed dog or collar 221 upon a slidable pin 222 (Figs. 17 and 24) normally engages teeth 223 upon control drum 180, which is operatively connected to the other end of shaft 154, and locks the shaft 154 and spider 210 against rotation at other times, as during direct printing. This control drum and its manner of operation and control will be described later.

Missed sheets

At the entrance to the printing space is located the stationary V-bar 149, Figs. 20 and 40*a*, before referred to, rigidly secured at its ends to the side frame members. Said bar is provided with a longitudinal V-shaped groove or channel 225 which opens downwardly, and which is intersected at intervals by a series of spaced notches or recesses 225*a*. In the body of the bar is rotatably mounted a long small diameter rod 226 having a series of spring feeler fingers 227 extending across and intersecting the bottom of the V-groove and spaced at intervals along its length. Rod 226, at one end, has an arm 228 which actuates a single-pole double-throw electric switch, marked generally 229, Fig. 48, in an electrical control circuit, the purpose of which switch is to move the blanket cylinder away from the impression cylinder, in case a sheet is missed.

Switch 229 is in a circuit 230 from L_1, including a switch 231, normally biased toward closed position, as by spring 232, and actuated by a cam recess 233 in a ring 234 on the impression cylinder 14. Said switch 229 includes two contacts 235, 236, the first in a circuit 237 including a coil 238 and the second in a circuit 239 including coil 238*a*. These two coils actuate a distributing valve 240 (Fig. 47) which controls the flow of oil to servomotor cylinders 241 for operating the blanket cylinder 15 by means of rods 242. Valve 240 is stable in either of two positions, one holding blanket roll in operative or printing position and the other holding it in inoperative or trip position, said valve being later referred to more in detail.

Switch 231 is momentarily closed each time the cam recess 233 comes around. If, at this particular moment a sheet has entered the V-bar recess and has thus moved switch 229 to the position shown in Fig. 48, coil 238 is momentarily energized, thus actuating valve 240 and moving the blanket roll to printing position, if it is not already there. If it is already there, it simply stays there.

On the other hand, if, at the same moment no sheet is present (because the feed has missed one, for example) switch 229 will remain in its normal or opposite position at contact 236. Thus coil 238*a* will be energized, thus oppositely actuating the valve 240 and causing the blanket cylinder to move away from the impression cylinder, to trip or nonprinting position.

A manually operated switch 243, biased to neutral position, in a circuit 244, enables either coil 238 or 238*a* to be energized, for moving the blanket cylinder to either of its positions, at the will of the operator.

The form and arrangement of the cylinders 241, and of the valve 240 which controls printing contact, will be described later more in detail.

Transfer of sheet to impression cylinder grippers and longitudinal sheet registration

The impression cylinder 14 has a body portion, the smooth cylindrical surface of which forms the backing upon which the sheet rests as it travels between the impression and blanket cylinders during transfer of the ink image from the blanket to the paper.

At its middle point V-bar 149 pivotally supports a two-armed lever 247 carrying two cams 248, 248*a*, Fig. 41, one on each arm, said lever being suitably biased, as by a spring, to always tend to move in one direction, and more specifically in a direction toward its reverse printing position.

In a longitudinal cavity in cylinder 14 is rotatably mounted a bar 249 to which are attached several spring gripping fingers, certain of which, 250, Figs. 17 and 41, are immovable on the bar, and others of which, say four or five, numbered 251, are pivoted. Several of the fingers carry small blocks 252. The bar as a whole is journalled at its ends in the cylinder body, and at one end is provided with a pinion 253, Figs. 17 and 43, meshing with a curved rack 254 on an arm 255 pivoted at 256 and having a second arm 257 provided with a roller 258 traveling in a cam groove 259 in a stationary plate 260 secured to the machine frame. Alongside the rotatable bar 249 is a second bar 261 of noncircular cross section having a flat sheet receiving face 262 presented outwardly, or toward the gripping fingers. This bar is slidable endwise in corresponding noncircular openings in end heads of the cylinder, beyond which at each end a rod extension of the bar is provided with a roller 263. Springs 245, one at each end, bias the bar 261 to a neutral or mid position.

On another bar 264 (Fig. 45) mounted to turn about the axis of bar 249, are slidably mounted, in an undercut groove, two side stop fingers 265, which may be set to any position along its length, usually being spaced apart just a little more than the width of the sheets being printed, say ¼ inch or so beyond each side edge. The stops normally project outwardly from the surface of the cylinder as in Fig. 42, so that as they come around they at first lie opposite the side edges of a sheet going through. But the guide 264 on which they are mounted, has arms 266, one at each end, adapted to engage metal rings 267 on the ends of the blanket cylinder 15, as the arms come around, to depress said arms and turn the bar, and thus retract the stops 265 to a position where they cannot contact with the blanket cylinder, thereby protecting it from injury.

In Figs. 36 to 40 the impression cylinder 14 rotates clockwise.

Fig. 36 shows the parts in their positions as the transfer grippers approach the blanket cylinder.

It may be assumed that the transfer grippers have delivered a sheet to its position on the rolls 148 and beneath "kiss" rollers 155, which have advanced the leading edge of the sheet to a position in the V groove of bar 149 and pressing edge-

wise against the feelers 227 in the bottom of said groove, thus operating switch 229. The "kiss" rollers, in whichever direction they are traveling by planetary movement, continue to gently coax the sheet forwardly with a large number of rapidly repeated light impulses, to straighten it, if it is askew, and to produce and maintain its complete longitudinal registration, and are prepared and ready to advance a following sheet, if one is present. The two sets of gripping fingers on the impression cylinder are fully retracted or, in other words, their ends are widely separated from the flat sheet receiving face 262 of bar 261, as in Fig. 36.

As the impression cylinder continues to rotate, roller 258 follows the stationary cam groove 259, which is shaped to cause or produce, at this time, counterclockwise rotation (Figs. 36 and 43) of the bar 249, thus advancing all gripping fingers toward the cooperating sheet receiving face 262 of bar 261. The two sets of gripping fingers are so formed or bent that the clamping faces of pivoted fingers 251 are a little ahead of those of the stationary fingers 250 and therefore contact the sheet first. But, before full contact of any fingers is reached, the flat faces of the gripping fingers, which are approaching the edge of the sheet flatwise, pass into recesses or notches 225a beyond or around its leading edge, as in Fig. 37, and present blocks 252 first to its under surface and then to its edge, as in Figs. 37 and 38, so that the edge of the sheet presses against the faces of the pivoted fingers and is accurately registered, fore and aft, in the angle between them and said blocks.

The gearing is so proportioned and timed that, as the gripping fingers turn with the bar on which they are mounted, and the impression cylinder advances, finger movement in the plane of the sheet actually is in a direction reverse to that of its advance. In other words, while the body portion of the impression cylinder, where it supports the gripping finger bar, moves clockwise with the cylinder and hence upwardly in Fig. 36, the ends of the gripping fingers and the blocks are moving to the left and downwardly, as in Figs. 37, 38 and 39, hooking around the edge of the sheet, as it were. This operation backs up the leading edge of the sheet against the clamping effect of rollers 148,155 and pushes or peels it out of the V-shaped groove in bar 149 and the impression cylinder. Ultimately, in about the position of Fig. 39, the pivoted spring fingers close upon the sheet receiving face of bar 261 and clamp the sheet to it. This all takes place before stationary grippers 250 have engaged or contacted the sheet.

At this particular moment one of the rollers 263 engages one of the cams 248, which causes the bar 261, as a whole, to move bodily to the right or to the left, according to the set up for direct or reverse printing, until that side edge of the sheet which leads in the direction of lateral sheet motion engages one of the stop fingers 265. This halts motion of the sheet as a whole, but the bar 261 continues its motion, with a small amount of over travel, dependent upon configuration of the cam 248. During such over travel of bar 261 the pivoted fingers turn on the bar, their gripping ends remaining with the sheet, and the bar slides along idly beneath the sheet, its clamping surface being smooth enough for that purpose.

During lateral registration the sheet is supported upon the table formed by the rollers 148 and rods 170 in concave form, and thus is considerably stiffened and strengthened, so that it moves laterally readily and easily, with no hesitation.

Thus, by such operations, the sheet is accurately registered fore and aft, or in the direction of its advance motion, by the intermittent advance coaxing of its leading edge first into the groove in the V-block and then into position against the blocks 252, and laterally by its lateral adjustment into engagement with a stop 265.

Now, while the impression cylinder continues to advance, a rising portion of the cam track 259 turns the bar 249 a little further so as to bring all of the stationary gripping fingers 250 into engagement with the sheet for more secure clamping thereof to the bar 261. This happens while roller 263 travels on the flat or high surface 248a of cam 248. At about the position shown in Fig. 40, when the sheet really has assumed S-form, the edge of the sheet reaches the blanket cylinder and is pinched by its pressure upon the impression cylinder, the two cylinders now becoming effective to cause further sheet advance until the leading edge is seized by the delivery grippers and released by the cylinder grippers, as will later appear.

Two cams 248 and two stops 265 are employed in order to always accomplish side or lateral registry by or with reference to the same physical edge of the sheet, during both direct and reverse printing. In other words, when the sheet is going through the first time, for direct printing, the right-hand cam 248 is effective to move the sheet to the right against the right-hand stop 265, while, when the sheet is going through the second time, for reverse printing, the left-hand cam and left-hand stop are effective. The means to determine which cam and stop are made effective during the two conditions is a part of the control mechanism now to be described.

Control drum mechanism

The control mechanism is actuated by the drum 180, before referred to. This is journalled in the right side frame wall at 180a, Fig. 15, and is provided with an extension 180b through the outer casing, where a flange 268 of the extension, Fig. 24 is provided with radial ribs 269 by means of which the drum may be manually turned about its axis. Along the margin of the flange, as shown in Fig. 23, the drum is provided with a scale 270, cooperating with a suitable pointer 271 on the casing, said scale being graduated, for example, in inches, to determine setting of the drum according to the length of a sheet being printed reversely. Legends "Reverse" and "Direct" are also used. Normally, when the machine is running, the drum is held or locked stationary by engagement of dog 221 with drum teeth 223 (Fig. 17).

On the drum are sprocket teeth 272 over which travels the control chain 151 meshing with a sprocket 274, journalled upon a cam sleeve 275 rotatable on shaft 154 (Fig. 26) between a head 276 thereof and a collar 277 fixed thereto. Cam sleeve 275 is provided with an external cam groove 278 into which projects a pin 279 fast with sprocket 274. The effect of this cam and and pin is to produce longitudinal or axial motion of shaft 154 upon rotation of control sprocket 274. The chain 151 not only supports cam 150, but also is provided with a side lug 280 arranged to engage a lever 281 (Fig. 27) pivotally mounted upon the machine frame and arranged to operate cam supporting lever 247 (Fig. 36) before referred to. At another point, chain 151 carries

a roller 282 located and designed to enter or leave a notch or recess 283 in plate 153.

Sheet transfer during reverse printing

Figs. 23 and 24 show the parts in the proper positions for direct printing. The dial has been turned counterclockwise, as far as it will go, its motion being limited, in that direction, by engagement of lug 280 with lever 281, and consequent operation of said lever against its bias to shift the cam carrying bar 247 to its direct printing position, in which lateral registering motion of the sheet is to the right and with reference to its right-hand edge.

Dog 221, by its engagement with drum teeth 223, locks the control drum against rotation and prevents movement of the control chain. Since roller 282, on the chain, lies in the recess 283, it locks plate 153 fast, thus preventing rotation both of shaft 154, to which the plate is splined, and of spider 210, keyed to said shaft, in the reversing mechanism.

Shaft 154 is in its right-hand position, Fig. 28, thus coupling the pinions 209 to sleeve 216.

Accordingly, the transfer chains 112 run in the counterclockwise direction, Figs. 1 and 20, each sheet being seized by the transfer grippers at its leading edge and being carried directly forward, printing surface up, beneath the control drum axis and across the rollers 148 to a position on the registering table where its original leading edge is ready for introduction to the V-groove, contact with the feelers, and seizure by the impression cylinder grippers for travel through the printing space. The printed sheets are piled upon the receiving dolly, as will later appear, printed face up.

Reverse printing

To now print reversely, for example, upon the sheets already printed directly, the impression cylinder is stopped, in a manner later described, an operation which at the same time stops all of the mechanism which operates to cause sheet motion through the machine, including the original sheet feeding devices, the transfer grippers and chains, the delivery grippers, and the stack operating devices.

The receiving dolly, with the sheets lying thereon in the same position in which they were delivered, is wheeled around to the free end of the machine and is there substituted for the empty dolly, but the fresh dolly is positioned so that what formerly were the trailing edges now become the leading edges and go through first. Guide members 75 are readjusted to the new stack, if that is necessary.

In this position of the parts the pin 222 lies opposite a recess 245 in the impression cylinder or a part fast therewith, such as gear 205, Fig. 17. Pin 222 therefore is pushed in to temporarily lock the impression cylinder in a definite or established position, from which it cannot escape until the pin is released. The hand crank 52 (Figs. 7 and 13) is pushed in, which expands or opens up and releases the spring clutch 47 and thereby uncouples the power motor drive from sprocket 46 to the shaft 48, stopping the plate and blanket cylinders, and also couples the clutch teeth on the hub of crank 52 to those on shaft 48, enabling said shaft and the mechanism operated thereby to be turned manually by means of the crank.

With the crank pushed in, the gearing is turned to rotate the plate cylinder to a position in which the plate may be changed. The direct printing plate is taken off and the reverse printing plate is substituted for it, with appropriate adjustment for fore and aft registration.

It may be here noted that the cone clutch 195, 197, by means of which gear 198 is coupled to the shaft 194, is another expedient useful, at times, in making minor corrections in the position of the plate cylinder with reference to the driving mechanism and other parts, for the purpose of securing accurately any desired fore and aft registering relation as between the paper sheet and the impression.

Dog 221 has been disengaged from teeth 223 by the operation of pushing in the pin 222. Therefore, while the impression cylinder is locked in its definite established position, the control drum 180 is free for rotation. It is now turned clockwise, manually, in Figs. 23, 24, to a position in which the graduations on the control drum dial indicate the length of the sheet to be printed reversely, whereupon pin 222 is pulled out of recess 245 and is restored to its former position, and the dog 221 again engages the drum teeth 223, as before, and locks the control drum in its newly established position.

Referring to Fig. 24, the first portion of clockwise rotation of the drum—enough to turn the small sprocket 274 about 135°—accomplishes several results.

First, the lug 280 has moved away from lever 281, releasing said lever and permitting long bar 247 to move by its bias to its opposite reverse printing position. This renders the second cam 248, at the opposite side of the machine, effective, so that when lateral registering movement of the sheet is produced, in the manner before explained, the sheet motion is now to the left, instead of to the right, but lateral registration, actually, is still with reference to the same physical edge of the sheet.

Second, the roller 282, engaged in the recess 283 of plate 153, has rotated said plate until the roller leaves the notch and reaches the position shown in Fig. 25. Rotation of plate 153 moves cam lug 152 to a position where it becomes ineffective and cam lug 152*a* to a position where it becomes effective to momentarily open and close the transfer gripper jaws for seizing a sheet presented to them by the feeding suction cups, a position, by the way, just as far below the horizontal plane through shaft 154 as the lug 152 was above it.

Third, since plate 153 is keyed to shaft 154, and has rotated 135°, said shaft is also turned 135°, which at the prevailing gear ratios causes clockwise rotation of chains 112 through 180°, or 1½ turns of small sprocket 113, advancing the transfer grippers 12 one half cycle, with corresponding relative rotation of the teeth of the reversing gear clutch, but nevertheless to a position in which such teeth are again in exact end to end relation and will mesh properly. Therefore when, during further rotation of the control drum, sprocket 274 is further rotated, the clutch teeth readily engage as the result of longitudinal shaft motion due to the cam groove 278. Also, the adjustment automatically maintains the timed relation of the grippers 12 to the impression cylinder grippers, without requiring any special relative adjustment between them, as the result of their new position or the fact that the chains 112 will now turn in the opposite direction.

Fourth, cam lug 150 has been adjusted to a

position approximating that where the original trailing edge of a minimum length sheet should lie when it is released by the transfer grippers, for example, a sheet eight inches long, the shortest length which this machine is intended to print. This position of lug 150 therefore may be considered as its zero reverse position.

Fifth, the rotation of sprocket 276 has caused its internal pin 279 to travel along a spirally curved portion of the cam groove 278, causing sleeve 275 to move axially; thus moving shaft 154 endwise. One effect of such shaft motion is to shift the clutch sleeve 216 endwise into coupled relation with pinion 213 and thus reverse the direction of drive to the transfer chains 112. The other is to engage clutch teeth 219 with their cooperating teeth on the stationary frame member 220, thus holding the shaft 154 and spider 210 nonrotatable. Such clutching effect is necessary, because the roller 282 (Fig. 24) no longer holds plate or disc 153 nonrotatable, so that the shaft 154 might otherwise rotate. However the dog 221 will still be effective, when again engaged with the teeth on the control drum, to hold it stationary, together with parts connected to it, including the control chains, plate 153 and cams 152, 152a, 289, and lug 150.

The control drum dial should now lie in such position that it indicates the length of the shortest sheet which the press will print (in this instance, eight inches—see Fig. 23), and also the fact that it is set for "Reverse" printing.

The second portion of clockwise adjustment of the control drum (though usually the adjustment is by one motion to completion) rotates it to a position where the dial indicates the actual total length of the sheet to be printed, to the nearest interval or fraction consistent with the pitch interval between gear teeth 223 on the control drum, enabling the pin 222 to be released or pulled out and dog 221 to engage teeth 223 and again lock the control drum and the parts connected thereto and operated thereby, as before, but of course in its new position. The intervals referred to are so chosen that in each different position to which the drum may be adjusted, the clutch teeth in the reversing mechanism, and between the shaft 154 and frame member 220, are in exact registry and may be readily engaged by endwise motion.

The same adjustment of the dial moves lug 150 to a new position, appropriate to the actual length of sheet to be printed.

The adjustable locking key 206, before referred to, (Figs. 18 and 45) which releasably connects the impression cylinder 14 to its shaft 194, assists in the preservation of gear relations and timing. This key is normally biased inwardly to locking position, in which the cylinder and shaft are solidly coupled, by a spring or springs 206a. In the cylinder is journalled a rotatable shaft 284 having arms 285, one near each end, operatively coupled to the key for lifting it out of the shaft keyway. The end of the shaft, beyond the printing area, carries a crank or lever 286, Fig. 18, having an inclined cam portion 287, beyond which is a stop shoulder 288. When the machine is being power driven and key 206 is in locked position, the cylinder rotates clockwise in Fig. 18. On the frame is mounted a longitudinally slidable dog or bar 289. Normally the inner end of the dog is endwise out of the path of planetary travel of lever 286.

When the machine is running and it is necessary to reset it, as for a new job, or to change from direct printing to reverse printing, or to stop it for any reason, the first effect of a stopping operation is to push in dog 289 (in the manner later described), thus bringing its inner end within range of lever 286. When said lever comes around, during the next revolution of the impression cylinder, it engages the dog and is swung inwardly, thus pulling out the key 206 and releasing the impression cylinder from its shaft. Motion of the cylinder stops when the stop shoulder 288 engages the dog. This is an exact position, reached during every stopping operation. The machine is so designed and set up that when it is stopped, while printing either direct or reverse, the the grippers 12 always stop in the position shown in full lines, Fig. 1 where they are open ready for gripping the next sheet to be delivered to them. In such position of the impression cylinder, the pin 222 is in exact registration with its special recess 245 in gear 205. But the control drum is still locked, as it always is while the machine is running, by engagement of dog 221 with teeth 223. By pushing in pin 222, the impression cylinder is locked stationary in a definite position in which it remains during all resetting operations and until again connected with shaft 194.

This arrangement accomplishes two results. Drive of the blanket and plate rolls from shaft 194, and of the dampening and inking mechanism from shaft 48, enables them to continue in operation when cylinder 14 is stopped, as is necessary to maintain the inking surfaces in good condition. Also, the timed relation of all parts which are timed or require timing, including all operating parts which have to do with feeding and delivery of the sheets, as well as sheet transfer and fore and aft and lateral registration, depend upon their common drive from the impression cylinder itself, by way of gears 203, 205, a relation which is always preserved unchanged, even when the cylinder and shaft are uncoupled, for the reasons described.

Having reset the machine for reverse printing, with adjustment according to the length of the sheet, the pin 222 is released and moves out, dog 289 is pulled out, and key 206 re-enters its keyway.

Now, assuming that an empty dolly has been applied at the delivery end of the machine and has been hoisted to its uppermost or sheet receiving position, the machine is ready for reverse printing and may be so operated.

Differences between direct and reverse printing

The chief differences between reverse and direct printing operations are these:

First, longitudinal registry is effected in the same manner, but lateral registry is effected during reverse printing by side motion of the sheet to the left, instead of to the right, thereby retaining the same side edge of the sheet as the basis of registry.

Second, the sheet is turned over, around a transverse axis, prior to its advance motion between the blanket and impression rolls. This is the result of reversing the direction of travel of transfer chains 112.

Transfer of the leading edge of the sheet from the suction cups to the transfer gripper jaws is effected in exactly the same manner as before, though the grippers are traveling in the opposite direction along cam track 132, and the mechanical switches function as before, but in reverse order. However, the sheet is dragged over the

top of the machine, by motion of the grippers with the upper stretches of the transfer chains, and down around the peripheries of large sprockets 114. On drive shaft 48, Figs. 19, 20, are removably mounted a series of thin plates 291, of generally triangular form, held together, in spaced parallel relation as a unit, by rods 292, the upper edges of which serve as a bridge to support the sheet as it moves forward over the top of the machine. Plates 291 are slotted, at 293, to enable the unit to be lifted up and thus removed, when desired.

Sheet motion with the grippers continues until the cam 150 is engaged by the end of push rod 126, which opens the gripper jaws, thus releasing the sheet at a time when it lies, in concave form, upon the table formed by rollers 148 and rods 170, but reversed, end for end, with printed face beneath, and with its trailing edge, now its leading edge, a short distance from the V-groove in the feeler bar to which it is being conveyed. Due to proportions of parts, timing and cam locations, and taking into consideration the reversed positions of the transfer grippers, the sheet is released and laid upon the registering table in substantially the same position as one fed during direct printing, and with the same physical edge actually leading, as before. Upon its release, the sheet is immediately subjected to the "kiss" impulses of rollers 155. Although these are traveling clockwise, Fig. 20, in a planetary path away from the impression cylinder, their peripheral surfaces, contacting the sheet and lightly pressing it against the rollers 148, travel toward the impression cylinder at the same speed as that of the surfaces of rollers 148. Thus, the coaxing effect of the two sets of rollers upon the sheet is exactly the same as before, urging it forward with a series of rapidly repeated "kiss" impulses and thus quickly introducing its leading edge into the V-groove of the feeler bar, as before. The kiss impulses are administered sequentially, as described, during both direct and reverse printing.

From this point on, the effect upon the sheet is the same as during direct printing, with the exception noted, as to the direction of lateral registering motion on the impression cylinder.

Sheet delivery mechanism

This mechanism (Fig. 46) is of the same general form as the sheet transfer mechanism before described and therefore requires but brief description. It operates in the same manner during either direct or reverse printing.

It includes two chains 294 traveling over sprockets 295, 296 mounted upon short shafts 297, 298 journalled in the side walls of hinged apron 59*a*, and operatively connected, by gears conventionally indicated at 203*a*, 203*b*, to be driven by each of the two gears 203, 205 (Figs. 18 and 46), fastened to the impression cylinder and before referred to. These chains are provided with three pairs of hanger members 299 (Figs. 11, 12), in each pair of which is rotatably mounted a cross bar 300 supporting a series of spaced gripper members 18, generally like those on the transfer chains and similarly opened and closed by endwise movement of an inner rod 302, endwise motion of which is produced by cams 303, 304, fixed on a side member of the apron. Each cam may be suitably adjustable, along the path of movement of the cam rod, for timing purposes. An arm 305 on each cross bar carries a roller 306 traveling in a cam track 307 in a plate 308 fixed to the apron or frame. Any number of gripper bars may be used, three being shown for convenience, and requiring the delivery chain, sprocket and driving mechanism to be so proportioned and timed that one complete cycle of travel of the delivery chains takes care of the delivery of three successive sheets.

Cam track 307 is so formed as to cause the gripper bars to travel and turn in such manner that they always extend or lie generally horizontally and opening backwardly or toward the impression cylinder, as shown in Fig. 46.

The cams 303, 304 are so located that the jaws of each pair of grippers open and close twice, once to seize a sheet presented by the impression cylinder grippers, and a second time when the seized sheet has reached the appropriate position above the stack on the delivery dolly. There it is released and falls gently, on the cushion of air beneath it, to its place on top of the pile, being guided to position by adjustable guides 308 corresponding to those employed at the feed end of the machine.

Descending motion of the delivery dolly is controlled by a four-way distributing valve 309, Fig. 47, similar to valve 81, but here actuated by coils 310, 310*a*, a hand switch 311, and a feeler switch 312 of any suitable form, one form being shown diagrammatically in Fig. 48.

The feeler switch includes a member 313 having a pin 314 traveling in a curved cam groove 315 in a fixed support 316, said member having a vertical slot 317 into which extends a fixed pin 318. Member 313 is biased to the full line position, Fig. 48. It carries the two contacts of the switch 312, one on and insulated from the member itself, and the other on a thin flexible blade 319, from which the contact is insulated. Switch 312 is normally biased to open position in a circuit 320 from one contact of the switch 311 to L_2.

During each cycle of travel of the delivery chains, as each set of grippers approaches the sheet delivery position, a portion 321 of the gripper supporting bar or hanger engages a projection 322 on member 313 and moves said member to the dotted line position, where it is out of the way of the approaching sheet, enabling the latter, when released, to fall gently on the air cushion beneath it, and without obstruction, to its proper position on the stack. When the gripper bar passes beyond the projection 322, member 313 returns to its former position above the stack.

As the stack is built up, a point is finally reached where it is high enough to hold the thin blade 319 in such position that the upper contact comes down upon the lower contact, thus closing the switch. Through hand switch 311 (biased to the dotted line position, Fig. 48) this energizes electromagnet 310 and actuates the valve 309, thus supplying fluid to the appropriate chamber of cylinder 70*a* and causing the dolly and stack to move down until they reach such position that during succeeding corresponding operations switch 312 does not close until the stack again builds up.

The mechanism is always self-accommodating to the stack being built up, constantly lowering the receiving dolly so that the net effect is to maintain the top of the delivery stack at substantially uniform level.

A second normally open switch 323, in a circuit 324, in parallel with circuit 320, is mounted in such a position that it is engaged and closed by the dolly 11*a*, should the latter rise

to an abnormal level, thus energizing the dolly lowering coil 310.

The second contact of switch 311 is connected by wire 325 to L_2 and enables said switch to be employed by manual control for elevating the dolly to its uppermost position.

Start and stop control

Reference has been made to the change speed mechanism 37 and its operating arm 37*a*, as well as to the dog 289 which controls the key 206 for coupling the impression roller to its shaft, and the dog 221 and pin 222 which lock the control drum and impression cylinder, when setting or resetting the machine. These parts are all interlocked, as shown somewhat diagrammatically in Fig. 49.

On the front of the machine is a dial 326 calibrated in terms of speed, such as 25 R. P. M., 50 R. P. M. or the like, and including a ring 327 having notches 327*a*, one for "stop" and one for each speed, to receive and releasably hold a crank or handle 328 on a shaft 329 provided with a grooved cam 330 within the casing. This cam is connected to a mutilated gear 331, the toothed part of which cooperates with teeth 332 on a gear segment 333, and the smooth part of which cooperates with a curved recess 334 in said segment. Segment 333 is part of an arm 335 pivoted upon the same shaft which supports operating arm 37*a*, being connected to said arm through a torsion spring 336 surrounding the shaft.

The arrangement is such that when segment 333 is turned counterclockwise in Fig. 49 it applies like turning moment to lever 37*a*, but yieldingly through the spring.

The groove of cam 330 cooperates with and actuates a pin or roller 337 on a reciprocable rod 338 slidable in suitable guides on the frame or casing, said rod having a V-shaped cam recess 339 to receive the similarly shaped cam end portion of a lock rod 340, the other end of which (see Fig. 17) may be moved into or out of interlocking or obstructing relation with pin 222, and which rod 338 also is pivotally connected to an arm 341 on one end of a shaft 342 having a second arm 343 provided with a pin 344 entering a recess in the key operating dog or bar 289.

Figs. 49 and 50 illustrate the parts in stop or idling position. That is to say, assuming that the main switch to motor 24 is closed, the change speed mechanism is operating at low speed; key 206 is out and impression cylinder 14 is uncoupled from its driving shaft 194, but said shaft, which drives the dampening and inking rolls, is rotating slowly. The control drum 180 is locked against adjustment, by dog 221.

Assuming that the control drum has been set or reset for either direct or reverse printing, and thus occupies a definite position in accordance with the length of the sheet, the crank 328 is rotated clockwise in Fig. 50. The first portion of its clockwise motion, up to say the speed of 25 R. P. M., which is the prevailing low rate of speed transmission through the mechanism 37, is idle insofar as effect upon gear segment 333 and lever 335 and the transmission mechanism are concerned, because the curved toothless part of the mutilated gear travels idly along the curved recess in which it is seated. However, the groove in cam 330 is so formed that this motion of rotation of shaft 329 moves rod 338 endwise to the left in Fig. 49, with two effects. First, the inclined cam recess 339 in rod 338 raises lock rod 340 and locks pin 222 in its outermost position, so that when the machine is running the control drum is locked. Second, endwise motion of rod 338 has turned the shaft 342 and moved the dog 289 outwardly, disengaging its inner end from the key-operating arm 286, thus permitting key 206 to move into engagement with the keyway in shaft 194 and lock the impression cylinder to its shaft.

Now, therefore, all parts of the machine are in operation and are turning, but at relatively low speed, because of the position of the controlling arm 328 at the low speed notch 25 R. P. M. This control handle may now be moved over to a higher speed, even as much as 100 R. P. M. However, the speed change mechanism does not jump instantly to the higher speed position. The effect is to impart torsion to the spring 336 and through it to arm 37*a*, which is thus yieldingly influenced to turn in the counterclockwise direction, Fig. 49. The effect is for the arm 37*a* to move over gradually toward its upper or high speed position, increasing the speed of rotation of the parts in proportion to their acceleration, until finally the parts rotate uniformly at the high speed determined by the position to which the handle 328 has been moved.

To stop the entire machine the operating handle 328 is turned reversely (counterclockwise in Fig. 50) to its "stop" position, which reduces the speed of the parts and withdraws the impression cylinder key 206 from shaft 194 and at the same time releases lock rod 340 from the pin 222, enabling that pin to be pushed in and the machine to be reset according to the operator's desire.

Also, at any time, the power clutch 47 may be released by pushing in the knob of handle 52, thus stopping the power shaft 48 and all parts operated thereby, permitting any desirable adjustment of the printing set-up by manual operations. These concluded, the handle is pulled out, power clutch 47 is again engaged and the machine starts, as before, with automatic accommodation of the change speed driving mechanism to increase in acceleration.

The dampening mechanism

Referring to Fig. 1, the dampening mechanism is largely of conventional form and operates in the usual manner, but it is actuated by fluid pressure, rather than mechanically. It includes a constantly rotating roll 345, which picks up water from the pan 346 and transfers it to a vibrating or oscillating roll 347, which conveys it to the plate cylinder by way of intermediate rolls, one of which is marked 348, also rotated continuously.

Vibrating roll 347 is supported by two pivoted arms 349, which are swung back and forth in any suitable manner, such as by being each pivotally connected to the rod 350 of the piston of a fluid pressure servomotor 351, Fig. 47, said piston being biased in one direction by a compression spring and moved in the opposite direction by fluid pressure supplied to it by a two-way distributing valve 352, the stem 353 of which is biased to pressure relief or drain position by spring 354 and is actuated to pressure supply position by a cam 355 attached to or forming part of the bull gear 51. This turns once for every two sheets printed, and cam 355 has two high lobes. Each time a high lobe of the cam actuates the valve stem, oil flows to the servomotor 351 and operates arms 349 to swing roll 346 in one direction into contact with roll 347, to which it transfers water to be applied to the

image on the plate cylinder. The rolls 345, 347 may be driven continuously by a chain 356 from the main shaft 48, Fig. 5, said chain passing around idlers 357, 358, to a sprocket 359 on one of the rolls of the inking mechanism later described.

Inking mechanism

This is also largely of conventional form, but is also fluid operated like the dampening mechanism. It is also of unit form for cleaning purposes.

As shown, the inking mechanism includes a series of rolls journalled at their ends in suitable bearings in frame members 361 supported by the walls of a pan shaped cover 362 mounted to swing about a horizontal axis near that of a vibrating roll 360, Fig. 1. The full lines show the rolls and cover in operating position. But, whenever roll cleaning or an ink change is necessary, the entire inking unit may be swung over to the dotted line position, when the cover becomes a pan, lying beneath the rolls, into which cleaning liquids applied to the rolls, may drain for withdrawal by way of discharge pipe 364, all without removal from the machine.

Ink, in paste form, supplied to the fountain or reservoir 365 is carried by the surface of roll 366 past the adjustable gate or scraper 367 to vibrating roll 360, which supplies it by way of the other intermediate rolls shown, to the plate roll 16.

The vibrating roll 360, at the inking fountain, may be vibrated intermittently in the same manner as the roll 347 of the dampening mechanism, and by similar servomotor operated mechanism (not shown) controlled by a distributing valve and cam on the bull gear, as before, not requiring detailed description.

Roll 366 at the ink fountain is rotated intermittently by generally similar operating mechanism, including a servomotor 377 similar to motor 351, flow of pressure to which is controlled by a distributing valve 378 operated by another cam 379 on the bull gear 51. Here, however, the piston rod of the servomotor operates a pawl 368 which actuates ratchet 369 on the end of roll 366.

Certain of the inking rolls, marked 370, 371 and 372 (metal rolls), not only are rotated continuously, but also may be moved endwise for distributing and working up the ink. These rolls are interconnected for joint drive. As shown chain 356, before referred to, drives a sprocket 359 on a jack shaft centered on the axis around which pan 362 pivots, said shaft serving as the driver for gearing (not shown) connecting it to the shaft of roll 370, which drives roll 371, and so on. The mechanism for vibrating one of these rolls, such as roll 370, endwise, is shown in detail, but somewhat conventionally, in Fig. 47. The servomotor for this purpose is built into the roll, although any suitable arrangement is permissible. Roll 370 is shown mounted to slide upon two aligned pistons 372 fixed in the frame. Oil under pressure is supplied to and withdrawn from opposite piston chambers 373 by suitable passages through the pistons controlled by a four way valve 374 operated by the high lobe of a cam 375 on bull gear 51, like the valve 352. The flow of oil, and consequently the rate of endwise reciprocation, for each roll may be varied by its own regulating valve 376.

Cam 375, for controlling reciprocation of the inking rolls, may include one or more adjustable or removable segments 375*a* for the purpose of varying the effective length of the high operating lobe of the cam, thus to vary the periods of right and left endwise roll movement, although this is not essential.

Mounting and adjustment of plates and blanket cylinders

Figs. 5 and 5*a* illustrate in detail the manner of mounting the plate and blanket cylinders. The same arrangement is employed at each end of each of these cylinders. As shown the shaft 380, of, for example, plate cylinder 16 is supported in a collar 381 carried by an arm 382 pivoted at 383 in the main frame. Within the collar the shaft is recessed twice, at 384, to provide an abutment member 385, opposite faces of which are engaged by adjustable set screws 386 mounted in the collar. Collar 381 is pivotally connected to one end of the operating rod 387, which at its other end is fast with the cylinder of servomotor 388, the double ended piston 389 of which is pivotally mounted upon the frame at 390.

Adjustment of the abutment member 385, by set screws 386, at one or both ends of each cylinder enables the several cylinders to be brought into exact parallelism. This adjustment, once made during the initial machine set up, is permanent and should last for the life of the machine.

A center lug 391 on each motor cylinder 388, within the upper chamber thereof, limits downward motion of the motor cylinder and of the plate cylinder which it operates and thus prevents either cylinder from sinking into the other below the printing surface, such as where cylinders meet gap to face or gap to gap.

Similar mechanism, requiring no description, provides adjustment and support for the blanket roll 15.

Adjustment and control of printing pressure

Referring to Fig. 5, it will be observed that the center of the blanket cylinder 15 is offset slightly to the right of the line M—M joining the center of the plate cylinder 16 and the pivots 392 about which the blanket cylinder swings. Therefore, the downward pressure applied from the plate cylinder to the blanket cylinder is all absorbed at the pivots 392, except for a small component, due to the offset, which resists and tendency of the blanket roll to escape as the result of driving friction.

In a similar manner, the pressure applied by the blanket cylinder to the impression cylinder is absorbed in the fixed bearing for the shaft 194 of the impression cylinder.

Thus, it is evident that the pressure between the plate and blanket cylinders may be set up and maintained independently of that between the blanket and impression cylinders, and vice versa.

It is really the driving friction between the contacting surfaces of the plate, blanket and impression cylinders which carries the brunt of power transmission, the gearing connecting them merely serving to insure and maintain accurate dot registration of the image. Accordingly it is important to provide and maintain uniform the desired pressure between cylinder pairs.

As before stated, this pressure is produced by the pressure effects in the servomotor cylinders 241, 388 which serve to raise and lower the plate and blanket cylinders, and is due to the use of pressure reducing, pressure relief and pressure sequence valves which supplement the controlling

effect of the distributing valves in the fluid pressure system now to be described.

Fluid pressure operating and control system

Referring to Fig. 47, this view is a diagram illustrating the entire hydrostatic or fluid pressure operating and control system. Many of the parts here shown conventionally are illustrated and described elsewhere. Some parts are exaggerated in size. The electromagnet coils for operating the distributing valves are indicated individually, but are not connected, their electrical connections being fully illustrated in Fig. 48 and described elsewhere.

The pump 34, which supplies a relatively small volume of oil at high pressure, takes its supply from reservoir 393, which also serves as the sump to which all oil is returned by the drainage connections. This pump causes the flow of oil under pressure to a single main pipe 394 which supplies oil to the distributing valve 240, which controls the flow of pressure to and from servomotor 241 for actuating the blanket roll 15. This servomotor 241 is the only piece of equipment actuated by pump 34. Valve 240, as before stated, is stable in either of two positions and is provided with pipe connections 395, 396 to the upper and lower chambers of servomotor 241, and with outlet connections 397, 398 to a drain pipe 399. It also communicates, by way of check valves 400, 400*a* with a pipe 401.

In the supply system for distributing valve 240 are a pressure relief or limiting valve 402 and a pressure reducing valve 403.

The pressure relief valve 402 may be of any suitable form. It is shown connected on its supply side, by a pipe 404, to the pipe 394, coming from pump 34, a branch 405 of pipe 404 including a pressure indicating gauge 406. The valve 402 is provided with a valve member 407 biased toward its seat and thus limiting relief through the valve, by a loading spring 408, the tension of which may be adjusted by a screw 409. The outlet from the relief valve communicates with a drain pipe 410.

Pressure reducing valve 403 includes a piston-like valve member 411 sensitive to a loading spring 412, the tension of which may be adjusted by a screw 413, and also sensitive, by way of a passage 414, to the opposing effect of the pressure on the outlet side of the valve, which communicates with the same pipe 401, before referred to, leading to the check valves 400, 400*a*.

The adjusting screws 409 and 413 are coupled together by gears 414 so that both may be simultaneously operated by the knob or head 415 on or connected to one of the screws. By adjusting these valves, relief valve 402 may be set to maintain any desired maximum pressure, indicated on the gauge 406, in the high pressure supply line 394, while the pressure reducing valve 403 reduces the pressure and maintain a definite reduced pressure, in the supply line 401 leading to the check valves.

The arrangement is such that in one position of the distributing valve 240 limited high pressure is supplied, for example, to the lower chamber of the servomotor 241, and thus to the blanket roll tending to move it downwardly, while reduced pressure is supplied to the upper chamber of the servomotor, and thus tends to elevate the blanket roll, while, in the other position of the distributing valve, the pressures in the two cylinder chambers are reversed. Drain of trapped pressure from the several chambers is effected momentarily and instantaneously as the valve moves from one position to the other.

The operation of this mechanism is as follows:

Let us assume that a series of sheets of uniform thickness is started through the press. When the first sheet reaches the trip switch in the recess of the V-block, distributing valve 240 is actuated to apply the blanket cylinder to the impression roll. The passages in the distributing valve are so arranged that the connection from the low pressure supply, through the valve to the drain outlet, is not cut off, and the low pressure is not trapped at the check valve, until the blanket cylinder has been moved down to a level where it would normally contact the impression cylinder. As the first sheet enters the bite between the blanket and impression cylinders, the blanket cylinder rises a very small amount, the thickness of the sheet, with a very small inflow to the upper or low pressure chamber through its check valve.

Now, as sheets of the same thickness go through the press, the position of the blanket roll remains unchanged. It floats on the reduced pressure motive liquid, as it were, and uniform printing pressure is applied to every sheet. However, if a thicker sheet goes through, for any reason, the blanket roll is again lifted an amount corresponding to the increased thickness, and will remain or float in this new position so long as any sheets continue to come through. Therefore, if following sheets are of the original thickness, they will not receive full printing pressure. If this happens, the situation may be corrected either automatically, by suitable mechanism not shown, or by withdrawing one sheet and compelling a "miss." Thereupon, the blanket roll automatically is readjusted to the thickness of the next sheet and continues, as before.

Of course, when any sheet is missed, the opposite coil, 238*a*, is energized; the distributing valve moves to its opposite position, and the blanket roll is lifted out of engagement with the impression roll, but is restored to the required printing position when the next sheet goes through.

The large-volume low-pressure pump 33 supplies fluid under pressure for controlling and operating a number of different devices. It also takes its oil supply from the reservoir 393 and delivers it to a pipe 416, from which branches are taken off to various instrumentalities.

One branch 417 supplies a distributing valve 418, similar in all respects to the valve 240, and controlling the flow of fluid pressure to and from the servomotor 388 for actuating the plate cylinder. This valve is actuated by two coils 419, 419*a* in circuit with a manually controlled switch 420, Fig. 48, by operation of which the plate roll may be moved either to printing or to trip position, as will be readily understood.

Reduced pressure is supplied to valve 418, by way of check valves 421, 422, from the pipe 423 coming from a pressure reducing valve 424 similar in all respects to valve 403. Fluid is supplied to valve 424 from the main 416 by way of a branch pipe 425, through which fluid flows to a pressure sequence valve 426, thence to a pipe 427, to which is connected a pressure gauge 428, and which pipe supplies the valve 418 and communicates with a pressure relief valve 429, similar in all respects to the valve 402 and provided with an outlet or drain pipe 430, communicating by pipe 399 with the reservoir, as shown.

The pressure sequence valve 426 may be of

any suitable form. It includes a through passage, from pipe 425 to pipe 427 and a secondary outlet to a pipe 431 by way of a valve member 432 connected to a piston 433 sensitive on one face to the pressure in the through passage and on its opposite face to the pressure of a loading spring 434 adjustable by a screw 435. The adjusting screw of this valve is provided with a gear 436 connected to the gears on the adjusting screws of the valves 424, 429, so that the same head 437 may be utilized to simultaneously adjust the three valves 426, 429, 424.

The purpose and manner of operation of valves 429, 424, in their control of the supply of high and low pressures to distributing valve 418 are the same as that for the corresponding valves which supply the distributing valve 240 and need not be repeated.

The purpose of sequence valve 426 is as follows: it allows free flow through the main passage of the valve, and hence to valve 424, until pressure builds up in the device controlled or operated (in this case servomotor 388) to a desired value, determined by the tension of the loading spring 434. When the built up pressure exceeds the desired value, piston 433 yields, and the valve opens and supplies oil under pressure to the secondary circuit, to wit, the pipe 431, while still maintaining flow into the main circuit represented by pipe 427. Now the valve acts simply as a T.

Going on, the secondary circuit 431 supplies one branch 438 leading to distributing valves 81, 309 for controlling the flow of oil to and from the double acting servomotors 70, 70a for actuating the elevators at the feed and delivery ends of the machine. These are ordinary distributing valves with communications to the servomotors and sump shown, and requiring no further description.

Secondary circuit 431 also includes a second branch 439, which communicates by way of a pressure sequence valve 440 with a primary pipe 441 leading to the distributing valve 352 for servomotor 351 already described, and a secondary pipe 442 which communicates with a second pressure sequence valve 443.

The two pressure sequence valves 440, 443 are similar in all respects to valve 426.

The primary outlet from sequence valve 443 is by way of pipe 444 to the distributing valve 378 for servomotor 377, while the secondary outlet is by way of pipe 445 to the distributing valve 374 for the servomotor 372, 373. Valves 378, 352 and 374 are all cam operated and are provided with appropriate drain connections, as shown, requiring no description.

Two cylinder presses

The invention is not limited to use in a three cylinder press, i. e., one where the plate, blanket and impression cylinders are separate and distinct from each other. It may also be used in presses of other types, such as the well-known two cylinder press, where the plate and impression cylinders are combined. Such an arrangement is shown, somewhat diagrammatically and conventionally in Fig. 52.

Here the blanket cylinder is indicated at 500 This corresponds with cylinder 15 before described. It cooperates with a combination cylinder 501 approximately twice the size of cylinder 500 and provided with a plate portion 502 corresponding with cylinder 16 and an impression portion 503 corresponding with cylinder 14.

The feeding and delivery elevators shown at 504, 505 are like those before described. From the feeding elevator sheets are delivered serially to transfer grippers on the chain 506, which carry them to the combination cylinder 501, the impression portion of which is provided with grippers like those on the impression cylinder 14 before described. These carry the sheets through the printing space and deliver the sheets to the grippers on delivery chains 507 which deposit them upon the delivery elevator, as before.

The dampening roller and inking rollers, conventionally indicated at 508, 509, respectively, are here beneath the combination roller.

In Fig. 52 the combination cylinder 501 rotates clockwise. The parts are shown in a position where the leading end of the impression portion of the combination cylinder has just reached that position where its grippers receive, accept and grasp the leading edge of a sheet delivered to it by the transfer grippers, as in the form before described. In this position the dampening and inking rollers, of course, are held out of contact with cylinder 501. As the combination cylinder turns, it carries the sheet through the printing space, where the blanket cylinder is applied to it and prints the image against the backing of the impression portion. While this is going on, the dampening and inking rollers, which are applied to cylinder 501 after the impression portion passes them, in turn are producing an ink image upon the plate portion 503 of cylinder 501. As the printed sheet passes beyond the printing space, its leading edge is seized by the delivery grippers, the carrying chains of which convey it to and deposit it upon the stack on the delivery elevator. The plate portion of cylinder 501, carrying the ink image thereon, next moves through the printing space and transfers its image to the blanket cylinder 500, a step which is substantially completed when the impression cylinder again reaches the transfer point, ready to accept the next sheet and carry it through the printing space, completing one cycle of the machine.

Reverse printing is accomplished in this press in the same manner as the one before described by reversing the direction of operation of the transfer chains, without effect of any kind upon the mechanism which subsequently is operative upon the sheet.

What we claim is:

1. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, a table from which the sheet is fed to said cylinders, two endless movable transfer chains, a gripper bar carried thereby and adapted by chain movement to move from a sheet receiving position to a sheet releasing position relative to said table, and means for reversing the direction of movement of said chains and hence of said gripper bar, the sheet releasing position to which said gripper bar is moved upon reversing the direction of movement of said chains being a different position than that to which the gripper bar otherwise is moved.

2. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, a table from which the sheet is fed to said cylinders, two endless movable transfer chains, a gripper bar carried thereby and adapted by chain movement to

move from sheet receiving to sheet releasing position, means for reversing the direction of movement of said chains, and an endless control chain having the same length as the transfer chains and traveling along a parallel path and provided with means for establishing the sheet release position.

3. Sheet handling mechanism, comprising sheet feeding means, sheet receiving means, and means for transferring a sheet from one to the other thereof, comprising two endless chains movable in parallel orbits along which the feeding and receiving means are spaced, a rod cross-connecting the chains and rotatably mounted therein, elongated grippers carried by said rod, and relatively stationary cam means for turning said rod as it travels with the chains to cause the grippers to lead the rod while seizing a sheet from the feeding means and to trail the rod while releasing a sheet to the receiving means.

4. Sheet handling mechanism, comprising sheet feeding means, sheet receiving means, and means for transferring a sheet from one to the other thereof, comprising two endless chains movable in parallel orbits along which the feeding and receiving means are spaced, a rod cross-connecting the chains and rotatably mounted therein, elongated grippers carried by said rod, relatively stationary cam means for turning said rod as it travels with the chains to cause the grippers to lead the rod while seizing a sheet from the feeding means and to trail the rod while releasing a sheet to the receiving means, and cam means effective upon the grippers to first open and then close them as they pass the feeding and receiving means.

5. Sheet handling mechanism, comprising sheet feeding means, sheet receiving means, and means for transferring a sheet from one to the other thereof, comprising two endless chains movable in a clockwise direction and in a counterclockwise direction in parallel orbits along which the feeding and receiving means are spaced, means for causing said chains to travel in either direction in their orbits, means for changing the direction of movement of said chains, a rod cross-connecting the chains and rotatably mounted therein, grippers carried by said rod, and relatively stationary cam means for turning said rod as it travels with the chains to cause the grippers to lead the rod while seizing a sheet from the feeding means and to trail the rod while releasing a sheet to the receiving means, said cam means being equally effective in either direction of travel of said chains.

6. Sheet handling mechanism, comprising sheet feeding means, sheet receiving means, and means for transferring a sheet from one to the other thereof, comprising two endless chains movable in a clockwise direction and in a counterclockwise direction in parallel orbits along which the feeding and receiving means are spaced, means for causing said chains to travel in either direction in their orbits, means for changing the direction of movement of said chains, a rod cross-connecting the chains and rotatably mounted therein, grippers carried by said rod, and relatively stationary cam means for turning said rod as it travels with the chains to cause the grippers to lead the rod while seizing a sheet from the feeding means and to trail the rod while releasing a sheet to the receiving means, cam means effective upon the grippers to first open and then close them as they pass the feeding and receiving means, both of said cam means being equally effective in either direction of travel of said chains.

7. Sheet printing mechanism, comprising cooperating blanket and impression cylinders, sheet advancing grippers traveling in a clockwise direction and in a counterclockwise direction in an orbit across the entrance to the printing space between said cylinders, said grippers having normally closed movable jaws adapted to be opened to release a sheet, means for causing travel of said grippers in opposite direction in said orbit, to thereby enable either face of the sheet to be presented uppermost as the sheet enters said printing space, means for changing the direction of travel of said grippers, and means to open said jaws, said opening means being effective in either direction of travel of said grippers.

8. Sheet printing mechanism comprising cooperating blanket and impression cylinders, sheet advancing grippers traveling in a clockwise direction and in a counterclockwise direction in an orbit across the entrance to the printing space between said cylinders, said grippers having normally closed movable jaws adapted to be opened to release a sheet, means for causing travel of said grippers in either direction in said orbit, means for changing the direction of travel of said grippers, and means to open said jaws, said means being adjustable along said orbit to different positions, one of which, effective when travel is in one direction, is fixed, and the other of which, effective when travel is in the opposite direction, is different from the first position.

9. Sheet printing mechanism comprising cooperating blanket and impression cylinders, sheet advancing grippers traveling in a clockwise direction and in a counterclockwise direction in an orbit across the entrance to the printing space between said cylinders, said grippers having normally closed movable jaws adapted to be opened to release a sheet, means for causing travel of said grippers in either direction in said orbit, means for changing the direction of travel of said gripper, and means to open said jaws, said means being adjustable along said orbit to different positions, one of which, effective when travel is in one direction, is fixed, and the other of which, effective when travel is in the opposite direction, is variable dependent upon variation in sheet length.

10. Sheet printing mechanism comprising cooperating blanket and impression cylinders, sheet advancing grippers traveling in a clockwise direction and in a counterclockwise direction in an orbit across the entrance to the printing space between said cylinders, said grippers having normally closed movable jaws adapted to be opened to release a sheet, means for causing travel of said grippers in either direction in said orbit, means for changing the direction of travel of said grippers, means to open said jaws, said means being adjustable along said orbit to different positions, one of which, effective when travel is in one direction, is fixed, and the other of which, effective when travel is in the opposite direction, is different from the first position, and control means operatable to both select the direction of travel of said grippers and adjust said adjustable means to its appropriate position.

11. Sheet printing mechanism comprising cooperating blanket and impression cylinders, sheet advancing grippers traveling in a clockwise direction and in a counterclockwise direction in an orbit across the entrance to the printing space between said cylinders, said grippers having nor-

mally closed movable jaws adapted to be opened to release a sheet, means for causing travel of said grippers in either direction in said orbit, means for changing the direction of travel of said grippers, means to open said jaws, said means being adjustable along said orbit to different positions, one of which, effective when travel is in one direction, is fixed, and in the other of which, effective when travel is in the opposite direction, is variable dependent upon variation in sheet length, and control means operatable to both select the direction of travel of said grippers and adjust said adjustable means to its appropriate position.

12. Sheet printing mechanism, comprising printing devices, a registering table ahead of said devices, means for depositing a sheet upon said table, spaced rollable means sequentially movable into brief periods of contact with a sheet lying upon said table for administering to it a plurality of impulses each tending locally to advance it toward said devices, and means for effecting such sequential movement of said rollable means.

13. Sheet printing mechanism, comprising printing devices, a registering table ahead of said devices, means for depositing a sheet upon said table, spaced rollable means sequentially movable into brief periods of contact with a sheet lying upon said table for administering to it a plurality of impulses each tending locally to advance it toward said devices, means for effecting such sequential movement of said rollable means, and a transversely extending abutment limiting advance of the sheet as the result of such impulses.

14. Sheet printing mechanism, comprising printing devices, a registering table ahead of said devices, means for depositing a sheet upon said table, spaced rollable means sequentially movable into brief periods of contact with a sheet lying upon said table for administering to it a plurality of impulses each tending locally to advance it toward said devices, means for effecting such sequential movement of said rollable means, and a transversely extending abutment limiting advance of the sheet as the result of such impulses, said last named means comprising a transversely extending bar having a V-groove to receive the leading edge of the sheet.

15. Sheet printing mechanism, comprising printing devices. a registering table ahead of said devices, means for depositing a sheet upon said table, spaced rollable means sequentially movable into brief periods of contact with a sheet lying upon said table for administering to it a plurality of impulses each tending locally to advance it toward said devices, means for effecting such sequential movement of said rollable means, a transversely extending abutment limiting advance of the sheet as the result of such impulses, said last named means comprising a transversely extending bar having a V-groove to receive the leading edge of the sheet, and means effective upon the sheet while engaged in the groove of the V-bar for disengaging it therefrom and advancing it to said devices.

16. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression cylinder for gripping the leading edge of a sheet and advancing it between said cylinders, a sheet receiving table ahead of said cylinders and from which the sheet is fed to said gripping means, means for applying to the exposed surface of a sheet lying on said table a series of rapidly repeated contact impulses to thereby advance it along said table toward said cylinders, and a stationary cross bar between the table and cylinders having a V-groove into which the leading edge of the sheet is advanced.

17. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression cylinder for gripping the leading edge of a sheet and advancing it between said cylinders, a sheet receiving table ahead of said cylinders and from which the sheet is fed to said gripping means, means for applying to the exposed surface of a sheet lying on said table a series of rapidly repeated contact impulses to thereby advance it along said table toward said cylinders having a V-groove into which the leading edge of the sheet is advanced, said gripping means being movably mounted upon the cylinder and provided with jaws, and operating means therefor arranged upon cylinder rotation to engage the leading edge of the sheet and withdraw it from the V-groove for unimpeded travel to and between said cylinders.

18. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression cylinder for gripping the leading edge of a sheet and advancing it between said cylinders, a sheet receiving table ahead of said cylinders and from which the sheet is fed to said gripping means, said table including a series of elongated, parallel, transversely extending rollers, means for rotating said rollers to advance a sheet lying upon them, a series of contact rollers above said table and movable with respect thereto along the path of advance of the sheet and adapted each to move into cooperative relation with the several rollers in serial order, thereby to apply to the sheet a series of rapidly repeated sheet advancing impulses.

19. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression cylinder for gripping the leading edge of a sheet and advancing it between said cylinder, a sheet receiving table ahead of said cylinders and from which the sheet is fed to said gripping means, and means for applying to the exposed surface of a sheet lying on said table a series of rapidly repeated contact impulses to thereby advance it along said table toward said cylinders.

20. Sheet printing mechanism, comprising printing devices, a transversely extending bar having a groove and lying in advance of said devices, means for advancing to said devices a sheet whose leading edge is registered in said groove, a registering table in advance of said bar, means for depositing a sheet thereon with its leading edge in a position short of said groove, and means operative while the sheet lies upon the table and effective upon it in order at several localized areas for advancing that portion of the sheet which may lag behind because the sheet is askew on the table.

21. Sheet handling mechanism, comprising a rod, means for causing said rod to move in parallelism through a series of positions along an endless orbit extended generally horizontally, sheet grippers upon said rod, a sheet receiving table lying below a portion of the orbit of said rod, means for opening said grippers to release a sheet carried by them when it reaches a predetermined position above said table, and means traveling with the rod as it moves across said table for applying to the sheet, after its release, a series

of impulses tending to advance it along said table.

22. Sheet handling mechanism, comprising a rod, means for causing said rod to move in parallelism in a clockwise direction and in a counterclockwise direction through a series of positions along an endless orbit extended generally horizontally, sheet grippers upon said rod, means for changing the direction of movement of said rod and hence of said sheet grippers, a sheet receiving table lying below a portion of the orbit of said rod, means effective in either direction of movement of said rod along its orbit for opening said grippers to release a sheet carried by them when it reaches a predetermined position above said table, and means traveling with the rod as it moves across said table for applying to the sheet, after its release, a series of impulses tending to advance it along said table.

23. Sheet handling mechanism, comprising a rod, means for causing said rod to move in parallelism through a series of positions along an endless orbit extended generally horizontally, sheet grippers upon said rod, a sheet receiving table lying below a portion of the orbit of said rod, means for opening said grippers to release a sheet carried by them when it reaches a predetermined position above said table, said table including a set of spaced rollers upon the surfaces of which a sheet upon said table rests, a second set of spaced rollers traveling with the rod above a sheet upon said table, and means for rotating said two sets of rollers in the sheet advancing direction to thereby advance a sheet after its release from said grippers.

24. Sheet handling mechanism, comprising a rod, means for causing said rod to move in parallelism through a series of positions along an endless orbit extended generally horizontally, sheet grippers upon said rod, a sheet receiving table lying below a portion of the orbit of said rod, means for opening said grippers to release a sheet carried by them when it reaches a predetermined position above said table, said table including a set of spaced rollers upon the surfaces of which a sheet upon said table rests, a second set of spaced rollers traveling with the rod above a sheet upon said table, and means for rotating said two sets of rollers in the sheet advancing direction, to thereby advance a sheet after its release from said grippers, the spacing of the two sets of rollers being different, whereby grip of the sheet between opposed rollers of the two sets occurs serially at intervals spaced lengthwise of the sheet.

25. Sheet handling mechanism, comprising two parallel rotatable shafts, operating means therefor, a pair of spaced sprockets on each shaft, two endless chains connecting said shafts, each thereof traveling over two sprockets, one of each pair thereof, a rod cross connecting the two chains and provided with sheet holding and carrying grippers, a sheet receiving table lying opposite a portion of the path of travel of said chains around the sprockets of one pair, means for causing the grippers to release the sheet for the reception of the sheet by the table, and means operated by said last named sprockets for applying to the sheet, after its release, a series of impulses distributed over its area and each tending to advance it along said table.

26. Sheet handling mechanism, comprising two parallel rotatable shafts, operating means therefor, a pair of spaced sprockets on each shaft, two endless chains connecting said shafts, each thereof traveling over two sprockets, one of each pair thereof, a rod cross-connecting the two chains and provided with sheet holding and carrying grippers, a sheet receiving table lying opposite a portion of the path of travel of said chains around the sprockets of one pair, means for causing the grippers to release the sheet for the reception of the sheet by the table, a cross rod cross connecting and mounted in said last named sprockets, and rollers carried by said rod and arranged to engage and advance a sheet lying on said table after release of such sheet.

27. Sheet handling mechanism, comprising two parallel rotatable shafts, operating means therefor, a pair of spaced sprockets on each shaft, two endless chains connecting said shafts, each thereof traveling over two sprockets, one of each pair thereof, a rod cross connecting the two chains and provided with sheet holding and carrying grippers, a sheet receiving table lying opposite a portion of the path of travel of said chains around the sprockets of one pair, means for causing the grippers to release the sheet for the reception of the sheet by the table, said table including spaced members which support the sheet only at intervals, and a series of rollers mounted upon and spaced along and traveling with said last named sprockets and adapted, after release of the sheet, to engage the sheet above some of said spaced supporting members for advancing it upon said table.

28. Sheet handling mechanism, comprising two parallel rotatable shafts, operating means therefor, a pair of spaced sprockets on each shaft, two endless chains connecting said shafts, each thereof traveling over two sprockets, one of each pair thereof, a rod cross connecting the two chains and provided with sheet holding and carrying grippers, a sheet receiving table lying opposite a portion of the path of travel of said chains around the sprockets of one pair, means for causing the grippers to release the sheet for the reception of the sheet by the table, said table including spaced members which support the sheet only at intervals, and a series of rollers mounted upon and spaced along and traveling with said last named sprockets and adapted, after release of the sheet, to engage the sheet above some of said spaced supporting members for advancing it upon said table, the spacing of said rollers being different from the spacing of said supporting members, whereby the several rollers are effective upon the sheet serially in definite order.

29. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression roller for gripping the leading edge of a sheet and advancing it between said cylinders, a sheet receiving table ahead of said cylinders and from which the sheet is fed to said gripping means, means for applying to the exposed surface of a sheet lying on said table a series of rapidly repeated "kiss" impulses to thereby advance it along said table toward said cylinders having a V-groove into which the leading edge of the sheet is advanced, said gripping means being movably mounted upon the cylinder and provided with jaws and operating means therefor arranged upon cylinder rotation to engage the leading edge of the sheet and withdraw it from the V-groove for unimpeded travel to and between said cylinders, means rendered effective by printing rotation of the impression cylinder for moving said gripping means lengthwise of the cylinder, and stop means engageable

by a side edge of the sheet for limiting lateral sheet travel.

30. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, means carried by the impression roller for gripping the leading edge of a sheet and advancing it between said cylinders, means for lifting a sheet from the top of a pile thereof and for carrying and feeding it to said gripping means, said last named means being selectively adjustable at the will of the operator to either of two conditions by selection of which the sheet may be passed between the cylinders with its original leading edge either leading or trailing, means rendered effective by printing rotation of the impression cylinder for moving said gripping means lengthwise of the cylinder in either direction, means actuated by adjustment of said adjustable means for preselecting the direction of motion of said gripping means, and two stop means, one for each side edge of the sheet, for limiting lateral sheet travel.

31. Sheet printing mechanism, comprising cooperating blanket and impression cylinders, a V-bar extending lengthwise of said cylinders at the entrance to the printing space and having a groove into which the leading edge of each sheet is fed, means carried by and movable with the impression cylinder for engaging the leading edge of the sheet in said groove for withdrawing it from said groove and advancing it to the printing space, said last named means including pivoted fingers which engage the sheet edges, blocks carried by said fingers against which the sheet edge is registered, abutment members against which the sheet is clamped by said fingers, stop means engageable by a side edge of the sheet for limiting lateral sheet movement, and means for moving some of said fingers laterally with reference to the direction of sheet travel, to thereby laterally register the sheet against said stop means.

32. Sheet printing mechanism, comprising cooperating blanket and impression cylinders, a V-bar extending lengthwise of said cylinders at the entrance to the printing space and having a groove into which the leading edge of each sheet is fed, means for longitudinally feeding a sheet to such position with either of its end edges leading, means carried by and movable with the impression cylinder for engaging the leading edge of the sheet in said groove for withdrawing it from said groove and advancing it to the printing space, said last named means including pivoted fingers which engage the sheet edge, blocks carried by said fingers against which the sheet edge is registered, abutment members against which the sheet is clamped by said fingers, stop means engageable by a side edge of the sheet for limiting lateral sheet movement and means for moving some of said fingers laterally, to the right if one end edge of the sheet is leading or to the left if the other end edge leads, thereby to laterally register the sheet against said stop means but always with reference to the same side edge thereof.

33. Sheet printing mechanism, comprising printing devices, sheet feeding devices, endless transfer chains movable through parallel orbits and provided with sheet holding grippers having movable jaws adapted to transfer a sheet from the feeding devices to the printing devices, means for causing orbital travel of said transfer chains in either direction, and an endless control chain movable in an orbit adjacent the orbit of one of said transfer chains and provided with cams effective upon the grippers to open and close the jaws thereof at various positions dependent upon the length of sheet.

34. Sheet printing mechanism, comprising printing devices, sheet feeding devices, endless transfer chains movable through parallel orbits and provided with sheet holding grippers having movable jaws adapted to transfer a sheet from the feeding devices to the printing devices, means for causing orbital travel of said transfer chains in either direction, and an endless control chain movable in an orbit adjacent the orbit of one of said transfer chains and provided with cams effective upon the grippers to open and close the jaws thereof at various positions dependent upon the direction of travel of the transfer chains.

35. Sheet printing mechanism, comprising printing devices, sheet feeding devices, endless transfer chains movable through parallel orbits and provided with sheet holding grippers having movable jaws adapted to transfer a sheet from the feeding devices to the printing devices, means for causing orbital travel of said transfer chains in either direction, and an endless control chain movable in an orbit adjacent the orbit of one of said transfer chains and provided with cams effective upon the grippers to open and close the jaws thereof at various positions dependent upon both the length of sheet and the direction of travel of the transfer chains.

36. Sheet printing mechanism, comprising cooperating plate, blanket and impression cylinders, a rotatable shaft on which the impression cylinder is journaled, means for rotating said shaft, an operating connection from said shaft to the plate and blanket cylinder for driving them, a releasable driving connection between said shaft and the impression cylinder, and sheet feeding, transferring and delivery means cooperatively related to the printing space between said blanket and impression cylinders and driven by said impression cylinder independently of the plate and blanket cylinders.

37. Sheet printing mechanism, comprising sheet feeding devices, a plate cylinder, a blanket cylinder, and an impression cylinder, means for rotating said cylinders, devices for transferring sheets from said feeding devices to the printing space between the blanket and impression cylinders, said transfer devices being adjustable to deliver the sheets to said space with either sheet face uppermost for either direct or reverse printing, means for adjusting said transfer devices, and two separate and independent stop means, one for stopping the sheet feeding devices and the sheet transfer devices and the impression cylinder, so that these parts are maintained at all times in proper timed relation, and the other for stopping the rotation of the plate and blanket cylinders, the ability of the plate and blanket cylinders to continue their rotation when the sheet feeding device, the sheet transfer devices and the impression cylinder are stopped enabling the plate and blanket cylinders to be maintained during such times in proper operative condition.

38. Sheet printing mechanism, comprising sheet feeding devices, a plate cylinder, a blanket cylinder, and an impression cylinder, means for rotating said cylinders, devices for transferring sheets from said feeding devices to the printing space between the blanket and impression cylin-

ders, said transfer devices being adjustable to deliver the sheets to said space with either sheet face uppermost for either direct or reverse printing, means for adjusting said transfer devices, and two separate and independent stop means, one for stopping the sheet feeding devices and the sheet transfer devices and the impression cylinder, so that these parts are maintained at all times in proper timed relation, and the other for stopping the rotation of the plate and blanket cylinders, the ability of the plate and blanket cylinders to continue their rotation when the sheet feeding device, the sheet transfer devices and the impression cylinder are stopped enabling the plate and blanket cylinders to be maintained during such times in proper operative condition, the means for stopping the plate and blanket cylinders including a manually operatable device for rotating such cylinders and for adjusting the transfer devices to pre-select the desired sheet face to be uppermost.

39. Sheet printing mechanism, comprising sheet feeding devices, a plate cylinder, a blanket cylinder, and an impression cylinder, means for rotating said cylinders, devices for transferring sheets from said feeding devices to the printing space between the blanket and impression cylinders, said transfer devices being adjustable to deliver the sheets to said space with either sheet face uppermost for either direct or reverse printing, means for adjusting said transfer devices, and two separate and independent stop means, one for stopping the sheet feeding devices and the sheet transfer devices and the impression cylinder, so that these parts are maintained at all times in proper timed relation, and the other for stopping the rotation of the plate and blanket cylinders, the ability of the plate and blanket cylinders to continue their rotation when the sheet feeding device, the sheet transfer devices and the impression cylinder are stopped enabling the plate and blanket cylinders to be maintained during such times in proper operative condition, the stop means for the plate and blanket cylinders including a manually operatable device for rotating such cylinders and for adjusting the transfer devices to pre-select the desired sheet face to be uppermost, and the other or first mentioned stop means including means for always bringing the impression cylinder to rest in the same position rotatively with reference to the transfer devices.

40. Sheet printing mechanism, comprising sheet feeding devices, a plate cylinder, a blanket cylinder, and an impression cylinder, means for rotating said cylinders, devices for transferring sheets from said feeding devices to the printing space between the blanket and impression cylinders, said transfer devices being adjustable to deliver the sheets to said space with either sheet face uppermost for either direct or reverse printing, means for adjusting said transfer devices, and two separate and independent stop means, one for stopping the sheet feeding devices and the sheet transfer devices and the impression cylinder, so that these parts are maintained at all times in proper timed relation, and the other for stopping the rotation of the plate and blanket cylinders, the ability of the plate and blanket cylinders to continue their rotation when the sheet feeding device, the sheet transfer devices and the impression cylinder are stopped enabling the plate and blanket cylinders to be maintained during such times in proper operative condition, the stop means for the plate and blanket cylinders including a manually operatable device for rotating such cylinders and for adjusting the transfer devices to pre-select the desired sheet face to be uppermost, and the other or first mentioned stop means including means for always bringing the impression cylinder to rest in the same position rotatively with reference to the transfer devices, and means for temporarily locking the impression cylinder in such position during the adjusting operation.

41. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, supporting means for a stack of sheets, means providing two sheet paths between said supporting means and said cooperating cylinders, means for transferring a sheet through one or the other of said sheet paths from said supporting means to said cooperating cylinders, and means associated with one of said sheet paths for reversing the sheet face for face.

42. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, supporting means for a stack of sheets, means providing two sheet paths between said supporting means and said cooperating cylinders, means for transferring a sheet through one or the other of said sheet paths from said supporting means to said cooperating cylinders, and means associated with one of said sheet paths and effective at the will of the operator for reversing the sheet face for face.

43. Sheet printing mechanism of the character described, comprising cooperating rotatable blanket and impression cylinders, supporting means for a stack of sheets, means providing two sheet paths between said supporting means and said cooperating cylinders, means for transferring a sheet through one or the other of said sheet paths from said supporting means to said cooperating cylinders and including means carried by the impression cylinder for gripping the leading edge of the sheet, and means associated with one of said sheet paths for reversing the sheet face for face.

44. Sheet printing mechanism, comprising printing devices, supporting means for a stack of sheets, means providing two sheet paths between said supporting means and said printing devices, a lateral register device adapted to contact the side edges of said sheet and movable in one direction as the sheet travels through one of said sheet paths and movable in the other direction as the sheet travels through the other of said sheet paths, and control means effective to establish travel of the sheet through one of said sheet paths and simultaneously therewith, to render operative the lateral register device in the direction associated with such sheet path.

45. Sheet printing mechanism, comprising printing devices, supporting means for a stack of sheets, means providing two sheet paths between said supporting means and said printing devices, said sheet paths differing in that opposite faces of a sheet are uppermost when in the two paths, a lateral register device adapted to contact the side edges of said sheet and movable in one direction as the sheet travels through one of said sheet paths and movable in the other direction as the sheet travels through the other of said sheet paths, and control means effective to establish travel of the sheet through one of said sheet paths and simultaneously therewith, to render operative the lateral register de-

vice in the direction associated with such sheet path.

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