

Oct. 2, 1962

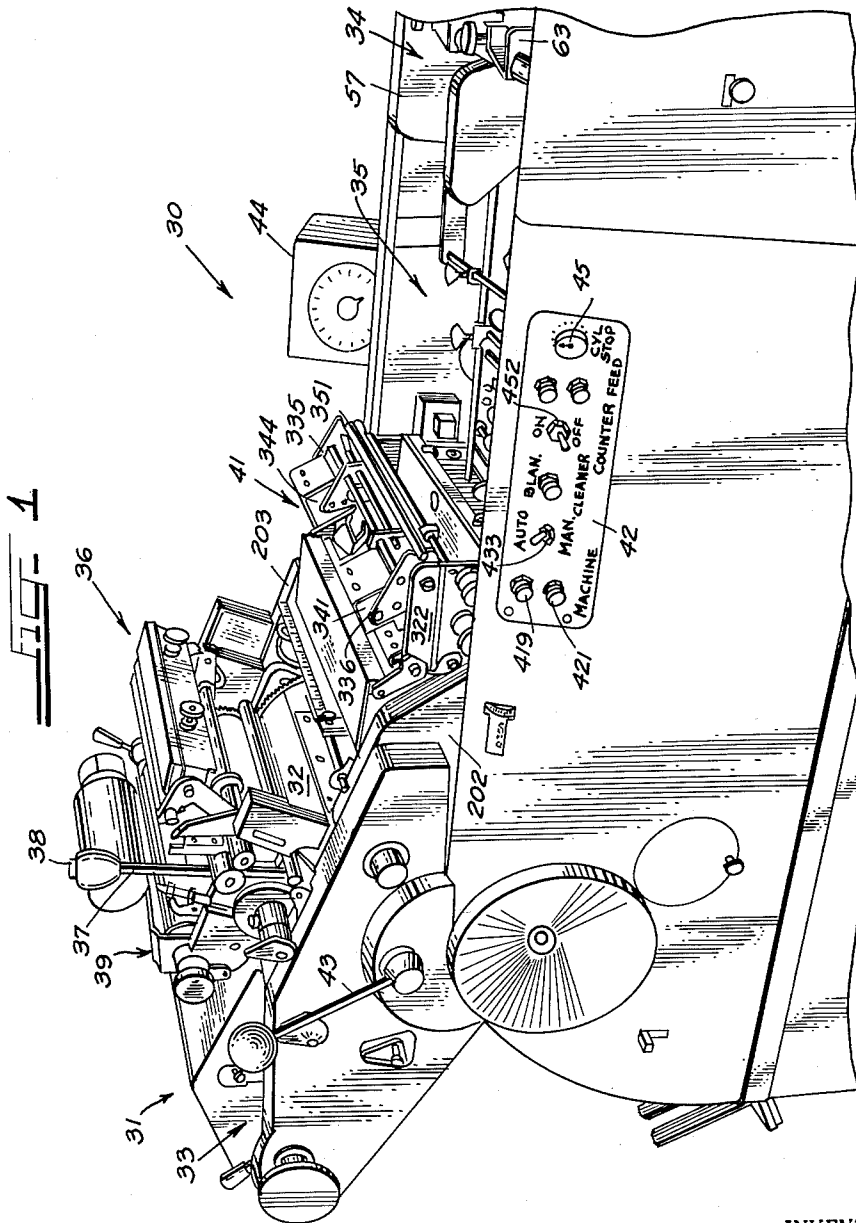
H. F. GAMMETER ET AL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 1



INVENTORS:
HARRY F. GAMMETER
JACKSON L. BOHNERT
BY
Wallace and Cannon
ATT'YS.

Oct. 2, 1962

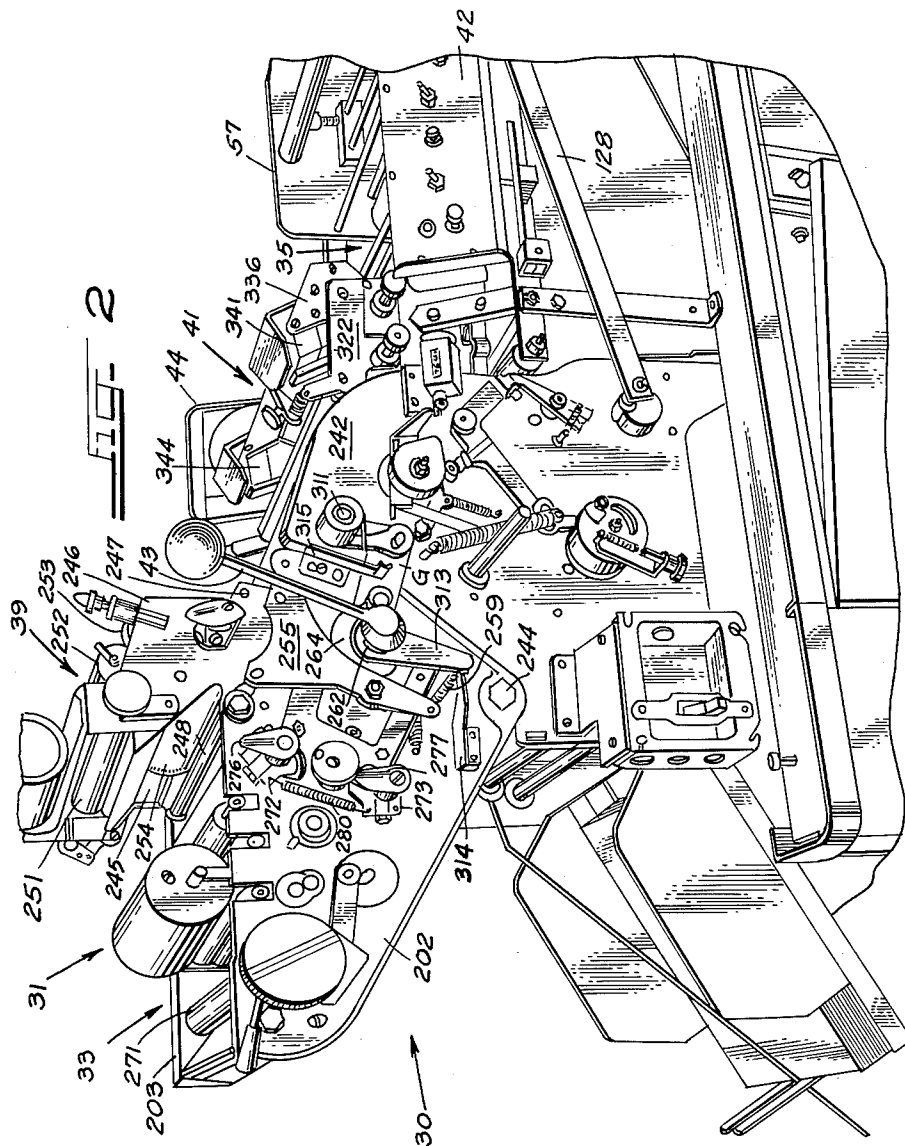
H. F. GAMMETER ET AL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 2



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY
Wallace and Cannon
ATT'YS.

Oct. 2, 1962

H. F. GAMMETER ETAL

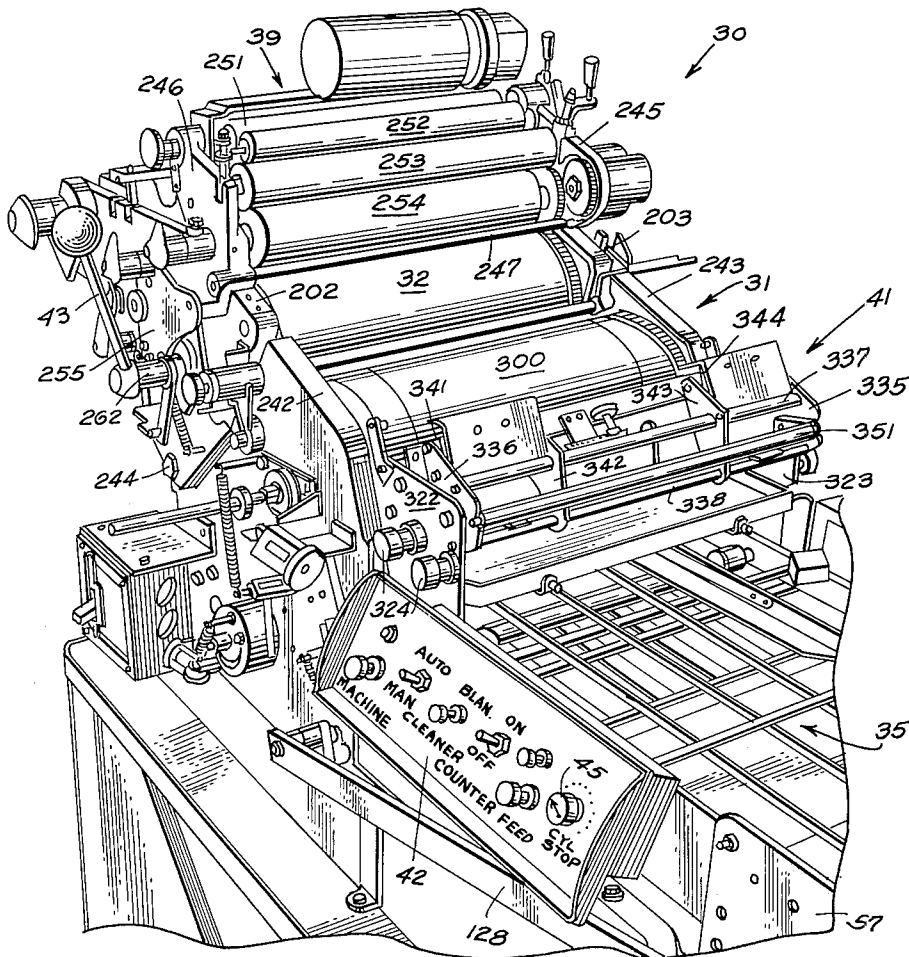
3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 3

FIG. 3



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY
Wallace and Cannon
PHLS.

Oct. 2, 1962

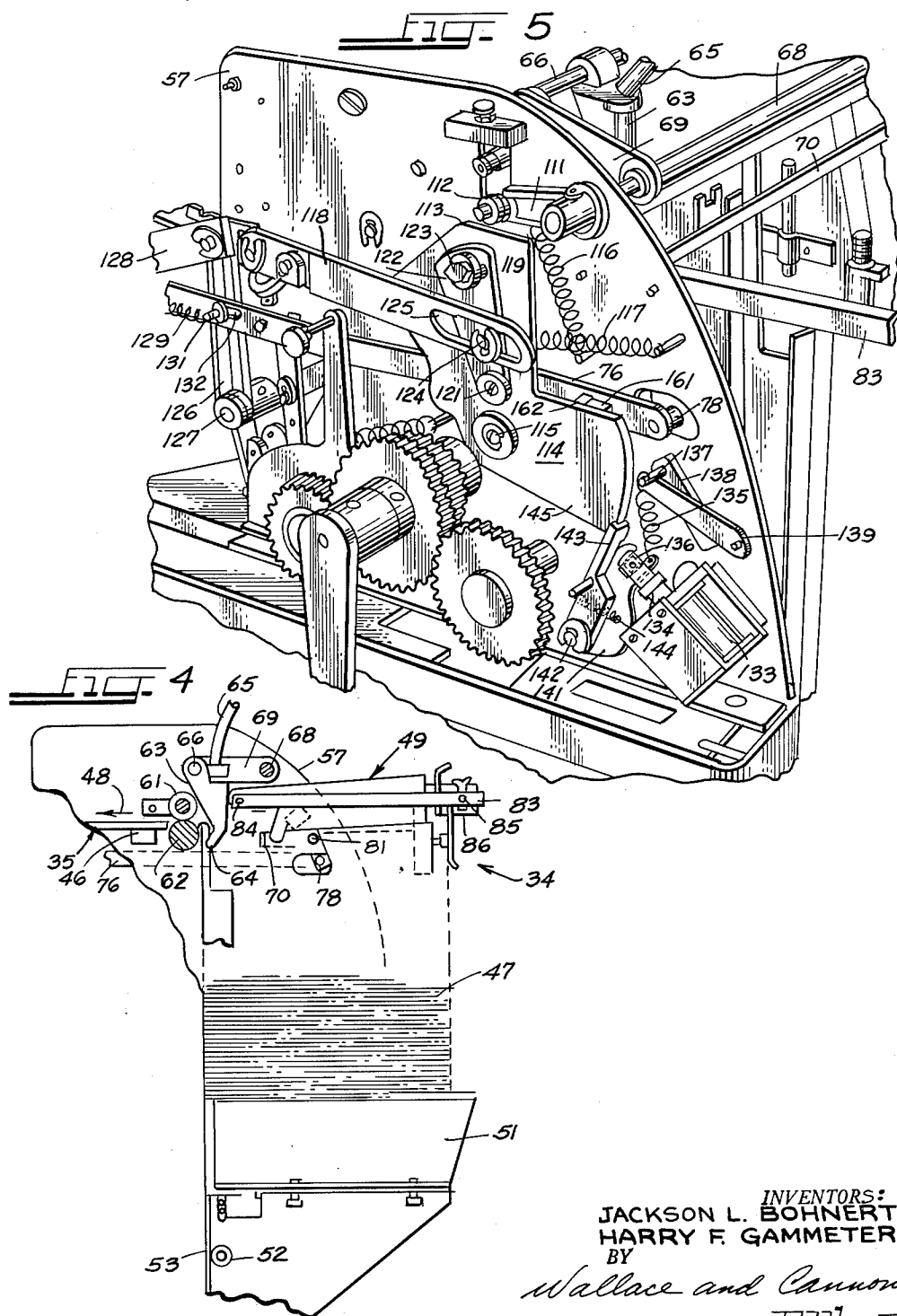
H. F. GAMMETER ETAL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 4



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY

Wallace and Cannon
FLL:5-

Oct. 2, 1962

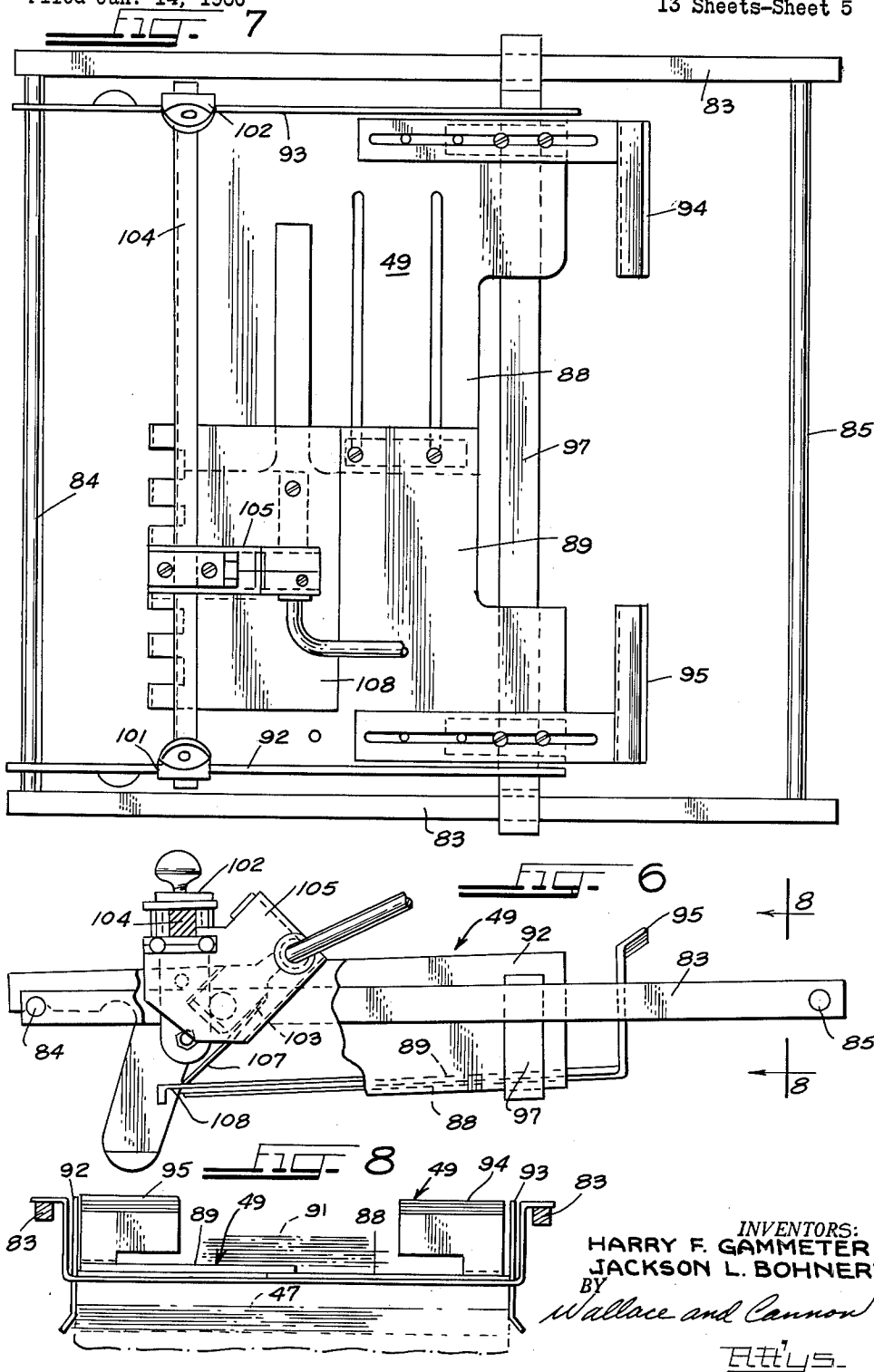
H. F. GAMMETER ETAL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 5



Oct. 2, 1962

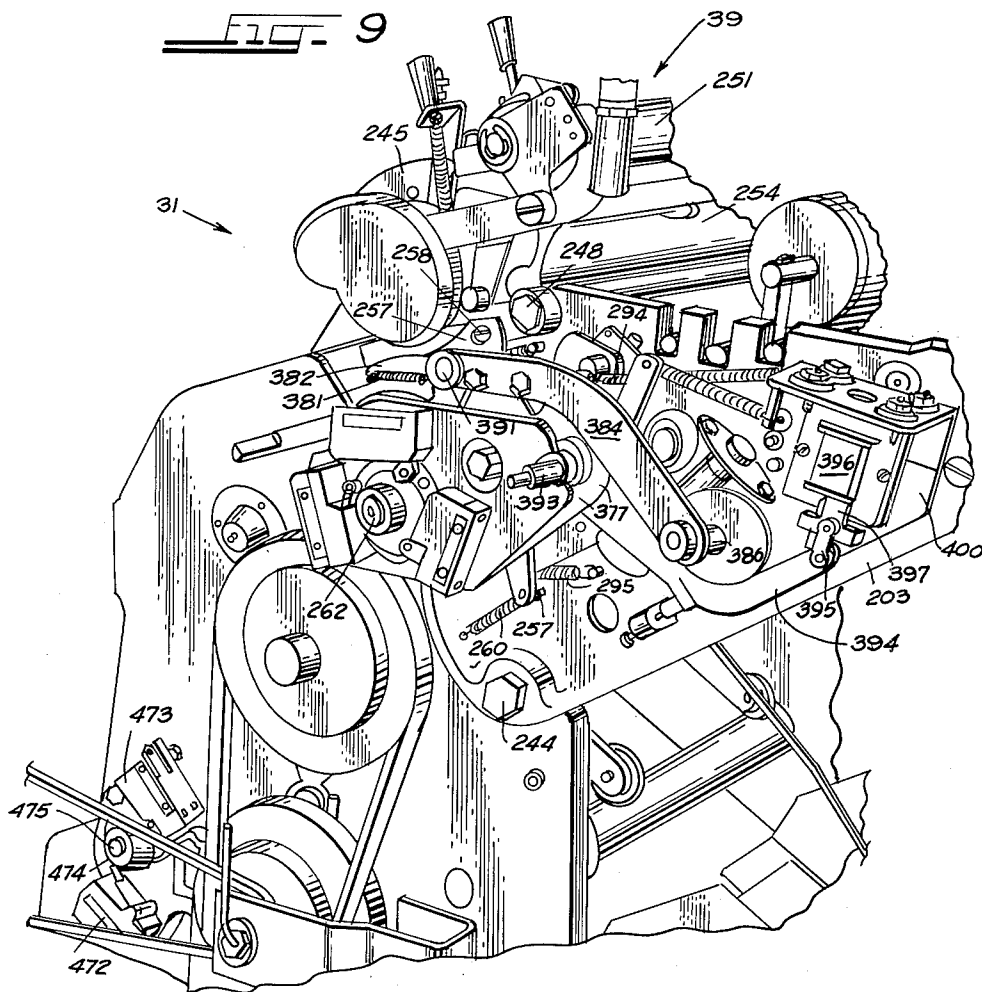
H. F. GAMMETER ETAL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 6



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY

Wallace and Cannon

Attys.

Oct. 2, 1962

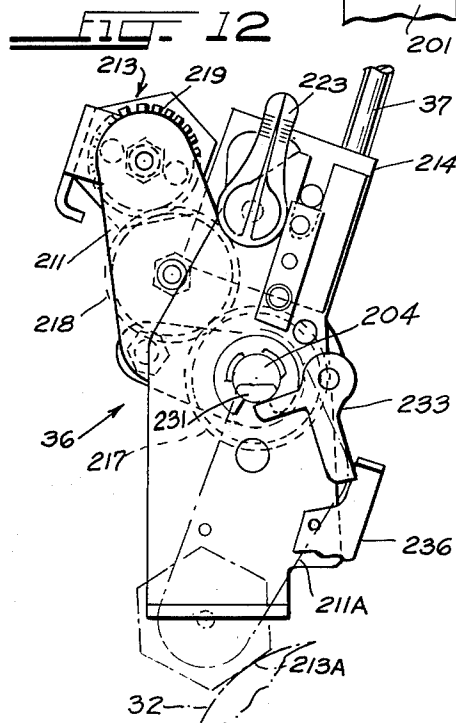
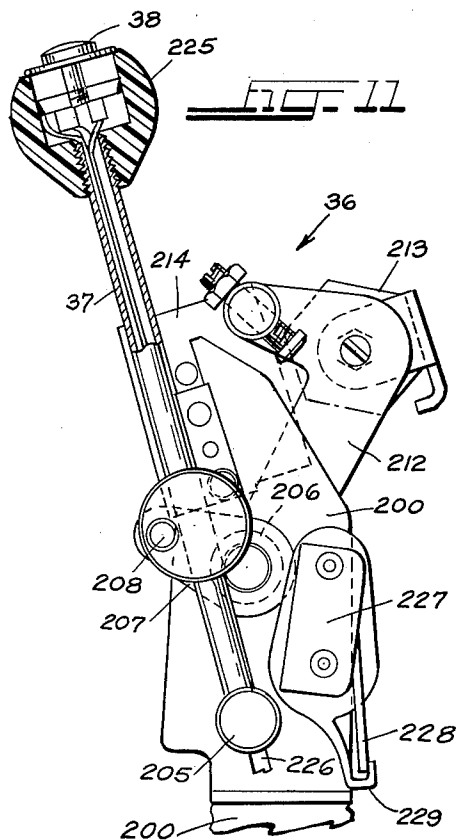
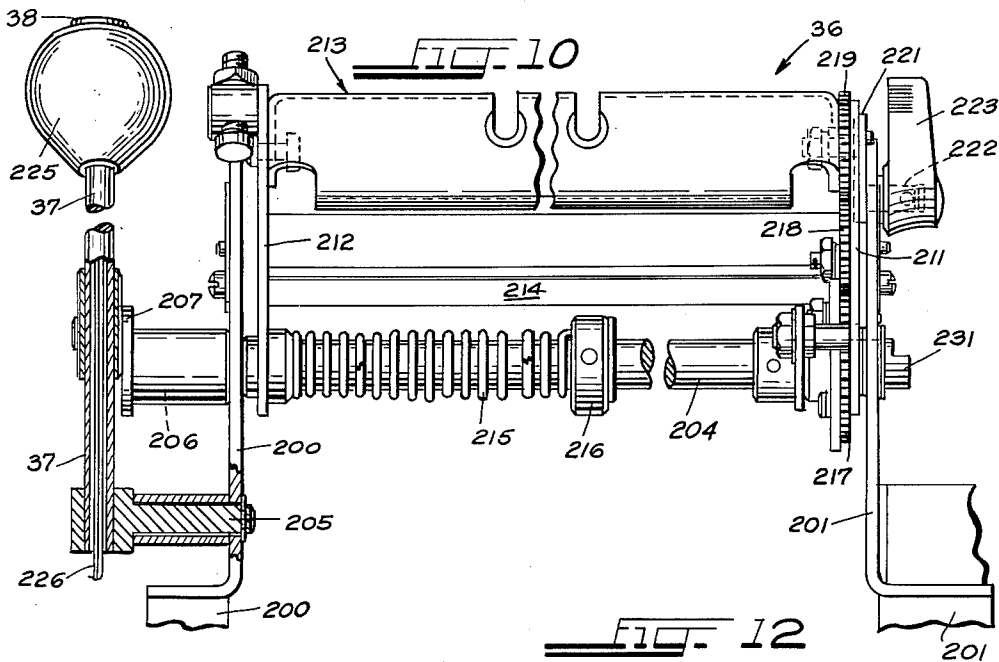
H. F. GAMMETER ET AL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 7



INVENTORS:
HARRY F. GAMMETER
JACKSON L. BOHNERT

BY

3,056,346

Filed Jan. 14, 1960

13 Sheets-Sheet 8

Fig. 14

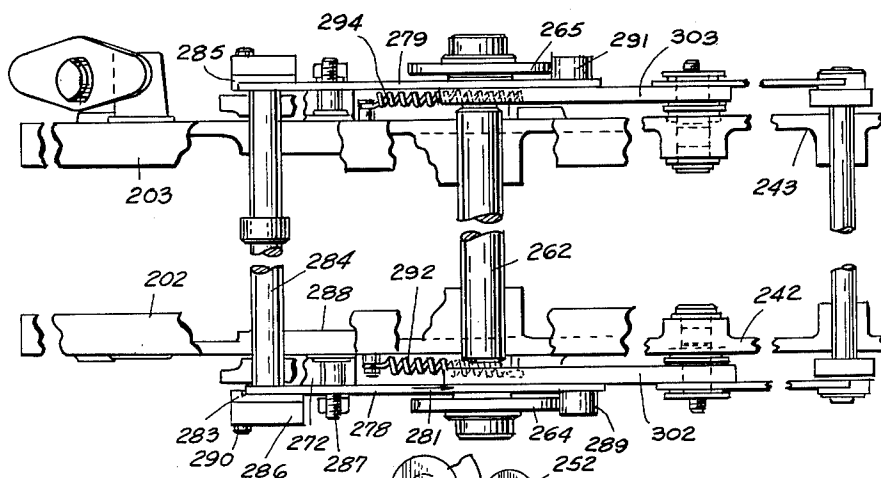


Fig 13

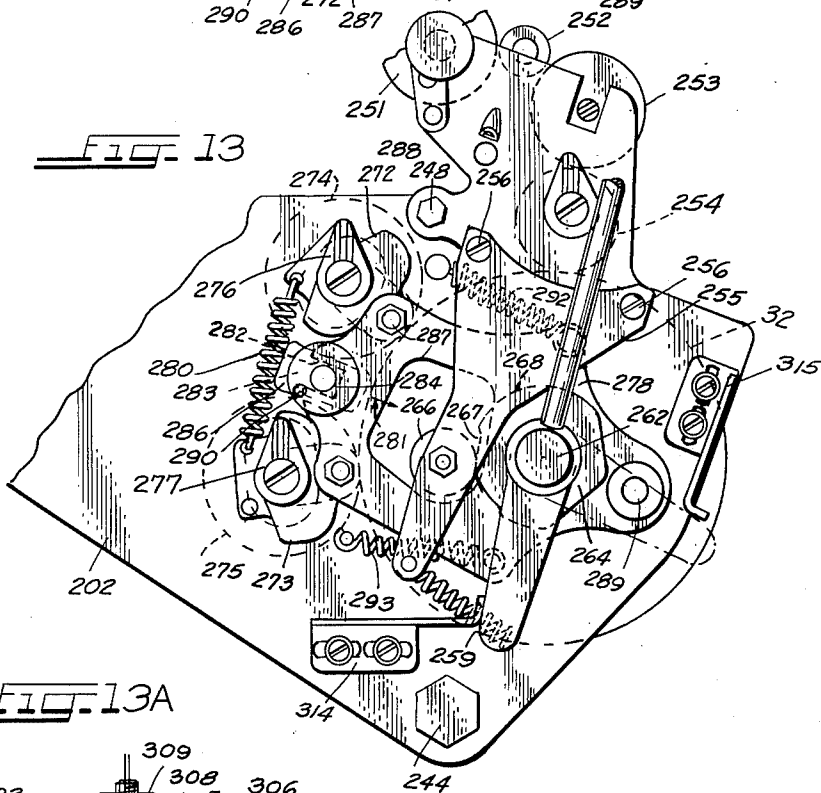
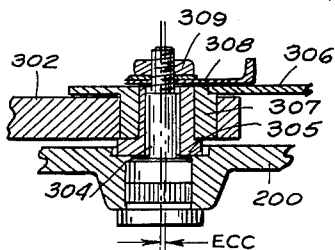


FIG-13A



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY

Wallace and Cannon

Atlys.

Oct. 2, 1962

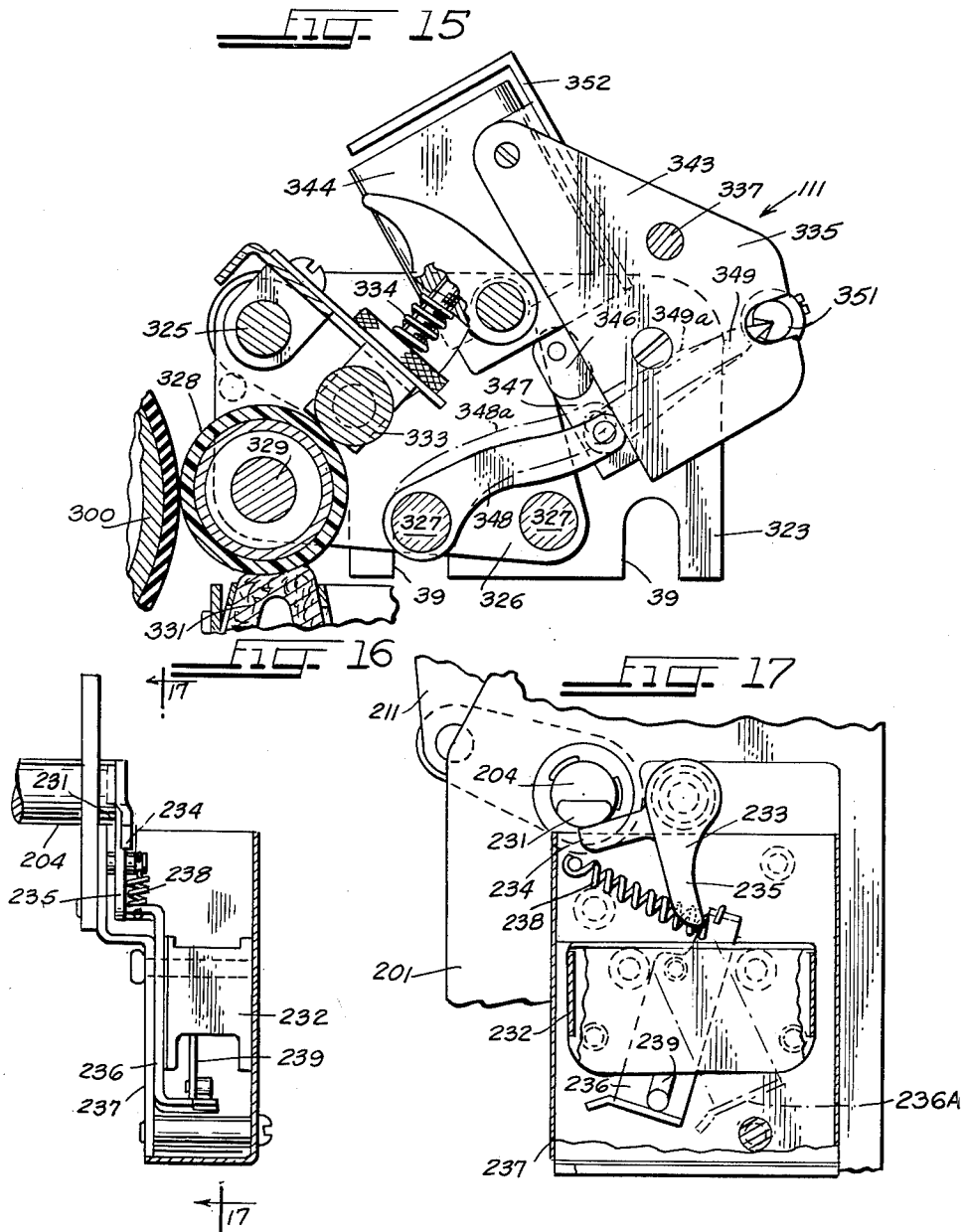
H. F. GAMMETER ET AL

3,056,346

PRINTING MACHINE

Filed Jan. 14, 1960

13 Sheets-Sheet 9



INVENTORS:
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY

Wallace and Cannon

ATTYS.

Oct. 2, 1962

H. F. GAMMETER ETAL
PRINTING MACHINE

3,056,346

Filed Jan. 14, 1960

13 Sheets-Sheet 13

FIG. 21

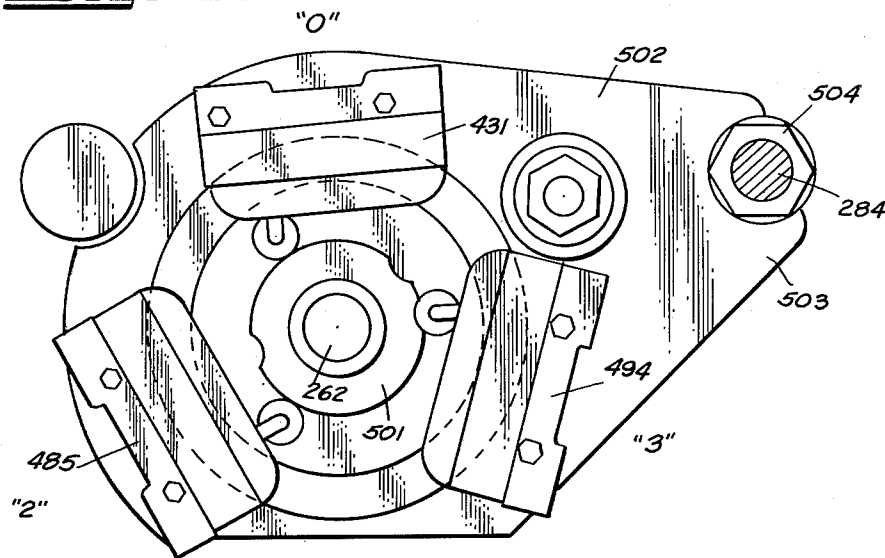


FIG. 22

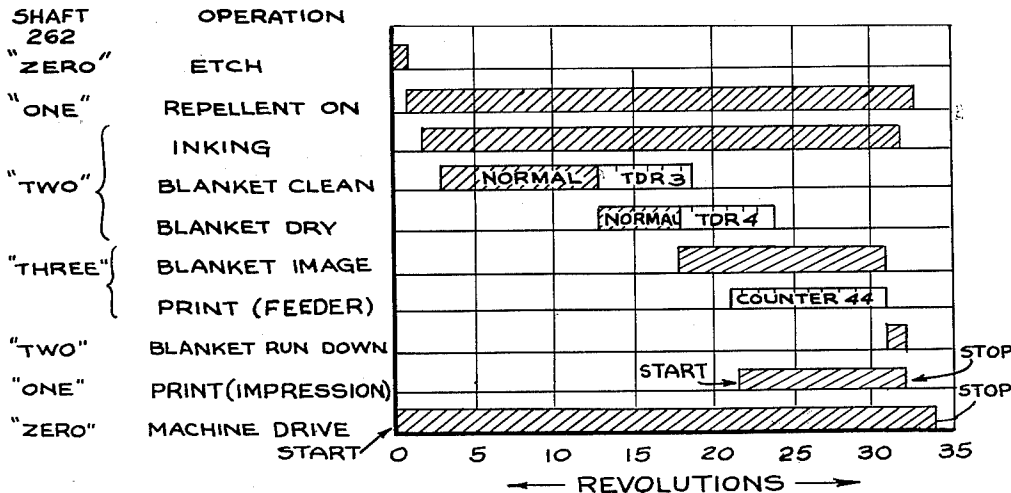
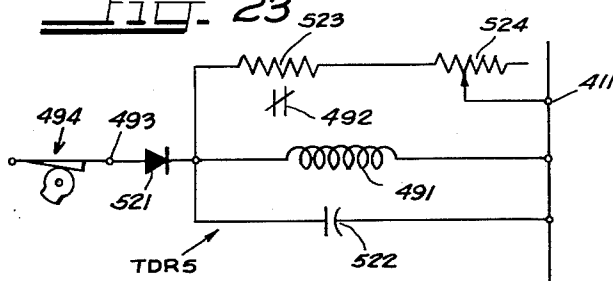


FIG. 23



INVENTORS.
JACKSON L. BOHNERT
HARRY F. GAMMETER
BY
Wallace and Cannon
ATTYS.

1

3,056,346

PRINTING MACHINE

Harry F. Gammeter, Cleveland Heights, and Jackson L. Bohnert, Euclid, Ohio, assignors to Addressograph-Multigraph Corporation, Cleveland, Ohio, a corporation of Delaware

Filed Jan. 14, 1960, Ser. No. 2,546

24 Claims. (Cl. 101-144)

This invention relates to a new and improved printing machine, and more particularly to an offset printing machine in which virtually all operations of the machine may be controlled automatically by sequential control apparatus incorporated in the machine, without requiring attention from the operator.

It is frequently desired to apply offset printing machines to applications which require frequent changes of the material being printed and relatively short printing runs, such applications are sometimes referred to as "systems" printing applications. In applications of this kind, the paper upon which data is printed is usually relatively well standardized, permitting substantial standardization of the sequential operations of the printing machine in carrying out a printing operation. However, it may frequently be desirable to use the same printing machine as is used for system work in connection with other printing tasks, such as promotional printing or other applications using planographic masters or print-receiving sheets which are substantially different from those used in the systems work. It may thus be desirable to provide for complete manual control of the printing machine, and its sequence of operations, to permit such dual usage. It may also be desirable to provide for automatic sequential control of the printing machine in response to a counter which is effective to count the number of sheets fed through the machine, or, alternatively, in response to the feeding of all the paper from a particular storage location.

It is a primary object of the invention, therefore, to provide a new and improved control system for operating an offset printing machine in automatic sequence.

More specifically, it is an object of the invention to provide an automatic sequence control system for an offset duplicating or printing machine which is effective to control all operations of the printing machine, following etching of the planographic master used in the machine, in predetermined sequence and without requiring any further attention from the operator.

It is another object of the invention to control all of the sequential operations of an offset printing or duplicating machine, following the etching of planographic masters used therein, by controlling the rotational position of a single main control shaft.

A related object of the invention is to provide an automatic electrical system for rotating the aforementioned main control shaft through a number of different operating positions and also to provide an alternate control for the main control shaft in a form of a single operating handle which may be actuated manually by the machine operator.

A particular object of the invention is to control and actuate a blanket cleaner, incorporated in an offset duplicating or printing machine, in response to electrical signals, to automatically clean and subsequently dry the blanket cylinder of the printing machine.

A further and related object of the invention is to provide for adjustment of the timing of the cleaning and drying operations carried out by the electrically operated blanket cleaner, and to render the adjustments substantially independent of each other.

Another object of the invention is to combine, in a single operating handle, the actuation of the plate-etch applicator of an offset duplicating or printing machine,

2

the starting of the machine, and the initiation of automatic sequential control of further operations of the machine.

An additional object of the invention is to provide, in an automatic sequence control system for an offset printing or duplicating machine, a means for automatically controlling imaging of the blanket in the printing machine for a predetermined adjustable number of revolutions before printing is actually initiated.

A further and related object of the invention is to separate the master and blanket cylinders of an offset printing machine, automatically, before the printing operation is completed, and to provide for adjustment of the number of sheets printed after blanket imaging is interrupted.

Another object of the invention is to control automatic sequential operation of an offset duplicating or printing machine in response to the presence or absence of print-receiving sheets in a storage location other than the main supply of such sheets, and specifically to control interruption of printing operations in response to the emptying of such sheets from the auxiliary supply. More particularly, it is an object of the invention to afford a control arrangement of this kind in conjunction with and as an alternative to interruption of machine operations in response to the counting of a predetermined number of sheets fed through the printing machine.

It is a general object of the invention to provide for adjustment of the timing of all critical operational stages in an automatic sequence control system for an offset duplicating or printing machine.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention.

In the drawings:

FIG. 1 is a perspective view of an automatic printing machine constructed in accordance with a preferred embodiment of the invention;

FIG. 2 is a perspective view of the printing station of the printing machine of FIG. 1 with the covers removed;

FIG. 3 is a perspective view of the machine, with the covers removed as in FIG. 2, taken from another view point;

FIG. 4 is a sectional view, partly schematic, showing a part of the paper feed mechanism of the printing machine;

FIG. 5 is a perspective view of a feeder control device utilized in the printing machine of the invention;

FIG. 6 is an enlarged detail view, partially cut away of a part of the paper feed apparatus;

FIG. 7 is a plan view of the device of FIG. 6;

FIG. 8 is an elevation view, partly in cross section, taken approximately along line 8-8 in FIG. 6;

FIG. 9 is a perspective view of a part of the automatic control mechanism of the invention located on the opposite side of the machine from that shown in FIG. 2;

FIG. 10 is an elevation view of a part of the plate etch application mechanism of the printing machine of the invention;

FIG. 11 is an elevation view, partly in cross section, showing one end of the apparatus of FIG. 10;

FIG. 12 is an elevation of the opposite end of the plate etching apparatus of FIG. 10;

FIG. 13 is a detail view of a part of the control apparatus shown in FIG. 2;

FIG. 13A is an enlarged sectional detail view of a linkage connected to the control apparatus of FIG. 13;

FIG. 14 is a plan view of the control mechanism of FIG. 13, with certain additional apparatus included;

FIG. 15 is a sectional elevation view of the blanket cleaner mechanism of the printing machine;

FIG. 16 is a detail view, partly in cross section, of a switching device included in the printing machine;

FIG. 17 is a further detail sectional view of the switch device of FIG. 16, taken approximately along line 17—17 therein;

FIG. 18 is an enlarged elevation view of a major part of the automatic control apparatus of the printing machine, including most of the apparatus illustrated in FIG. 9;

FIG. 18A is a detailed view of a part of FIG. 18;

FIG. 19 is a plan view of the apparatus of FIG. 18;

FIG. 20 is a detail schematic diagram of the electrical control circuit for the printing machine;

FIG. 21 is a detail drawing, on an enlarged scale, of additional switching apparatus used in the printing machine;

FIG. 22 is a timing chart utilized to explain the sequence of automatic operations in the printing machine; and

FIG. 23 is a detail schematic of an adjustable relay used in the control circuit of the machine.

General Description

A general understanding of the construction and operation of the printing machine of the invention may best be obtained by reference to FIG. 1, in which a printing machine 30 constructed in accordance with a preferred embodiment of the invention is illustrated in perspective. As shown therein, the printing machine 30 is an offset printing machine or duplicating machine which in many respects is conventional in construction. Thus, the printing machine 30 comprises a printing head 31 which includes the usual master cylinder 32 upon which a conventional lithographic or other planographic master may be mounted. The printing head 31 further includes a blanket cylinder and an impression cylinder, not visible in FIG. 1, which may be of conventional construction. An inking mechanism generally indicated by the reference numeral 33 is incorporated in the printing head 31 and is utilized to apply ink to a lithographic master mounted upon the master cylinder 32. In the course of a printing operation, ink is applied to the master, transferred to the blanket cylinder, and printed upon a sheet of paper or the like which is passed between the blanket and impression cylinders of the printing head 31.

The paper feed mechanism 34 of the printing machine 30 is located at the right-hand side of the machine, as seen in FIG. 1. Preferably, the paper feed mechanism is of the vacuum type and is utilized to feed individual sheets of paper or the like from a stack or supply included in the paper feed mechanism. The paper feed may be substantially similar to that shown in Patent No. 2,293,046 to Curtis and may include an apparatus for elevating the stack of paper, as sheets are fed therefrom, of the kind described in Patent No. 2,358,560 to Curtis. The sheet feeder 34 is illustrated in detail in FIGS. 4-8 and is described hereinafter in connection with those figures. The sheet feeder 34 is connected to the printing head 31 by a conveyor table 35 which may be of conventional construction and which may include suitable jogging or other aligning devices for assuring accurate alignment of the sheets of paper as they enter the printing head 31.

In addition to the main operating cylinders, such as the master cylinder 32 and the inking apparatus 33, the printing head 31 includes certain additional operating devices which are automatically controlled in operation of the printing machine and which are directly employed in the printing process. The head 31 also includes a manually controlled plate-etch applicator 36 which is

utilized to apply an etching solution to the planographic master on the master cylinder 32 during the initial stages of a printing run. Operation of the plate-etch applicator 36 is controlled by an operating handle 37 which is also provided with a control switch 38. The construction and operation of the plate-etch applicator 36, with its control handle 37 and switch 38, are described in substantial detail hereinafter in connection with FIGS. 10-12 in particular. The applicator mechanism itself, however, is in many respects substantially similar to that described and claimed in Patent No. 2,798,426 to E. J. Janke and D. B. Brewster, to which reference may be made for details of the plate-etch operation.

As in most printing machines using planographic masters, it is necessary to apply a repellent solution to the master cylinder during the course of normal operation. For this purpose, the printing head 31 is provided with a repellent applicator 39. In general, the repellent applicator 39 is substantially conventional in construction except for the mechanism employed to actuate and deactivate the applicator in the course of the automatic sequence of operations carried out by the printing machine 30. The repellent applicator 39 is described hereinafter in substantial detail, particularly in connection with FIGS. 9, 13 and 14. For the present general discussion, it is sufficient to assume that the device 39 affords a means for applying a repellent solution to the master cylinder 32, in a course of a printing operation, and for interrupting the supply of repellent solution during an automatically controlled sequence of operations.

The printing machine 30 further includes an automatically controlled blanket cleaner 41 which is mounted upon the frame of the printing head 31 in position to engage the blanket cylinder of the printing machine 30; in FIG. 1, the blanket cleaner device 41 obscures the view of the blanket cylinder. In many respects, the blanket cleaner 41 is substantially similar to the blanket cleaner described and claimed in Patent No. Re. 24,739 to L. F. Mitchell and E. J. Janke, and reference may be made to that patent for details of operation of a blanket cleaner device of this kind. In addition, the blanket cleaner is described in some detail hereinafter, particularly in connection with FIG. 15. The blanket cleaner is utilized to remove ink from the blanket, between individual printing operations, to permit a change in the data being printed without requiring removal of the blanket cylinder or the blanket from the printing head 31.

Primary control of the printing machine 30 is effected by means of a series of switches and other control devices mounted upon a control panel 42 on the side of the machine. Additional control is provided by manual controls, such as the plate etch control handle 37 and others, as described in detail hereinafter. In particular, a main control handle 43 may be utilized to control a major portion of the machine operation whenever the automatic electrical control system of the invention is not employed. When the machine is set for automatic control, a counter 44 is utilized to determine the length of a given printing run.

When conditioned for automatic operation, the printing machine 30 carries out a predetermined sequence of operations based upon a very limited number of control steps performed by the machine operator. Presuming that there is an adequate supply of paper in the storage stack of the feeder 34, the operator sets the counter 44 to print a predetermined number of sheets fed into the machine from the feeder. Thereafter, the machine operator starts the printing machine 30 in operation by actuating the switch 38 in the handle of the plate etch applicator. At the same time, the operator pivots the plate etch unit control handle 37 from its normal or "off" position, shown in FIG. 1, in a clockwise direction, to initiate operation of the plate etch applicator 36. Plate etching is a manually controlled operation in the machine

5

30, and the number of machine cycles required to apply an etching solution to the planographic master on the master cylinder 32 is left to discretion of the machine operator.

After the plate etching operation, the operator releases the handle 37, which returns to its initial position as shown in FIG. 1. When the handle 37 reaches its "home" position, it actuates a control switch, described hereinafter in connection with FIGS. 16 and 17, which is effective to initiate automatic sequential operation of the printing machine 30, the sequence of automatic operations being illustrated in the timing chart, FIG. 22. The automatic control system of the printing machine first operates to initiate application of repellent solution to the planographic master mounted upon the master cylinder 32. That is, the repellent solution applicator 39, which previously has not been effective to apply repellent to the master, is conditioned for normal operation in the initial stage of automatic operation and is effective to apply a repellent solution to the planographic master.

The next automatically controlled operation is the inking of the master on the master cylinder 32. In the preferred arrangement described hereinafter, the two final or form rolls of the ink train comprising the inking system 33 are brought into contact with the master on the cylinder 32 after the repellent solution applicator 39 has been in operation for one machine cycle. However, it should be understood that this sequence of operation may be varied to some extent, and that two or more cycles may elapse, after the repellent applicator 39 has been actuated and before inking of the master is initiated.

As indicated in the timing chart of FIG. 22, the blanket cleaner 41 is preferably started in operation approximately one machine cycle after inking of the master on the cylinder 32 has been initiated. The blanket cleaner applies a cleaning solution to the blanket on the blanket cylinder for a substantial interval, which may be of the order of ten machine cycles, in order to remove from the blanket any ink which may remain thereon as a result of previous printing operations. This time interval, however, can be adjusted by means of a potentiometer as shown in FIG. 20 and described hereinafter. After the ink from previous printing operations has been cleaned from the blanket, it is necessary to dry the blanket, since any substantial amount of cleaning solution remaining on the blanket would interfere with subsequent printing operations. Usually, the drying operation can be accomplished in an interval of about 5 or 6 machine cycles.

Once the blanket cleaning and drying operations have been completed, imaging of the blanket can be initiated. Like the other steps in operation of the machine 30, this is accomplished automatically by the control system described in detail hereinafter. As indicated in the timing chart of FIG. 22, five or six machine cycles are usually employed to build up an adequate ink image on the blanket, although this operation can also be adjusted to suit the requirement of the printing machine. When imaging of the blanket is completed, the printing machine 30 is ready for operation and the feeder 34 is started. Actually, the feeder is started approximately two cycles before blanket imaging is completed in order that first sheet of paper will be fed into the printing head 31 at the time that the blanket imaging operation is finished. Thus, the machine starts printing of the sheets fed from the feeder 34 and printing is continued until the automatic control system halts operation.

Each of the sheets fed from the feeder 34 actuates a sensing switch 46 mounted upon the conveyor table 35 (see FIG. 4) as the sheet is fed toward the printing head 31 of the machine. This switch actuates the counter 44 which, as noted hereinabove, is set to count a predetermined number of sheets, by the operator, before machine operation is initiated. Whenever the counter apparatus completes the total count for which it has been set, imaging of the blanket is interrupted, as indi-

6

cated in the timing chart of FIG. 22. Usually, blanket imaging is interrupted one or two cycles before the end of the printing operation and this is done in order to reduce the amount of ink remaining on the blanket at the end of the printing operation and thus to assure that a normal cleaning operation, in the next subsequent use of a printing machine, will be effective to remove substantially all of the ink from the blanket. The residual image on the blanket is sufficient to print the last two sheets effectively, and there is no substantial deterioration in print quality.

When the counter completes its counting operation, that is, when the desired number of sheets have been printed, the automatic control system of the printing machine 30 stops the feeding of sheets from the feeder 34 into the printing head 31. In the next cycle of operation, inking of the master on the cylinder 32 by the ink mechanism 33 is interrupted. In the next machine cycle, the repellent applicator 36 is effectively disengaged from the master cylinder 32, thereby interrupting application of the repellent solution to the planographic master. Thereafter, operation of the printing machine 30 is interrupted entirely, the master cylinder 32 being brought to rest in a "home" position wherein the master mounted on the cylinder may be conveniently changed by the operator. A potentiometer 45 mounted on the control panel 42 is utilized to afford a fine adjustment of the "home" position of the master cylinder to make sure that removal and replacement of the master can be accomplished in a minimum time.

From the foregoing description of the general construction and operation of the machine 30, it is apparent that substantially all of the machine operations are carried out, in a predetermined sequence, automatically and without requiring attention from the machine operator. For this reason, two printing machines such as the machine 30 can be easily and effectively controlled by one machine operator. Thus, one of the machines can be started in operation, as described hereinabove. While the machine is carrying out the described automatic sequence of operations, the operator is able to start another machine in operation in the same manner. When the first machine has completed its printing run, the operator is able to remove the master from the master cylinder, install a new master, and start a second printing run, the second machine continuing to operate without requiring attention. By the same token, a new run of the second machine can be started while the first machine continues in automatic operation. Furthermore, because the various operations of the machine 30 are accurately and automatically timed, relative to each other, high quality can be maintained in the printing operation despite the fact that the data being printed are frequently changed and only short runs of the machine are employed.

As described hereinafter, the feeder 34 may include both a main stack and an auxiliary supply of sheets to be printed, the auxiliary stack being located in a separate receptacle usually referred to as a systems feeder chute. Usually, it is desirable to print all of the sheets from the systems chute before the counting operation of the counter 44 is initiated. That is, the counter is preferably arranged to count only sheets fed from the main stack in the feeder 34. This is accomplished, in the printing machine 30, by a sensing switch mounted on the systems feeder chute, as described in detail hereinafter, which prevents the initiation of a counting operation by the counter 44 until such time as the systems chute is empty.

Sheet Feeder and Control Mechanism

The sheet feeder 34 is illustrated in detail in FIGS. 4-8, along with a part of the conveyor table 35. The conveyor table may be substantially conventional, but the sheet feeder mechanism 34 is somewhat modified in its construction and operation, and follows the construction described and claimed in the co-pending application

of E. J. Janke, Serial No. 827,585, filed July 16, 1959. As noted hereinabove, the basic sheet feeding mechanism is in many ways substantially similar to that shown in the aforementioned Curtis Patents Nos. 2,293,046 and 2,358,560. As shown in FIG. 4, the sheet feeder 34 comprises a table 51 which is supported for movement in a vertical direction by a suitable mechanism, such as that described in Patent No. 2,358,560 to Curtis, being guided by means of one or more rollers 52 which engage vertically extending channels 53, the channels 53 comprising a part of the frame of the printing machine 30. The table 51 supports the main stack 47 of sheets to be fed into the printing head of the machine.

The top sheet in the stack 47 is separated from the rest of the stack and is fed to a pair of feed members or rolls 61 and 62 by means of a suction foot 63. The suction foot 63 comprises a hollow casting, the lower end 64 of which is open. The upper end of the suction foot is connected by a flexible conduit 65 to a vacuum system (not shown). The suction foot is adjustably secured to a shaft 66 to permit transverse adjustment of the suction foot with respect to the stack 47. The shaft 66 is journaled at its ends in a pair of arms 69 which are secured to a cross shaft 68 rotatably mounted in the side plates 57 of the printing unit 30. The shaft 68 is connected to an operating linkage which is utilized to rotate the shaft 68 and to effect a predetermined movement of the suction foot 63 during operation of the printing machine.

Operation of the sheet feeder 34, as thus far described, is substantially the same as shown in the aforementioned Patent No. 2,293,046 to Curtis. During each sheet-feeding cycle of operation, the shaft 68 is rotated to impart an up-and-down movement to the shaft 66. This movement of the shaft 66 first raises the suction foot 63 and then moves the suction foot toward the right of the feed rolls 61 and 62. The top sheet of the stack 47 is held to the base of the suction foot by means of a vacuum maintained through the flexible connection 65 to the suction foot. As the foot inserts the sheet between the rolls 61 and 62, the suction is automatically released, releasing the sheet of paper and permitting the rolls to move the sheet in the direction indicated by the arrow 48 across the conveyor table 35. In completing the cycle, the suction foot 63 moves rearwardly and downwardly toward the top of the stack 47, thus conditioning the sheet feeder for the next feeding cycle.

The paper table 51 is periodically raised by a power operated mechanism controlled by the height of the stack 47, this mechanism being substantially conventional in character. The stack advancing mechanism comprises a bail 70 which extends across the top of the stack and is pivotally mounted on the side plates 57 of the machine. The bail 70 is pivotally movable about a pivot 81 and is connected to an operating linkage comprising a bar 76, the connection being generally indicated by the reference numeral 78. During each cycle of operation of the sheet feeding mechanism 34, the bail 70 is moved upwardly out of contact with the top of the stack of sheets 47. After a sheet has been fed from the stack, the bail is again moved downwardly until it engages the top of the stack. Whenever the top of the stack 47 falls below a predetermined level, the bail 70 actuates a mechanism which is effective to raise the entire stack through a predetermined distance to permit the feeding of further sheets therefrom. A complete system of this kind is described in detail in the aforementioned Patent No. 2,358,560 to Curtis.

A guide frame is mounted in the upper part of the sheet feeder mechanism 34 and comprises a pair of bars 83 which are adjustably mounted on the frame plate 57. At their forward ends, as best shown in FIGS. 6 and 7, the two bars 83 are interconnected by a cross bar 84, and the rear ends of the bars 83 may be similarly interconnected by a second cross bar 85. The cross bar 85 is employed to support a pair of adjustable guides 86

(see FIG. 4) which project downwardly and engage the sides of the stack of paper or other sheets 47 to control the position of the sheets at the top of the stack.

The sheet feeder mechanism 34 further includes a systems chute 49, which is mounted upon the frame comprising the support bars 83 and the traverse bar 84. The systems chute comprises a pair of substantially L-shaped frame members 88 and 89 which together form a chute or receptacle for supporting a second stack of sheets 91 in position to be fed into the printing unit 30. As shown in FIG. 7, the two frame members 88 and 89 are adjustably secured to each other in a manner which permits narrowing or widening of the systems feed chute. At its forward end, the side portion 92 of the frame member 89 is provided with a slot for engaging the traverse support bar 84, and a similar slot is formed in the side member 93 of the frame member 88. A pair of adjustable guides 94 and 95 are mounted on the rear portions of the two frame members 88 and 89 and comprise a means for locating the rear end of the stack 91. The guide members 94 and 95 may be adjusted forwardly or rearwardly to accommodate relatively small or relatively large sheets in the stack. The rear portion of the systems feeder chute 49 is supported by a transverse support member 97, the end portions of which are seated upon the bars 83 and the center portion of which provides a support for the rear part of each of the frame members 88 and 89 of the systems chute.

In the forward end of the systems chute 49 there are provided a pair of support brackets 101 and 102 which are affixed to the side walls 92 and 93 of the systems chute. A traverse support member 104 is adjustably mounted in the brackets 101 and 102. Upon the support member 104 there is mounted a bracket assembly 105 which serves as a support for a sensing switch 103. As illustrated in FIG. 6, the switch 103 includes a depending arm 107 which normally projects downwardly through a slot in the forward end of a plate 108 affixed to the frame member 89. With a stack of paper or other sheets disposed in the systems chute, such as the stack 91, however, the switch arm 107 cannot project downwardly through the forward slot in the plate 108 but rather is held up above the plate 108 so long as any paper remains in the chute. Thus, the switch arm 107 may be employed to maintain the switch 103 in an open condition whenever the chute 49 contains any sheets to be printed and in a closed condition whenever the chute is empty.

As best illustrated in FIG. 4, the sheets disposed in the systems chute 49 are located immediately above the stack 47 and project outwardly of the chute beneath the suction foot 63. Thus, the suction foot 63 and the associated apparatus of the sheet feeder 34 is effective to feed individual sheets from the stack 91 in the chute 49 as well as from the stack 47. Moreover, the sheet feeder feeds the sheets from the stack 91 and empties the systems chute 49 before any paper is fed from the stack 47, since the chute 49 is located above the main supply stack. Thus, a series of special-purpose sheets may be located in the chute 49 and, in normal operation, are all printed by the printing machine 30 before any of the sheets in the stack 47 are printed.

When the printing machine 30 is placed in operation, the sheets in the stack 91 are first fed through the printing head 31, since these sheets are located in the systems chute 49. When the systems chute 49 is emptied, the machine continues operation by imprinting sheets from the main stack 47. As noted hereinabove, the machine is provided with an automatic counting apparatus, comprising the counter 44, so that the machine is automatically shut off upon printing of a preselected number of sheets from the main stack 47. FIG. 5 illustrates an automatic feeder control mechanism which is incorporated in the printing machine 30 and which is utilized to control operation of the feeder 34. As noted hereinabove,

the feeder control is essentially the same as that described in the co-pending application of E. J. Janke, Serial No. 827,585, filed July 16, 1959. The feeder control mechanism comprises a cam follower arm 111 which is affixed to the outboard end of the rocker shaft 68 which controls movement of the feeder suction foot 63. A roller 112 on the end of the cam follower arm 111 engages a cam surface 113 upon a suction foot operating cam 114, the cam 114 being pivotally mounted upon the side plate 57 by suitable means, as indicated by the reference numeral 115. A spring 116 is connected to the cam follower arm 111 and maintains the roller 112 in engagement with the cam surface 113. The cam 114 is normally biased toward rotation in a clockwise direction by suitable means such as a spring 117.

The cam 114 is connected to a cam drive link 118 by means of an adjustable connection plate 119. One end of the plate 119 is pivotally mounted upon the cam 114, as indicated by the reference numeral 121. The other end of the plate 119 is provided with an elongated arcuate slot 122 in which a screw 123 is engaged, the screw 123 being threaded into the cam 114. The plate 119 is connected to the link 118 by means of a pin 124 which extends from the plate 119 through a slot 125 in the link 118.

The end of the link 118 opposite the connection to the cam 114 is connected to a lever 126 that is pivotally mounted upon a shaft 127. The lever 126 is also connected to a link 128 which is utilized to drive the lever 126 as described hereinafter. The intermediate portion of the lever 126 is yieldably connected to the operating arm 76 by suitable means such as a spring 129, one end of the spring being connected to the arm 76 and the other end being connected to a pin 131. The pin 131 is mounted upon the lever 126 and extends through an elongated slot 132 in the arm 76. As described hereinabove, the arm 76 is connected to the operating linkage of the bail 70 as indicated by the reference numeral 78.

As thus far described, the feeder operating mechanism shown in FIG. 5 is substantially conventional and corresponds to feeder devices now in commercial use. Accordingly, only a very brief description of operation of the feeder control is required herein. During each cycle of operation of the printing machine, the link 128 pivots the lever 126 about the shaft 127. As the lever 126 moves in a clockwise direction, the link 118 is driven to the right, thereby pivoting the cam 114 in a clockwise direction about the pivot point 115. As the cam 114 moves in a clockwise direction, the cam follower arm 111 is permitted to move in a counterclockwise direction, this movement being effected by the biasing force supplied by the spring 116. The resulting counterclockwise rotation of the shaft 68 on which the cam follower arm 111 is mounted pivots the support for the suction foot 63, comprising the arm 69 and the shaft 66, in a counterclockwise direction, lowering the suction foot into contact with the topmost sheet in the feeder, either in the main stack 47 or the auxiliary stack 91 (see FIGS. 4 and 8). Later in the same cycle of operation, the link 128 pivots the lever 126 back in a counterclockwise direction, reversing the movements described hereinabove and effectively raising the suction foot 63 back to the initial position shown in FIG. 5. During the same cycle of operation, the arm or bar 76 is first moved to the right as seen in FIG. 5, pivoting the bail 70 downwardly into contact with the top of the main stack of paper. At the end of the cycle, however, the reverse movement of the lever 126 again pulls the arm 76 to the left. As a consequence the bail 70 is again pivoted out of contact with the paper in the main stack.

In the mechanism illustrated in FIG. 5, however, provision is made for an automatic control of the feeder by means of a solenoid 133. The armature 134 of the solenoid 133 is connected to a lever 141 by means of a pivot block 136. A spring 135 is connected at one end to the

lever 141 and at the other end to a pin 137 mounted upon an arm 138 which is held in position on the side plate 57 by means of a retaining plate 139. The latch lever 141 is pivotally mounted upon a stud 142 secured to the side plate 57. A pawl 143 is pivotally mounted upon the stud 142 and is yieldably connected to the latch lever 141 by suitable means such as a spring 144. The latch lever 141 is urged toward or away from pawl 143, depending on the position of the arm 138. The pawl 143 is engageable in a notch in the lower portion of an extension portion 145 of the cam 114. The electrical control circuit of the solenoid 143 is described hereinafter in connection with FIG. 20.

When the printing machine 30 is first placed in operation, the link 128 is reciprocated as described hereinabove and tends to drive the cam 114 in a reciprocating pivotal movement about the pivot point 115. The cam, however, is prevented from moving by engagement of the pawl 143 with the latch portion 145 of the cam. At the same time, a block 161 mounted upon the cam plate 114 engages a stop member 162 on a bail operating arm 76 and prevents the normal reciprocating movement of the arm 76. Consequently, the bail 70 is held in its normal or up position and the suction foot 63 is held in its initial or unoperated position, elevated above the stack or stacks of paper in the feeder (see FIG. 4). Accordingly, no paper is fed through the printing machine as long as the solenoid 133 remains unenergized.

To start the feeder the automatic sequence control system of the invention operates to complete an energizing circuit for the solenoid 133, as set forth in detail hereinabove. When this occurs, and the solenoid 133 is energized, the armature 134 is pulled inwardly of the solenoid against the bias afforded by the spring 135. The movement of the armature pivots the latch plate 141 in a clockwise direction and the pawl 143 is also rotated in a clockwise direction by virtue of the connection to the plate 141 afforded by the spring 144. This movement releases the pawl 143 from engagement with the latch portion 145 of the cam 114, permitting normal operation of the cam and hence providing for operation of the feeder mechanism in the usual manner as described hereinabove.

In the course of operation of the machine, and after a predetermined number of print-receiving sheets have been printed, the counter 44 is actuated to open the circuit of the solenoid 133, as described hereinafter in connection with FIG. 20. The bias afforded by the spring 135 pulls the armature 134 outwardly of the solenoid coil, driving the latch plate 141 back in a counterclockwise direction to the initial position shown in FIG. 5. If the cam plate 114 is in its original position, as illustrated in FIG. 5, the pawl 143 cannot immediately engage in the notch in the latch portion 145 of the cam. However, differential movement between the pawl 143 and the plate or lever 141 is permitted by the yieldable connection between these two members and, as soon as the cam plate 114 returns to its original position, as shown in FIG. 5, during completion of its normal cyclic movement, the pawl 143 engages and latches the notched portion of the latch extension 145 on the cam. Thus, whenever the solenoid 133 is de-energized, the mechanism of FIG. 5 automatically operates to latch the feeder mechanism 34 in a position in which the suction foot 63 is elevated from the top of the upper stack and in which the bail 70 is in its upper position. Accordingly, the suction foot 63 does not interfere with the depositing of additional sheets in the systems chute 49 (see FIG. 4). By thus latching up the mechanism with the suction foot 63 and bail 70 in raised position, it is possible for the operator to insert additional sheets in the systems chute in a very short time, thereby speeding up operation of the printing machine to a substantial extent.

Plate-Etch Applicator

The plate-etch applicator 36 for the printing machine 30 is illustrated in FIGS. 10-12, as well as in FIG. 1, and

11

a switching device which is actuated by the plate-etch applicator is shown in FIGS. 16 and 17. As illustrated in FIGS. 10-12, the plate-etch applicator comprises a pair of frame members or side plates 200 and 201 which are mounted upon the side frame members 202 and 203, respectively, of the printing head 31 (see FIG. 1). A shaft 204 is mounted upon and extends between the two frame members 200 and 201, one end of the shaft 204 being extended beyond the frame member 200 as best seen in FIG. 10. The handle 37 of the plate-etch applicator 36 is pivotally mounted upon the frame member 200 upon a suitable pivot pin or shaft 205 and extends generally upwardly past the extension portion 206 of the shaft 204. A crank or operating lever 207 is affixed to the extension portion 206 of the shaft 204 and is pivotally connected to the handle 37 as indicated by the reference numeral 208. Thus, pivotal movement of the handle 37 is effective to impart a rocking or pivoting movement to the shaft 204.

A pair of spaced arms or brackets 211 and 212 are mounted upon the shaft 204 and extend upwardly therefrom at an angle from the vertical, as illustrated in FIGS. 11 and 12. A transfer member 213 of hexagonal cross-sectional configuration is mounted between the upper ends of the brackets 211 and 212, the mounting arrangement being such that the transfer member is rotatable about its own axis. A repellent solution fountain 214 is mounted between the frame members 200 and 201 at position to engage the transfer member 213 when the transfer member is in its normal or inoperative position as shown in FIGS. 10-12. The repellent fountain 214 may comprise a metal receptacle or trough and a sponge member mounted therein for transferring repellent solution from the trough to the transfer member 213. The transfer member 213 is normally retained in the inactive position illustrated in FIGS. 10-12 by means of a torsion spring 215 which is disposed in encompassing relation to a part of the shaft 204, one end of the spring 215 being secured to a fixed collar 216 on the shaft and the other end being secured to the bracket member 212.

A train of gears comprising a drive gear 217, an intermediate or idler gear 218, and a driven gear 219 are located at the right-hand end of the plate-etch applicator 36, as seen in FIG. 10, and are utilized to provide a driving connection between the shaft 204 and the transfer member 213. The drive gear 217 is secured to the shaft 204 for rotation therewith, the intermediate gear 218 is suitably mounted upon the bracket 211, and the end or driven gear 219 is mounted upon the transfer member 213 for rotation therewith. At the same end of the plate-etch applicator 36, a cam 221 is positioned to engage the bracket member 211; the cam 221 is affixed to a suitable shaft 222 journaled in the frame member 201. A handle 223 is mounted on the shaft 222 to rotate the cam 221 between the normal or inactive position and an actuated position in which it engages the bracket member 211 to move the transfer member 213 out of contact with the fountain 214.

As thus far described, the plate-etch applicator 36 is substantially similar to the applicator described and claimed in the aforementioned patent to Janke et al. 2,798,246. Furthermore, operation of the applicator 36 is essentially the same as the applicator described in that patent. Thus, when it is desired to apply a plate-etch solution to the planographic master mounted upon the master cylinder 32 (see FIG. 12), the handle 37 is pivoted in a clockwise direction. The pivotal movement of the handle 37 is transmitted to the shaft 204 and hence to the brackets 211 and 212. The driving connection between the handle 37 and the brackets 211 and 212 is such that the angular travel of the brackets about the axis of the shaft 204 is substantially larger than the angular travel of the handle about its pivot member 205. Consequently, movement of the handle 37 through an angular displacement of the order of 45° swings the

12

brackets and the applicator 213 to the position illustrated in phantom outline in FIG. 12 and identified therein by reference numerals 211A and 213A with the transfer member 213 in contact with the surface of the master cylinder 32. With the plate-etch applicator handle held in this position, etching solution is transferred from the transfer member 213 to the planographic master on the surface of the cylinder 32 to effect etching of the master. Subsequently, the operator returns the handle 37 to its original position upon completion of the etching operation. The gear train 217-219 is effective to rotate the transfer member 213 by a predetermined amount so that the same surface of the transfer member engages the etching solution fountain 214 and is used in the next subsequent operation of the plate-etch applicator.

The construction of the plate-etch applicator 36 has been modified, as compared with the arrangement described in the Janke et al. Patent No. 2,798,426, by the incorporation therein of three different switch devices. As best shown in FIG. 10, in the sectional portion thereof, the switch 38 is mounted within a knob 225 at the end of the handle 37. This switch is a momentary contact push-button switch of conventional construction and is utilized, as noted hereinabove, to start the printing machine 30. The electrical leads 226 for the switch 38 extend through the tubular handle 37 to afford a means for connecting the switch 38 to the remainder of the control circuit described in detail hereinafter in connection with FIG. 20. The switch 38 is sometimes referred to hereinafter as the plate-etch handle switch.

A second switch 227 is mounted upon the frame member 200, as best shown in FIG. 11. The switch 227, which is referred to hereinafter as the machine start switch, is provided with an operating arm 228 in position to be engaged by a switch actuator 229, the switch actuator 229 being pivotally mounted upon the frame member 200. When the handle 37 is pivoted in a clockwise direction from its normal or inactive position, as shown in FIG. 11, to its actuated or etching position, the switch actuator 229 is engaged by the bracket 212. As a consequence the actuator is pivoted in a clockwise direction and engages the switch arm 228, thereby actuating the switch 227. As described hereinafter in connection with FIG. 20, it is necessary to actuate both of the switches 38 and 227 in order to initiate automatic operation of the printing machine 30.

The third switch controlled by the plate-etch applicator 36 is actuated in response to rotation of the shaft 204. As shown in FIGS. 10 and 12, a cam 231 is formed on the end of the shaft 204 on a portion of the shaft which projects outwardly of the frame member 201. The cam 231 is employed to actuate a switch 232, sometimes referred to hereinafter as the sequence start switch, the switch actuating mechanism being illustrated in FIGS. 16 and 17. This mechanism comprises a cam follower 233 which comprises a crank having a follower arm 234 in position to engage the cam 231. The other arm 235 of the cam follower crank 233 engages a switch actuating lever 236 which is pivotally mounted upon a switch casing or housing 237. The actuating lever 236 is biased into the engagement with the crank arm 235 by suitable means such as a spring 238.

In FIGS. 12 and 17, the cam 231 and the cam follower crank 233 are illustrated in the normal or unactuated position for these elements. The cam 231 engages the crank arm 234 and holds the crank 233 in the illustrated position, against the biasing force of the spring 238, and the actuating lever 236 is maintained in the position shown in solid lines in FIG. 17. When the handle 37 is pivoted to effect a plate-etching operation, however, the shaft 204 rotates in a counterclockwise direction, as seen in FIGS. 12 and 17. As the shaft 204 rotates, the cam 231 initially holds the follower crank 233 in its original position; continued rotation of the shaft, however, beyond an angle of approximately 90°, moves the cam beyond

the end of the follower arm 234 to an extent sufficient to permit limited movement of the crank 233 in a clockwise direction. Consequently, the actuating lever 236 moves to an alternate position 236A (FIG. 17), permitting the switch arm 239 to move outwardly of the switch 232.

The sequence starting switch 232 is not actuated by this initial movement of the switch arm 239, however. Rather, the switch selected for this part of the machine is one which is closed momentarily as the switch arm is moved back toward its original position. Switches of this kind are well known in the art; for example, a conventional switch having a fold-over finger or toggle arrangement for the arm 239 may be employed. Thus, the switch 232 is actuated only upon release and return movement of the handle 37 toward its original or inactive position. Upon such return movement, the shaft 204 is rotated in a clockwise direction back toward the position of FIGS. 12 and 17, the cam 231 engages the arm 234 and rotates the follower counterclockwise to its original position, the lever 236 is driven from position 236A back to its original position, and the switch arm 239 is restored to its initial position. Preferably, the switch arrangement is such that the switch 232 is actuated with the handle 37 approximately midway between its extreme operating and inactive positions, but this is not a particularly critical matter so long as the switch is closed momentarily at some point during return movement of the handle. It is the closing of the switch 232 which initiates the automatic sequential operation of the printing machine 30, including those operations which control application of repellent solution to the master on the cylinder 32, inking of the master, cleaning of the blanket, feeding of paper, and all of the other operations carried out by the machine.

Repellent Solution Applicator

The construction and operation of the repellent solution applicator 39 can be best understood by reference to the perspective views of FIGS. 2, 3 and 9 and the detail views of FIGS. 13 and 14. In general, the mechanical arrangement of the repellent applicator 39 is substantially similar to repellent application units which are well known in the art and have been in commercial use for some time. Consequently, only a brief description is provided herein with respect to the repellent applicator per se. On the other hand, the control mechanism for the repellent applicator comprises a substantial feature of the present invention, and this aspect of the applicator 39 is described in greater detail hereinafter.

As best shown in FIGS. 2 and 3, the frame members 202 and 203 which comprise the upper head portion of the printing head 31 are pivotally mounted upon the lower machine frame members 242 and 243. The upper head of the machine includes the master cylinder 32, the inking system 33 and the plate-etch applicator 36 of the machine. The repellent solution applicator 39 is also mounted upon the upper head of the printing machine and comprises a pair of frame members 245 and 246 which are connected to each other by suitable tie rods and shafts such as the connector rod 247. The frame for the repellent applicator 39, comprising the two frame members 245 and 246, is pivotally mounted upon a shaft 248 which extends transversely of the printing head 31 between the two main frame members 202 and 203. In operation, the entire repellent applicator unit 39 is pivoted about the shaft 248 between an initial or inactive position and an active position, as described in detail hereinafter.

The repellent solution applicator 39 comprises a series of rollers which form a repellent application train and which are mounted in the applicator frame 245, 246. The roller arrangement employed in the present instance is generally illustrated in FIG. 13, although the mounting details for the rollers and the drive arrangement there-

for are not shown, since these are substantially conventional in character and construction. Thus, the repellent application train comprises a fountain roll 251, a ductor roll 252, a distributing roll 253 and a repellent form roll 254. In operation, the ductor roll 52 is moved back and forth between the fountain roll 51 and the distributing roll 253 by a conventional mechanism, the oscillating mechanism for the ductor roll not being illustrated in the drawings. The repellent form roll 254 is positioned to engage the outer surface of the master cylinder 32 to apply a repellent solution thereto during operation of the printing machine.

An operating lever or cam follower lever 255 is rigidly affixed to the repellent applicator frame member 246 by suitable means such as a pair of screws 256, as best shown in FIG. 13. A similar cam follower lever 257 is affixed to the frame member 245 on the opposite side of the machine by similar means such as the screws 258, portions of the cam follower lever 257 being visible in the perspective view of FIG. 9. As shown in FIG. 13, a biasing spring 259 is connected to the lower end of the lever 255 and biases the lever 246 toward rotation in a counterclockwise direction about the shaft 248. A similar biasing spring 260 is connected to the lower end of the lever 257 (see FIG. 9) and tends to bias that lever in a clockwise direction about the shaft 248. Thus, the two springs 259 and 260 conjointly tend to tip the entire repellent solution applicator about the shaft 248 and lift the repellent form roll 254 out of contact with the master cylinder 32 (see FIG. 13). Stated differently, the springs 259 and 260 tend to maintain the repellent solution applicator in an inactive position in which the form roll 254 does not contact the master cylinder 32 and, accordingly, no repellent solution is applied to the master cylinder.

The printing head 31 of the printing machine 30 includes a master control shaft 262 which extends transversely of the upper head of the machine and is journaled in suitable bearings in the frame members 202 and 203. The shaft 262 extends outwardly of the two frame members and a pair of cams 264 and 265 are mounted thereon, as shown in FIG. 14. The two cams 264 and 265 are similar in configuration, the shape of the cams being illustrated by the cam 264 as shown in FIG. 13. The cam 264 engages a cam follower roller 266 which is mounted upon the lever 255, the roller 266 being maintained in the engagement with the cam 264 by the biasing action of the spring 259. A similar arrangement is employed on the opposite side of the machine; because the cam follower structures are substantially identical, only the one has been shown. As indicated in FIG. 13, the cam follower 266 is normally positioned in engagement with a reduced diameter or dwell portion 267 on the cam 264 when the repellent solution applicator 39 is not being used. With the cam and the cam follower in the position shown in FIG. 13, the form roll 254 is displaced from the periphery of the master cylinder 32 as a result of the biasing action afforded by the springs 259 and 260.

To actuate the repellent solution applicator 39, the control shaft 262 is rotated through a minor arc in a counterclockwise direction (FIG. 13). When this is done, a lobe portion 268 on the cam 264 engages the cam follower roller 266 and pivots the lever 255 in a counterclockwise direction about the shaft 248, against the bias force exerted by the spring 259. The same action is effected by the cam 265 on the opposite side of the machine. As a consequence, the repellent applicator unit 39 is pivoted about the shaft 248, bringing the repellent form roll 254 downwardly into engagement with the master cylinder 32 and initiating application of repellent solution to the lithographic master on the master cylinder. The pivotal movement of the applicator 39 is relatively small, since it is only necessary to separate the form roll from the master cylinder by an extremely small distance. Actuation of the repellent applicator, as de-

scribed hereinabove, may be effected by means of the manual control handle 43. Thus, by pivoting the handle 43 through an arc of approximately 15° from the position shown in FIG. 2, the repellent solution applicator 39 may be moved from its normal or inactive position to an active or operating position. On the other hand, the same effect may be achieved by rotating the control shaft 262 by automatic electrically controlled means as described in detail hereinafter in connection with the automatic sequence control system of the invention.

The Blanket Cleaner

The blanket cleaner 41 for the printing machine 30, which is shown in FIGS. 1-3 and in the detail view of FIG. 15, is substantially similar in construction, as noted hereinabove, to the blanket cleaning device described and claimed in Patent No. Re. 24,739 to Mitchell et al. Thus, the blanket cleaner 41 includes a pair of side plates or frame members 322 and 323 which may be mounted upon the frame of the printing machine by suitable fastening means such as the nuts 324 (see FIG. 3). Between the frame members 322 and 323, there is mounted an auxiliary frame comprising a pair of end plates 326 (see FIG. 15) which are connected to each other by suitable cross frame members such as the rods 327. The auxiliary frame, comprising the two end plates 326 and the rods 327, is pivotally mounted upon a shaft 325 which extends across and is mounted upon the two main frame members 322 and 323 of the blanket cleaner.

A blanket cleaning roller 328 is rotatably mounted upon a shaft 329, the shaft 329 being mounted between the two frame members 326 of the auxiliary frame. The cleaning roller 328 is in position to engage a wick 331 which may be disposed in a reservoir of cleaning liquid, as disclosed in the aforementioned Mitchell et al. patent. Moreover, the cleaner roll 328 is positioned to engage the blanket cylinder 300 of the printing machine 30 and to be moved into and out of engagement with the blanket cylinder as described in detail hereinafter.

The blanket cleaner 41 may also be provided with a squeegee roller 333 disposed in an engagement with the blanket cleaner roll 328. The roller 333 is pressed against the blanket cleaner roll by means comprising an adjustable tensioning screw 334, being provided with an adjustment and actuating mechanism substantially similar to that shown in the aforementioned Mitchell et al. patent.

The actuating mechanism of the blanket cleaner 41, however, is somewhat different from that shown in the aforementioned Mitchell et al. patent. As shown in FIG. 3, a pair of solenoid frame support plates 335 and 336 are mounted upon the blanket cleaner frame members 323 and 322, respectively and are interconnected by means of a pair of traverse rods or brace members 337 and 338. A bracket member 342 is mounted upon the rods 337 and 338 and forms, with the support plate 336, a support bracket for a first solenoid 341. A similar bracket member 343 is mounted upon the traverse support members or rods and forms, with the plate 335, a second solenoid support bracket which supports a second solenoid 344 (see FIGS. 1 and 3). The two solenoids 341 and 344 are connected by suitable linkages to the pivotal carriage of the blanket cleaner, comprising the pivotal end plates 326 and the rods 327; since the same linkage is used for each of the solenoids, only the linkage for the solenoid 344 has been illustrated in the drawings (see FIG. 15).

As shown in FIG. 15, the solenoid 344 is provided with an armature 345 having a yoke 346 mounted thereon, the yoke 346 being pivotally connected to a connecting link 347. The link 347, in turn, is pivotally connected to a crank or lever 348, the lever 348 being pivotally mounted upon the rod 327 nearest the cleaner roll 328. The link 347 is also pivotally connected to an additional lever 349, the opposite end of the lever 349 being disposed

in engagement with a stop member 351 which comprises a transverse rod extending across the blanket cleaner between the support plates 335 and 336 as best shown in FIG. 3.

Operation of the blanket cleaner 41 is substantially similar to that of the Mitchell patent and therefore need not be described in detail herein. Briefly, during operation of the blanket cleaner a cleaning solution is transferred from the wick or supply member 331 to the cleaner roll 328 and from the cleaner roll 328 to the blanket cylinder 300. The squeegee roll 333 controls the distribution of the cleaning solution on the cleaner roll 328 and prevents application of excessive amounts of the cleaner to the blanket roll.

In FIG. 15, the blanket cleaner 41 is shown in its unactuated or normal position with the cleaner roll 328 displaced from contact with the surface of the blanket cylinder 300 by a relatively small distance. In order to operate the blanket cleaner, the solenoid 344 is energized, pulling the solenoid armature inwardly thereof and generally upwardly as seen in FIG. 15. At the same time, of course, the solenoid 341 (FIG. 3) is also energized to effect the same operation with respect to its connecting linkage. As shown in FIG. 15, this movement of the armature straightens the articulated linkage comprising the levers 348 and 349, moving these levers to the positions 348A and 349A, shown in phantom outline. This action is effective to pivot the carriage for the cleaner roll, comprising the pivotal end plates 326 and rods 327, through a relatively small angle about the shaft 325, thereby bringing the cleaner roll 328 into contact with the surface of the blanket cylinder 300. As long as the two solenoids remain energized, the blanket cleaner 41 remains in operation. Upon de-energization of the solenoids, the linkage 348, 349 returns to its original position and the pivotal carriage for the cleaner roll 328 pivots back to its original position, again separating the cleaner roll from the blanket cylinder. It is thus seen that the blanket cleaner 41 is controlled entirely by electrical control of the solenoids 341 and 344, and this electrical control is incorporated in the automatic sequence control system of the invention as described in greater detail hereinafter.

The Inking Mechanism

The inking and ink control mechanism for the printing machine 30 is best illustrated in FIGS. 2, 13 and 14, although portions of the mechanism are also shown in other parts of the drawings. In general, it may be said that the ink application apparatus 33, sometimes referred to as the ink train, is substantially conventional in construction and comprises a plurality of ink rollers which are utilized to transfer ink from a fountain roll 271 to the master cylinder of the printing machine. For example, the ink train may include a suitable series of transfer rolls, and one or more oscillating or ductor rolls, and the like, in accordance with conventional practice. The terminal elements in the ink train comprise a pair of form rolls 274 and 275 which engage the planographic master on the master cylinder 32 and are illustrated in dash outline in FIG. 13. These two rolls are mounted upon a pair of mounting members or brackets 272 and 273, as illustrated in FIG. 2, and extend transversely of the upper portion of the printing head 31. The two brackets 272 and 273 are interconnected by a spring 280 and may be pivoted manually, using the handles 276 and 277 (FIG. 2) to move the form rolls 274 and 275 toward and away from contact with the master cylinder 32 (see FIG. 13). The mounting arrangement for the form rolls is essentially the same on both sides of the machine, only one set of handles being provided. As thus far described, it will be recognized by those skilled in the art that the ink train is substantially conventional in construction; accordingly, no detailed description of its operation is deemed necessary herein.

A pair of ink form roll control brackets 278 and 279

are mounted upon opposite sides of the printing head 31, as illustrated in FIG. 14. The bracket 278 is supported upon the control shaft 262, but the opening in the bracket is elongated to permit movement of the bracket relative to the shaft in a direction generally indicated by the arrow 281. At the left-hand end of the bracket 278, as seen in FIGS. 13 and 14, the bracket is provided with a guide slot 282 which engages a guide and stop member 283 that is mounted upon a transverse shaft or rod 284. The shaft 284 extends across the upper head of the machine (see FIGS. 13 and 14). This guide arrangement restricts movement of the bracket 278 to a direction parallel to the arrow 281. At the opposite side of the machine, the bracket 279 is similarly supported by engagement with a portion of the shaft 262 and by means of a guide member 285 mounted on the transverse rod or shaft 284.

In the illustrated construction, the form roll support brackets 272 and 273 are pivotally mounted on the bracket 278, instead of being mounted in conventional manner on the frame member 202. Similarly, the form roll support brackets on the opposite side of the machine are pivotally mounted on the bracket 279 rather than on the frame member 203. Finished bosses may be provided on the frame members to engage the mounting studs for the form roll brackets as illustrated by the stud 287 and the boss 288 in FIG. 14, to guide movement of the form roll brackets. This construction also permits adjustment of end play in the form rolls by means of the adjustment member 286 threaded onto the end of the shaft 284, the split adjustment member being provided with a locking screw 290 to prevent displacement from adjusted position during operation of the machine.

A cam follower roller 289 is mounted on the bracket 278 in position to engage the cam 264. Similarly, a cam follower roller 291 is mounted upon the bracket 279 and engages the corresponding cam 265 on the opposite side of the machine (see FIG. 14). As seen in FIG. 13, a pair of springs 292 and 293 are connected to the bracket 278 and bias the bracket to bring the cam follower 289 into engagement with the cam 264. These springs also urge the bracket toward abutment with the guide 283. On the opposite side of the machine, a similar pair of springs are used to maintain the follower 291 in engagement with the cam 265, these springs 294 and 295 being seen in FIG. 9.

In considering the operation of the inking mechanism, it may first be assumed that the shaft 262 and the cam 264 are in the rotational position illustrated in FIG. 13. The corresponding position for the handle 43 which may be used for manual actuation of the shaft 262 is illustrated in FIG. 2. With the control shaft 262 in this position, the brackets 278 and 279 are maintained at the extreme leftward limit of their travel, as seen in FIGS. 13 and 14. The limit to movement of the brackets in this direction is established by the guide and stop members 283 and 285, respectively.

With the control shaft 262 in the position illustrated in FIGS. 2 and 13, the form rolls 274 and 275 may be actuated between nominal "on" and "off" positions by means of the control handles 276 and 277, in conventional manner. However, even if the manual control handles for the ink form rolls are pivoted to their "on" positions, pivoting the ink form rolls toward the master cylinder 32, the form rolls are not brought into ink-transferring contact with the master cylinder. That is, the two brackets 278 and 279, upon which the form rolls are mounted as described hereinabove, maintain the form rolls in spaced relation to the master cylinder 32 so long as the control shaft 262 remains in its initial or "zero" position as shown in FIGS. 2 and 13. For normal operation of the printing machine the manual control handles for the ink form rolls are maintained in their "on" positions, subsequent movement of the ink form rolls being effected by operation of the control shaft 262.

To move the ink form rolls into ink-transferring con-

tact with the master cylinder 32, the control shaft 262 is rotated in a counterclockwise direction, as seen in FIGS. 2 and 13, moving the handle 43 to the position illustrated in FIG. 3. As the shaft 262 rotates, the consequent rotation of the cam 264 drives the cam follower 289 to the right, as seen in FIG. 13. At the same time, the cam 265 effects a corresponding movement of the cam follower 291 (see FIG. 14). Accordingly, the two brackets 278 and 279 are moved conjointly in a direction indicated by the arrow 281. This movement of the brackets 278 and 279, which is effected against the biasing force afforded by the springs 292-295, is effective to move the ink form rolls 274 and 275 through a relatively short distance and into engagement with the master cylinder 32. Thus, the linkage between the shaft 262 and the ink form rolls affords an effective and convenient means for moving the form rolls into and out of engagement with the master cylinder, this movement being controlled entirely by rotation of the control shaft 262. The control shaft 262 is subject to actuation by an automatic mechanism, described hereinafter, in addition to being manually controllable by means of the handle 43.

As a part of the inking mechanism, the printing machine of the present invention also provides a means for controlling the transfer of ink from the master cylinder 32 to the blanket cylinder 300. The blanket-imaging control means comprises a pair of links or levers 302 and 303 each having one end eccentrically mounted upon the shaft 262. The operating connection for the lever 302, at the end opposite the shaft 262, is best illustrated in FIG. 13A. As shown therein, a relatively short shaft or stud 304 is mounted upon the frame member 200. On the shaft 304, there is mounted an anchor bushing 305, the bushing being rotatable relative to the shaft. A pressure adjusting arm 306 is included in the mounting assembly illustrated in FIG. 13A, the arm 306 being provided with an eccentric bushing 307 disposed in encompassing relation to the bushing 305. The lever 302, in turn, fits around the bushing 307 on the pressure adjusting arm 306. The pressure adjustment assembly further includes a locking key 308 which engages in a slot in the end of the bushing 305 and which is held in place by means of a suitable fastener, such as the nut 309, thereby affording a means for adjusting and locking the bushing 305 in predetermined angular orientation upon the shaft or stud 304. The end of the pressure adjustment arm 306 is releasably engaged and clamped in predetermined angular position by a suitable clamping device 311 (see FIGS. 2 and 14).

With the control shaft 262 in the normal or "zero" position illustrated in FIG. 13, the links 302 and 303 (FIG. 14) are effective to maintain the upper head of the printing machine displaced by a relatively short distance from the lower head of the machine, thereby maintaining a small spacing between the master cylinder 32 and the blanket cylinder 300 of the machine. When the shaft 262 is rotated in a counterclockwise direction, however, as by means of the handle 43, the eccentric connections to the links 302 and 303 cause the links to pull the upper head of the machine, pivoting it in a clockwise direction about the support shaft 244 (see FIGS. 2 and 13). Consequently, counterclockwise rotation of the shaft 262 is effective to engage the master cylinder in ink-transferring contact with the blanket cylinder, thereby providing for imaging of the blanket from a master mounted on the master cylinder 32. Adjustment of the relative pressure between the two operating cylinders of the machine is effected by loosening the nut 309 to release the key 308, and also loosening the retaining device 311. In this way, the eccentrics 305 and 307 may be rotated to effectively lengthen or shorten the link 302 and thereby adjust the normal operating pressure between the master and blanket cylinders. The mounting arrangement for the link 303, as shown in FIG. 14, is substantially similar to that for the link 302, permitting ad-

justment on both sides of the machine and thereby providing for maintenance of even pressure longitudinally of the master and blanket cylinders.

To provide for effective control of movements of the shaft 262, particularly when actuated by means of the manual control handle 43, a stop member 313 may be mounted on the shaft 262 for rotation therewith (see FIG. 2). A pair of fixed stops 314 and 315 may be mounted on the frame member 302 (see FIGS. 2 and 13) in position to engage the stop member 313 and limit the rotational movement of the shaft 262. In the illustrated embodiment of the machine, the rotational movement of the shaft 262 is restricted to approximately 60°.

Automatic Sequence Control Mechanism

FIGS. 9, 18 and 19 illustrate, in substantial detail, the operating mechanism of the automatic sequence control apparatus of the present invention. In addition, other figures, and particularly FIG. 14, are referred to hereinafter in explaining the operation of the automatic sequence control mechanism and its relation to the operating units of the machine as described hereinabove. FIGS. 18 and 19 include some of the elements illustrated and described hereinbefore in connection with FIG. 14, particularly the main control shaft 262. As described hereinabove, the angular orientation of the control shaft 262 is effective to control the application of a repellent solution to the master cylinder 32 and also controls the application of ink to the master cylinder and the transfer of the ink image from the master cylinder to the blanket cylinder 300. In addition, the angular orientation of the shaft 262 controls energization of the operating solenoids of the blanket cleaner and the actuation of the sheet feeder of the printing machine, as described hereinafter. In addition to the control shaft 262, FIG. 19, also illustrates the cam 265, the cam follower 291, the ink control bracket 279, the shaft or rod 284, and the operating lever or link 303, thus making it possible to correlate this view with the previously described views, and particularly FIG. 14.

As best shown in FIGS. 18 and 19, the automatic sequence control mechanism 370 comprises a ratchet member 371 which is mounted upon the control shaft 262 and which is affixed to the control shaft for rotation therewith. The ratchet 371 is provided with a series of pawl-engaging slots 372 and with a corresponding series of detent-receiving depressions 373. The slots 372 are positioned for engagement by a projection or lug 374 on a control pawl 375, whereas the depressions 373 are engageable by a detent roller 376 mounted upon a detent lever 377. The control pawl 375 is pivotally mounted upon a pin 378 which is secured to and supported by a pawl lever 379. The pawl lever 379 is mounted upon the shaft 262 for rotation with respect to the shaft. The control pawl 375 is biased for rotation in a counterclockwise direction, relative to the pin 378, by means of a spring 381 which connects the pawl to an extension portion 382 of the pawl lever 379.

Actuation of the control pawl 375 is effected by an operating linkage comprising a pawl lever operating link 384. One end 385 of the operating link 384 is eccentrically mounted upon an operating shaft 386, the shaft 386 being a shaft which rotates through a complete revolution during each operating cycle of the printing machine 30. The opposite end of the operating link 384 is provided with an adjustable link extension 388. The extension 388 is adjustably mounted on the end of the operating link by suitable means, such as the bolts 389, which afford a secure connection between the extension 388 and the operating link but permit adjustment of the extension longitudinally of the operating link. The link extension 388 is pivotally connected to the pawl lever 379 by suitable means such as the connecting pin 391.

The pawl 375 is also connected, in part, by a pawl lifting lever 392 that is pivotally mounted upon the shaft

284 (see FIGS. 18 and 19). One end 394 of the pawl lift lever 392 is connected by a linkage 395 to an automatic sequence control solenoid 396, the linkage 395 connecting the pawl lift lever to the armature 397 of the solenoid. The solenoid 396 is mounted upon a bracket 400 that is affixed to the frame member 203 of the upper edge of the printing machine 30 (see FIG. 9). A spring 398 is connected to the lever 392 and to the bracket 400 and tends to bias the lever 392 toward movement in a clockwise direction about the shaft 284, as seen in FIG. 18. Clockwise rotation of the lever 392 is limited by an adjustable stop member 399 that is mounted upon the frame member 203 in position to engage a projection 401 on the pawl lift lever.

The other end 402 of the pawl lift lever 392 is provided with an upper surface, as seen in FIG. 18, having a configuration essentially similar to the external surface of the control ratchet 371, except that the surface 403 is not provided with slots such as the slots 372. The pawl lift lever surface 403 is positioned to engage a roller 404 that is rotatably mounted upon a pin or shaft 405, the pin 405 being mounted upon the control pawl 375. As best shown in FIG. 18, the pawl lift lever surface 403 normally engages the roller 404 to prevent counterclockwise rotation of the pawl 375, but can be displaced from engagement with the roller to permit counterclockwise rotation of the pawl by pivoting the pawl lift lever 392 in a counterclockwise direction about the shaft 284.

The detent lever 377, like the lever 392 is pivotally mounted upon the shaft 284. A spring 406 is connected to the end of the detent lever opposite the detent roller 376, the spring 406 also being connected to a pin 407 mounted upon the bracket 400. Thus, the spring 406 biases the lever 377 toward rotation in a clockwise direction, as seen in FIG. 18, and tends to maintain the detent roller 376 in engagement with one of the slots 373 but also permits efficient counterclockwise rotation of the lever 377 to allow the re-positioning of the detent roller in the other detent slots.

In operation, the automatic sequence control mechanism 370 illustrated in FIGS. 9, 18 and 19 is effective to rotate the control shaft 262 to and through a series of different control positions. In this regard the automatic sequence control mechanism effectively replaces the control which could otherwise be exercised by the machine operator using the handle 43 as described hereinabove.

During each cycle of machine operation, as noted hereinabove, the shaft 386 rotates through one complete revolution. Starting from a position shown in FIG. 18, the rotational movement of the shaft 386 pulls the pawl lever operating link 384 to the right, as seen in this figure, pivoting the pawl lever 379 in a clockwise direction about the shaft 262. The control pawl 375, of course, moves with the pawl lever 379, on which it is mounted. Subsequently, in the same cycle of machine operation, the lever 384 moves back to the left, as seen in FIG. 18, toward its original position. During this part of the cycle the pawl lever 379 is pivoted back in a counterclockwise direction and the control pawl 375 is again constrained to move with the lever 379. These reciprocating movements of the pawl lever operating link 384, the pawl lever 379, and the control pawl 375 are not ordinarily effective to change the operating condition of the printing machine 30, however. The roller 404, as it rides along the surface 403 of the pawl lift lever 392, holds the control pawl 375 out of engagement with the slots 372 in the face of the control shaft ratchet member 371. Accordingly, in most cycles of machine operation, the movement of the pawl lever operating link 384, and the consequent movement of the pawl lever and control pawl do not alter the operating condition of the printing machine.

Actuation of the automatic sequence control 370 is effected by energization of the solenoid 396. Thus, in a given cycle of machine operation, the solenoid may be

energized, pulling the armature 397 upwardly as seen in FIGS. 9 and 18. As a consequence, the pawl lift lever 392 is pivoted in a counterclockwise direction about the shaft 284, against the biasing force exerted by the spring 398, moving the foot portion 402, and specifically the surface 403, of the pawl lift lever away from the roller 404 carried by the control pawl 375. During this cycle of machine operation, accordingly, the lug or extension 374 on the control pawl 375 is permitted to drop into one of the slots 372 as the control pawl is moved to the right, as seen in FIG. 18, by the action of the pawl lever operating link 384 and the pawl 379, as described hereinabove. During the latter part of the same cycle, when the operating linkage for the control pawl 375 is effective to move the pawl back toward the left, the engagement of the lug 374 in one of the slots 372 is effective to rotate the ratchet 371 in a counterclockwise direction to a new control position determined by engagement of the detent element 376 in one of the depressions 373 in the ratchet. Thus, actuation of the solenoid 396 at a predetermined time relative to the cyclic operation of the shaft 386, which controls the control pawl operating linkage, is effective to cause the pawl to drive the ratchet 371, and hence the control shaft 262, in a counterclockwise direction from one operating position to another.

To rotate the control shaft 262 in a counterclockwise direction, as described hereinabove, the solenoid 396 should be energized at a time when the control pawl 375 approaches the extreme right-hand limit of its oscillating or reciprocatory movement (FIG. 18). The solenoid can also be used to actuate the automatic sequence control mechanism 370 to drive the control shaft 262 in a clockwise direction, however, simply by changing the timing of energization of the solenoid. Thus, the solenoid 396 may be energized with the control pawl 375 approaching or approximately located at the extreme left-hand limit of its oscillating movement, this being the position illustrated for the control pawl in FIG. 18. When this is done the lug or projection 374 on the control pawl drops into one of the slots 372. The subsequent movement of the control pawl to the right, effected by the continued operation of the shaft 386, the pawl operating link 384 and the pawl lever 379, causes the pawl to drive the ratchet 371 and rotate the ratchet and the shaft 262 in a clockwise direction. Again, and as before, the solenoid 396 is held energized for a time sufficient to rotate the ratchet 371 to bring a different one of the depressions 373 into engagement with the detent member 376 and thus locate the ratchet and the control shaft 262 in a different one of the several operating conditions for the shaft. Regardless of the direction of rotation of the shaft 262, the solenoid 396 should be de-energized before the direction of movement of the control pawl 375 is reversed in order to prevent the control pawl from simply oscillating the ratchet and the shaft 262. On the other hand, since the final position of the ratchet 371 is determined primarily by engagement of the detent member 376 in the depressions 373, the timing of energization of the solenoid 396 is not so critical as to unduly limit or complicate the operation of the automatic sequence control mechanism 370.

FIG. 18A shows, in enlarged detail, the pawl 375 and the ratchet wheel 371, and illustrates the engagement of the pawl lug or tooth 374 in one of the apertures 372 of the ratchet wheel. As shown in this figure, there is a clearance 380 between the lug 374 and the aperture wall, which provides a time interval for engagement and disengagement of the tooth 374, allowing time for the lug to move into the aperture. The resulting lost motion in this drive mechanism is offset by providing for additional throw of the crank, line 384, so that the ratchet wheel 371 is moved through the full angular distance between adjacent positions of the detent 373, 376 in each operation of the mechanism 370.

Electrical Automatic Sequence Control Circuits

The electrical control circuit for the automatic sequence control mechanism 370 and the other electrically controlled components of the printing machine 30, described hereinabove, is illustrated in schematic form in FIG. 20. The location of certain cam-operated control switches, and the devices employed to actuate those switches, are illustrated in FIGS. 9 and 21. Thus, the electrical control apparatus of the automatic sequence controlled printing machine 30 may best be understood by reference to FIGS. 9, 20 and 21, taken in conjunction with the timing chart of FIG. 22.

As shown in FIG. 20, the electrical control circuit for the printing machine 30 may comprise a pair of electrical supply lines or busses 410 and 411 which may be connected to a suitable source of electrical current, such as a conventional sixty-cycle A.C. source, by means of a suitable energizing circuit which may include a main switch and the usual overload protection (not shown). The control circuit includes a drive motor control relay DMR having an operating coil 413 and including two pair of normally open contacts 414 and 415. The main drive motor 416 for the printing machine is connected across the two main busses 410 and 411 in a series circuit which includes the normally open contacts 414 of the relay DMR. One terminal 417 of the operating coil 413 is connected to the supply line 411. The other terminal 418 of the relay coil is connected in series circuit relationship with a machine start switch 419 and a machine stop switch 421 to a terminal 422. The normally open contacts 415 of the relay DMR are connected in parallel with the start switch 419 to afford a holding circuit for the relay as described more fully hereinafter.

The control circuit of FIG. 20 further includes two additional relays, a control relay CR2 and a time delay relay TDR1. The control relay CR2 comprises an operating coil 423 and a pair of normally open contacts 424; the control relay also is provided with a pair of normally closed contacts 425. The time delay relay TDR1, on the other hand, comprises an operating coil 428 and two pair of normally open contacts 426 and 427. It should be understood that the time delay relay TDR1, and the other time delay relays shown in FIG. 20 and described hereinafter, are not illustrated completely in the drawings; rather, the time delay circuits of the relays have been omitted, to a substantial extent, in FIG. 20, to avoid overcrowding and consequent confusion in the drawings. It should be understood that these time delay relays are essentially conventional in construction, and that any suitable time delay relay circuit may be employed. Each of the time delay relays is provided with one or more potentiometers or other suitable means for adjusting the delay time required for the relay to return to its normal or unactuated condition, upon de-energization, such delay-adjustment devices being well known and hence requiring no illustration.

The terminal 422 of the main start switch 419 is connected to the main bus or supply line 410 through a circuit comprising, in series therewith, the normally closed contacts 425 of the control relay CR2. The normally open contacts 427 of the time delay relay TDR1 are connected in parallel with the normally closed contacts 425 of the control relay CR2 to afford an alternate energizing circuit for the drive motor relay DMR, as explained more fully hereinafter. One terminal of the operating coil 423 of the relay CR2 is connected to the main bus 411, whereas the other terminal of the control relay coil is connected through the normally open contacts 424 of the relay to an auxiliary or secondary bus 429, the secondary bus 429 being connected back through the normally open contacts 414 of the relay DMR to the other main bus 410. The normally open contacts 426 of the time delay relay TDR1 are connected in parallel with the contacts 424 of the control relay CR2 to afford an alternate energizing circuit for the operating coil 423.

The terminal 422 in the energizing circuit of the relay DMR is also connected through a normally closed cam-controlled switch 431 to a first switch section 432 in a "manual-automatic" switch assembly 433. The ganged switch 433, which also includes three additional switch sections 434, 435, and 436, is shown in its "automatic" position, the switch section 432 being closed. In addition to the switches 431 and 432, the same circuit includes, in series, the push-button safety switch 38 in the handle 37 of the plate etch applicator and the starting switch 227 which, as described hereinabove, is actuated by movement of the handle 37 of the plate etch applicator (see FIGS. 10-12). From the switch 227, a return circuit is provided back to the common terminal 437 between the manual start switch 419 and the stop switch 421. Thus, the series circuit comprising the switches 38, 227, 431, and 432 is effectively connected in parallel with the main start switch 419 to afford an alternate starting circuit for the machine, and it is this alternate circuit which is normally used in automatically controlled operation of the machine.

The operating circuit for the printing machine 30 includes the counter 44 (see FIG. 1), which is provided with a reset coil 438 and a count coil 439 (FIG. 20). The counter 44 also includes two pair of normally open contacts 441 and 442 and a pair of normally closed contacts 443. The contact arrangement of the counter 44 is such that all of the contacts 441-443 are held open when the reset coil 438 is energized; when the reset coil is de-energized, the contacts assume the condition shown in the drawings. When the counter has completed a counting operation, the contacts 441 and 442 close, and the contacts 443 open. The contacts 441 of the counter 44 are connected in series with the operating coil 428 of the time delay relay TDR1 and with a normally-open terminal 506 of the cam control switch 431. The other side of the operating coil 428 is returned directly to the main bus 411. An alternate energizing circuit for the operating coil 428 is provided by one section 445 of a four-pole double-throw switch 446. The other sections of the switch 446 are designated by the reference numerals 447, 448, and 449, respectively. With the switch 446 in the illustrated position, the switch section 445 is effectively open circuited. The switch 446 is maintained in the illustrated counter-control position whenever it is desired to utilize the counter 44 to control operation of the printing machine. When switch 446 is moved to its alternate or system-feed position, however, closing the section 445, a bypass circuit is effectively provided, shunting the contacts 441 of the counter 44.

The two operating coils 438 and 439 of the counter 44 are connected together at the terminal 451, which in turn is connected to the main bus 411. The counter coil 439 is connected in an energizing circuit comprising an "on-off" switch 452, a counter pulse switch 46, and section 449 of the switch 446. The switch 452 is located on the main control panel 42 of the printing machine 30 (see FIG. 1), whereas the counter pulse switch 46 is located on the conveyor 35 and is actuated from its normal closed position to an open condition by each sheet of paper fed through the printing machine 30. From the switch section 449, the energizing circuit for the count coil 439 is returned to the secondary bus 429 through a paper-no paper switch 103 which is mounted on the systems feeder chute 49 of the printing machine 30 (see FIG. 6) and which is closed only when the systems chute is empty.

A further control relay CR7 is incorporated in the electrical sequence control system. The relay CR7 includes an operating coil 455, two pair of normally open contacts 456 and 457, and two pair of normally closed contacts 458 and 459. The reset coil 438 of the counter 44 is connected in series with the normally closed contacts 458 of the control relay to the secondary bus 429 of the electrical system. The reset coil is also connected in series with the normally open contacts 456 of the con-

trol relay back to one terminal 444 of the switch section 449 in the switch 446.

One of the normally closed contacts 443 of the counter 44 is connected to the operating coil 461 of a time delay relay TDR6, the other terminal of the coil 461 being connected to the main bus 411. The other of the normally closed contacts 443 is connected to both sides of a double-pole double-throw pump motor switch 462. With the switch 462 in the position illustrated in FIG. 20, a circuit is established from the normally closed contact 443 through the pump motor switch, through a sequence stop switch 463 and a sequence start switch 464, to the secondary bus 429. The other side of the pump motor switch 462 is returned to the terminal 422 of the main start switch 419 of the machine, this branch of the circuit being open with the pump motor switch 462 in the position illustrated in FIG. 20. In addition to being connected to the counter contacts 443, the pump motor switch 462 is also connected through a pair of normally open contacts 465 in the time delay relay TDR6 to the feeder solenoid 133, the other terminal of the feeder solenoid being connected to the main bus 411. The relay contacts 465 are also connected through the section 447 of the switch 446 to a vacuum valve solenoid 466, the other terminal of the solenoid 466 being returned to the main bus 411. The remaining pole 467 of the switch section 447, which is open circuited with the switch 446 in the position shown in FIG. 20, is connected to a terminal 468 of the paper-no paper switch 103, the terminal 468 being electrically connected back to the secondary bus 429 whenever there is any paper in the systems chute of the printing machine 30. One of the normally open contacts 442 of the counter 44 is connected to the "automatic" side of the switch section 434 in the manual-automatic control switch 433. The "automatic" pole 471 of the switch section 434, in turn, is connected to the energizing coil 428 of the time delay relay TDR1. This same connection, of course, affords an interconnection between the "automatic" pole 471 of the switch section 434 and the section 445 of the counter control switch 446.

The other side of the normally open contacts 442 of the counter 44 is connected in series with a cam-controlled pawl pulse switch 472 which is connected to one side of the pawl solenoid 396, the other side of the solenoid 396 being returned to the main bus 411. As shown in FIG. 9, the switch 472 is paired with a similar switch 473, the two switches 472 and 473 being actuated by a single cam 474 mounted upon a shaft 475 which rotates through a single revolution during each cycle of machine operation. The switch 472 is used to actuate the pawl solenoid 396 (FIG. 18) which drives the shaft 262 in a counterclockwise direction, as seen in FIG. 13, and thus is effective to actuate the control shaft in reverse from its final operating position ("three") back to its normal ("zero") position, as described in detail hereinbefore. The switch 473, on the other hand, is used to actuate the pawl control solenoid 396 to drive the control shaft 262 in the opposite direction from the "zero" position to the "three" position, and thus to initiate a series of machine operations, in predetermined sequence, as described in greater detail herein-after.

The pawl pulse reverse switch 472 (FIG. 20) is also connected to one pole 470 of the switch section 448 in the switch 446, this pole being open circuited with the switch 446 in the position illustrated in FIG. 20. The switch section 448 is returned to the secondary bus 429 through the paper-no paper switch 103, thereby affording an alternate energizing circuit for the pawl solenoid 396 when the switch 446 is established in its alternate operating position.

The next relay in the control circuit of FIG. 20 is the pump motor relay PMR, which is provided with an operating coil 477 and two pair of normally open contacts 478 and 479. The energizing circuit for the pump motor relay comprises the pump motor switch 462, which is

connected to one side of the coil 477, the other side of the coil being returned directly to the main bus 411. The relay contacts 479 are connected in series with the pump motor 481 between the main bus 411 and the other main bus 410 to afford an energizing circuit for the pump motor 481. The pump motor 481 is used to drive a vacuum pump (not shown) employed to operate the vacuum-type feeder 34 of the printing machine 30, as described hereinabove.

Another time delay relay TDR3 is incorporated in the control circuit of FIG. 20 and includes an operating coil 482 and two pair of normally open contacts 483 and 484. One side of the operating coil 482 is connected directly to the main bus 411. The other side of the relay coil is connected through a cam-controlled switch 485 to one of the normally closed contacts 459 of the control relay CR7. The energizing circuit for the coil 482 is completed by a circuit including in series, from the contacts 459, the plate etch applicator sequence start switch 232 (FIGS. 16-17), the section 436 of the manual-automatic control switch 433, and the secondary bus 429.

The cam-controlled switch 485 is a single-pole double-throw device, the normally open terminal 486 of the switch being connected to one of the normally open contacts 483 of the time delay relay TDR3. The terminal 486 is also connected to one of the normally open contacts 484 of the time delay relay. The other contact of the contact pair 484 is connected to the two blanket cleaner solenoids 341 and 344 described hereinabove in connection with the blanket cleaner 41 (FIG. 1), the two blanket cleaner solenoids being returned to the main bus 411. Thus, the normally open contacts 484 of the relay TDR3 are connected in an energizing circuit for the blanket cleaner solenoids. An alternate energizing circuit is provided through a manual blanket cleaner switch 487 which connects two solenoids 341 and 344 back to the secondary bus 429.

The connection from the terminal 486 of the switch 485 to the normally open contacts 483 of the relay TDR3 is utilized to incorporate contacts 483 in the energizing circuit of the operating coil 488 of the time delay relay TDR4. Thus, one terminal of the coil 488 is connected to one of the relay contacts 483, and the other terminal of the coil is returned to the main bus 411. The relay TDR4 is provided with a pair of normally closed contacts 489 which are connected in series with the pawl pulse forward switch 473 between the pawl control solenoid 396 and the normally closed contacts 459 of the control relay CR7.

One additional relay TDR5, which is also a time delay relay, is incorporated in the automatic sequence control circuit of FIG. 20. The relay TDR5 is provided with an operating coil 491 and a pair of normally closed contacts 492. One side of the operating coil 491 is connected directly to the main bus 411. The other side of the coil is connected to the normally closed pole 493 of a cam-operated single-pole double-throw switch 494. The common terminal 495 of the switch 494 is connected back to the sequence start switch 232 in the plate etch applicator. The switch terminal 495 is also connected to the secondary bus 429 through a circuit including, in series, the sequence start switch 464. A third circuit is also provided, connecting the switch terminal 495 to the secondary bus 429, this third circuit including, in series, therewith, the normally open contacts 478 of the pump motor relay PMR.

The normally open terminal 497 of the switch 494 is connected to one of the normally closed contacts 492 of the time delay relay TDR5. The other side of the contact pair 492 is connected back to the sequence start switch 232 of the plate etch applicator through a circuit including, in series therewith, the normally open contacts 457 of the control relay CR7. The contacts 457 are also incorporated in series in the energizing circuit for the operating coil 455 of the relay CR7, this circuit also

including, in series therewith, the "automatic" portion of the switch section 435 in the manual-automatic control switch 433. A direct return circuit is provided between the coil 455 and the main bus 411. The "manual" terminal 498 of the switch section 435 is utilized to provide an alternate energizing circuit for the coil 455, the terminal 498 being connected back to the terminal 418 of the stop switch 421.

The three cam-controlled switches 431, 485, and 494, each of which constitutes a controlling factor in the operation of the circuit illustrated in FIG. 20, are all operated from a single cam 501 which is mounted upon the main control shaft 262, as best shown in FIG. 21. As illustrated in that figure, the three switches are mounted upon a mounting plate 502 that is supported upon a shaft 262, one end 503 of the plate 502 being engaged with a guide member 504 mounted on a shaft 284 to hold the mounting plate in fixed position. Each of the switches is provided with a cam follower roller which engages the periphery of the cam 501. The switch 431 is maintained in the position illustrated in FIG. 20, by the action of the cam 501, only when the shaft 262 is in its initial or "zero" position (see FIG. 13). With the shaft 262 in any of its other operating positions, the switch 431 is actuated to its alternate operating condition from that shown in FIG. 20. The switch 485 is maintained in the position illustrated in FIG. 20, by the action of the cam 501 (FIG. 21) except when the shaft 262 is in its "two" position, at which time the switch 485 closes upon the terminal 486. The switch 494, on the other hand, remains in the operating condition illustrated in FIG. 20 until the shaft 262 reaches its final or "three" position.

The control circuit of FIG. 20 is shown conditioned for automatic operation of the printing machine 30. With the circuit conditioned as shown in this figure, the operator starts the printing machine by pressing the push-button 38 in the handle 37 of the plate etch applicator 39. The handle 37 is pulled downwardly by the operator, as described hereinabove, closing the switch 227. With both of the switches 227 and 38 closed, the drive motor relay DMR is energized through a circuit comprising, in series, the relay operating coil 413, the stop switch 421 (normally closed), the switch 227, the switch 38, section 432 of the manual-automatic switch 433, the cam-controlled switch 431 (closed at the "zero" position of the control shaft 262), and the normally closed contacts 425 of the control relay CR2. If, for some reason, the printing machine is to be started without operating the plate etch applicator 39, the drive motor relay DMR can be energized through an alternate circuit comprising the operating coil 413, the stop switch 421, the machine start switch 419, and the contacts 425 of the control relay CR2 simply by closing the start switch 419 momentarily. As soon as the relay DMR is energized, the normally closed contacts 415 are closed, setting up a holding circuit for the relay through the stop switch 421, the contacts 415, and the normally closed contacts 425 of the control relay CR2. Moreover, the contacts 414 of the relay DMR are also closed, thereby energizing the main drive motor 416 of the printing machine. The drive motor 416 is connected, through suitable mechanical drive linkages and the like, to the main operating shafts of the printing machine and initiates cyclic operation of the major printing machine components in conventional manner. When the machine is started, the reset coil 438 of the counter 44 is also energized by a circuit starting with the main bus 411 and including, in series, the normally closed contacts 458 of the control relay CR7, and the secondary bus 429, which is now effectively connected to the other main bus 410 through the contacts 414 of the DMR relay. With the reset coil 438 energized, the contacts 441 and 442 remain open and the contacts 443 are held open, as described hereinabove.

As noted hereinabove, the plate-etching operation is controlled manually by the machine operator. When this

operation has been completed, and the control handle 37 of the plate-etch applicator is returned to its normal position, the sequence start switch 232 is closed, as described hereinbefore. When the switch 232 closes, the operating coil 477 of the pump motor relay PMR is energized through a circuit starting at the main bus 411 and including, in series with the coil 477, the pump motor switch 462, the sequence stop switch 463, the sequence start switch 232, section 436 of the manual-automatic control switch 433, and the secondary bus 429. Alternatively, if the machine is to be started without using the plate-etch applicator, the pump motor relay PMR can be energized through a parallel circuit comprising the pump motor switch 462, the stop switch 463, and the sequence start switch 464. As soon as the relay PMR is energized, the contacts 479 close, thereby affording an energizing circuit for the pump motor 481. With the pump in operation, a vacuum is built up to provide for operation of the sheet feeder 34, as described hereinbefore. The contacts 478 of the pump motor relay PMR are also closed, affording a holding circuit for the pump motor relay comprising, in series, the bus 411, the operating coil 477, the pump motor switch 462, the sequence stop switch 463, the closed contacts 478, and the secondary bus 429.

The closing of the sequence start switch 232, and the subsequent closing of the contacts 478 of the pump motor relay, are also effective to energize the time delay relay TDR3 through a series circuit comprising the cam-controlled switch 485 and the operating coil 482 of the relay. The normally closed contacts 459 of the control relay CR7 also being included in this circuit. At the same time, the time delay relay TDR5 is also energized through a circuit comprising, in series, the main bus 411, the operating coil 491 of the relay, the cam-controlled switch 494, and the contacts 478 of the pump motor relay, which are now closed. Actuation of the time delay relay TDR5 is effective to open the contacts 492 of that relay, for a purpose to be described hereinafter. The two pair of normally open contacts of the relay TDR3, on the other hand, are now closed. Furthermore, with the holding circuit established for the pump motor relay PMR, the printing machine control circuit is conditioned to actuate the control mechanism 370 (FIGS. 18 and 19) to rotate the main control shaft 262 from its "zero" to its "one" position, and this action is effected during the next cycle of machine operation.

During the next cycle of machine operation, after actuation of the pump motor relay PMR, the pawl pulse forward switch 473 is closed for a relatively short interval; it will be recalled that this switch is closed during the same interval in each cycle of machine operation. The pump motor relay PMR is energized, and since the time delay relay TDR4 is not yet energized, the pawl control solenoid 396 is energized through a circuit including, in series, the bus 411, the solenoid 396, the pawl pulse forward switch 473, the normally closed contacts 489 of the relay TDR4, the normally closed contacts 459 of the control relay CR7, the contacts 478 of the pump motor relay, and the secondary bus 429. Energization of the pawl solenoid 396 is effective to actuate the automatic sequence control mechanism 370, as described hereinabove, to drive the main control shaft 262 from its "zero" to "one" position, initiating application of a repellent solution to the master cylinder 32 of the printing machine 30 as described hereinabove. On the very next cycle of machine operation, the pawl pulse forward switch 473 again closes, again energizing the pawl solenoid 396 and operating as before to advance the main control shaft 262 from its "one" position to its "two" position.

When the control shaft 262 moves to its "two" position, the cam 501 (see FIG. 21) actuates the switch 485, opening the energizing circuit to the time delay relay TDR3 (FIG. 20). The contacts 483 and 484 remain closed for a fixed period of time, however, due to the

time delay action of the relay. Consequently, the time delay relay TDR4 is energized through an operating circuit comprising, in series, the main bus 411, the operating coil 488 of the relay TDR4, the contacts 483 of the relay TDR3, the switch 485, contacts 459 of the control relay CR7, the contacts 478 of the pump motor relay PMR, and the secondary bus 429. With the time delay relay TDR4 energized, the contacts 489 are opened, thereby opening the operating circuit for the pawl solenoid 396 through the pawl pulse forward switch 473. Accordingly, and as long as the contacts 489 remain open, the pawl control solenoid 396 cannot be energized through the switch 473, despite the fact that the switch 473 is closed during every cycle of machine operation, with the result that the main control shaft 262 remains in its "two" position. This position of the main control shaft is maintained for a substantial number of cycles of machine operation, as described more fully hereinafter in connection with FIG. 22.

Rotation of the main control shaft 262 to its "two" position is also effective to energize the two blanket cleaner solenoids 341 and 344 through an operating circuit comprising, in series, the main bus 411, the solenoids, the contacts 484 of the time delay relay TDR3 (these contacts are still closed, as noted hereinabove), the switch 485, the contacts 459 of the control relay CR7, the contacts 478 of the pump motor relay PMR, and the secondary bus 429. Consequently, the blanket cleaner 41 is actuated, as described hereinabove, applying a cleaning solution to the blanket cylinder 300 of the printing machine 30. It should also be noted that the movement of the main control shaft 262 from its "zero" position is effective to actuate the cam-controlled switch 431 from its initial position, illustrated in FIG. 20, to its alternate position. Actuation of this switch, however, has no immediate effect upon operation of the other circuit components.

After a cleaning solution has been applied to the blanket cylinder for a predetermined number of cycles, it is necessary to allow some time for drying of the blanket. As noted hereinabove, the time delay relay TDR3 has been effectively de-energized by actuation of the switch 485 to its alternate position in engagement with the contact 486. After several cycles of machine operation, determined by the construction and setting of the time delay relay TDR3, the contacts 483 and 484 of the relay open. Opening of the contacts 484 is effective to de-energize the blanket cleaner solenoids 341 and 344, interrupting application of a cleaning solution to the blanket of the offset printing machine. At the same time, the operating circuit for the time delay relay TDR4 is opened by the opening of the contacts 483. This has no immediate effect upon the operating condition of the contacts 489 of the time delay relay TDR4, however; the contacts 489 remain open for several cycles of machine operation. During this period, accordingly, the pawl pulse circuit comprising the switch 473 remains open, so that the control shaft 262 cannot be advanced to its final operating position. The time delay interval of the relay TDR4 is adjusted to provide sufficient time for adequate drying of the blanket cylinder.

The next operational step carried out by the control circuit of FIG. 20 is directed to imaging of the blanket on the blanket cylinder. It will be recalled that rotation of the main control shaft 262 to its "two" position is effective to initiate inking of the master cylinder 32 through the ink-control linkage described hereinbefore, particularly in connection with FIGS. 13 and 14. Thus, inking is accomplished during a number of machine cycles before transfer of the ink image to the blanket cylinder is initiated. This allows sufficient time to build up an adequate ink image on the master.

After a given time interval established by the setting of the time delay relay TDR4, the contacts 489 of this relay are again closed, establishing an operating circuit

for the pawl solenoid 396 through the pawl pulse forward switch 473. When this occurs, the pawl solenoid is again energized, as described hereinabove, advancing the control shaft 262 to its "three" position by actuating the automatic sequence control mechanism 370 (see FIGS. 18 and 19) for the third time since initiation of machine operation. With the master control shaft 262 in this final operating position, the switch 431 remains in engagement with its alternate terminal 506, the switch 485 is returned to its original position, as shown in FIG. 20, and the switch 494 is actuated to engage the terminal 497, thereby opening the operating circuit to the coil 491 of the time delay relay TDR5. Actuation of the switch 485 to its original position is effective to again energize the operating coil 482 of the time delay relay TDR3, as described hereinabove, again closing the contacts 483 and 484. De-energization of the operating coil of the time delay relay TDR5, however, does not immediately permit the contacts 482 to close, since this relay also delays its operation by a predetermined interval, preferably equal to one or more machine cycles. The movement of the control shaft 262 to its final position is effective to bring the master cylinder 32 into engagement with the blanket cylinder 300, as described hereinbefore, through the linkage described particularly in connection with FIGS. 13 and 13A.

With the circuit of FIG. 20 conditioned as outlined immediately hereinabove, and with the control shaft 262 of the printing machine in its final or "three" position, the printing machine 30 is conditioned to initiate a printing and counting operation upon closing of the contacts 492 of the time delay relay TDR5. When the contacts 492 close, the control relay CR7 is energized through an operating circuit comprising, in series, the main bus 411, the relay operating coil 455, the switch section 435 of the manual-automatic switch 433, the relay contacts 492 of the time delay relay TDR5, the switch 494 (now closed on contact 497), the contacts 478 of the relay PMR, and the secondary bus 429. When the relay CR7 is energized, the contacts 456 and 457 close, and the contacts 458 and 459 open. The closing of the contacts 457 provides a holding circuit in parallel with the switch 494, so that the relay CR7 remains energized even though the switch 494 may subsequently be opened, as described herein-after.

The opening of the contacts 459 of the control relay CR7 effectively opens the operating circuit to the solenoid 396 through the pawl pulse forward switch 473. Consequently, although the pawl pulse forward switch is closed during each succeeding cycle of machine operation, the pawl solenoid 396 is not energized through this switch. Accordingly, the automatic sequence control mechanism 370 (FIGS. 18 and 19) cannot be actuated to drive the main control shaft 262 beyond its "three" position. Consequently, the switch 494 remains closed on the terminal 497, the switch 485 remains in the position illustrated in FIG. 20, and the switch 431 remains closed on the terminal 506. The opening of the contacts 458 of the relay CR7 effectively opens the original operating circuit for the reset coil 438 of the counter 44, thereby de-energizing the reset coil and permitting the counter to carry out a counting operation. The closing of the contacts 456 of the relay CR7 does not establish an alternate energizing circuit for the reset coil, since the circuit is open at the switch section 449 of the ganged control switch 446. Because the reset coil is de-energized, the contacts 441-443 of the counter 44 all revert to the original condition illustrated in FIG. 20.

Since the contacts 443 of the counter 44 are now closed, the time delay relay TDR6 is energized through an operating circuit comprising, in series, the main bus 411, the relay operating coil 461, the counter contacts 443, the pump motor switch 462, the sequence stop switch 463, the contacts 478 of the relay PMR, and the secondary bus 429. Accordingly, the relay contacts 465 of the time

delay relay TDR6 are closed. Consequently, the feeder solenoid 133 is provided with an operating circuit through the contacts 465 of the relay TDR6 and the pump motor switch 462 as described hereinabove. The vacuum valve 466 is also energized through a similar circuit which also includes the switch section 447 of the ganged control switch 446. Thus, operation of the feeder 34 is initiated and paper is fed through the printing machine 30 as described hereinabove.

Paper may be fed through the printing machine 30 both from the systems chute 49, and subsequently, from the main stack 37 (see FIGS. 4-8). As long as there are any sheets to be fed in the systems chute 37, the paper-no paper switch 103 remains closed upon the terminal 468. Consequently, the count coil 439 of the counter 44 cannot be energized, and the counter does not count the sheets fed through the machine, as long as the sheets are fed from the systems chute. When the last sheet of paper leaves the systems chute, however, the switch 103 returns to its normal position as indicated in FIG. 20. Thereafter, during each cycle of the machine in which a sheet of paper is fed into the printing machine, the counter pulse switch 46 operates to apply a pulse to the count coil 439 of the counter. The printing machine 30 continues to operate without change, printing and counting each sheet fed through the machine, until a predetermined number of sheets have been fed through the machine, this number being determined by the setting of the counter 44. The setting of the counter 44 may be adjusted for each run of the machine by the machine operator.

When the counter 44 has run out, the counter operates to close the contacts 441 and 442 and to open the contacts 443. The opening of the contacts 443 immediately de-energizes the time delay relay TDR6. The time delay action of the relay, however, holds the contacts 465 closed for a relatively short interval in order to maintain a complete operating circuit to the feeder solenoid 133 and the vacuum solenoid 466 long enough to permit completion of one or more feeding cycles. Usually, the time delay interval for the relay TDR6 is made equal to two or more machine cycles, although it may be less than one cycle or even somewhat longer than two cycles if desired.

Actuation of the counter 44 is also effective to energize the time delay relay TDR1. The operating circuit for the time delay relay includes, in series, a main bus 411, the operating coil 428 of the relay, the contacts 441 of the counter 44 (these contacts are now closed), the switch 431 (now closed on contact 506), the contact 425 of the control relay CR2, and the other main bus 410. With an operating circuit thus completed to the coil 428, the contacts 426 and 427 of the relay TDR1 are closed. Accordingly, the control relay CR2 is now energized through an operating circuit comprising, in series, the main bus 411, the operating coil 423 of the control relay, the contacts 426 of the relay TDR1, and the secondary bus 429. Accordingly, the contacts 424 are closed and the contacts 425 are opened in the control relay CR2. Opening of the contacts 425 in the relay CR2 does not de-energize the drive motor relay DMR, since an alternate energizing circuit for this relay is now provided through the contacts 427 of the time delay relay TDR1. The closing of the contacts 424 in the relay CR2 affords a holding circuit for this relay.

The closing of the contacts 441 and 442 in the counter 44 is also effective to set up an energizing circuit for the pawl control solenoid 396. The operating circuit for the pawl solenoid 396 includes, in this instance, the main bus 411, the solenoid 396, the pawl pulse reverse switch 472, the counter contacts 442, section 434 of the manual-automatic switch 433, the counter contacts 441, the switch 431, the contacts 427 of relay TDR1 (now closed), and the other main bus 410. Accordingly, in the next cycle of operation, when the pawl pulse reverse switch 472 is closed, the pawl solenoid 396 is energized and is effective

tive to actuate the automatic sequence control mechanism 370. As noted hereinabove, the timing for closing of the reverse switch 472 is substantially different from that for the forward switch 473. In this instance, the pawl control solenoid 396 is energized at a time such that the automatic sequence control mechanism is effective to rotate the main control shaft 262 back from its "three" position to its "two" position.

When the main control shaft 262 is rotated to its "two" position, as described immediately hereinabove, the switch 494 is returned to its initial operating condition as illustrated in FIG. 20, again engaging the contact 493 and opening the circuit to the contact 497. Consequently, the time delay relay TDR5 is again energized, opening the contacts 492. Opening of these contacts is not effective to de-energize the control relay CR7, however, because the control relay is provided with its own holding circuit through the contacts 457.

The cam-controlled switch 485 is also actuated to its "two" position, engaging the contact 486. This action does not establish any new operating circuits in the control arrangement, however, since the time delay relay TDR3 has not been energized during the time immediately preceding actuation of the switch 485 and the relay contacts 483 and 484 are both open. The operating condition of the switch 431, of course, does not change, and the switch remains in engagement with the contact 506.

During each of the next two cycles of machine operation, the pawl solenoid 396 is again energized, as described hereinabove, actuating the automatic sequence control mechanism 370 and driving the control shaft 262 first to its "one" position and, in the next cycle, to its "zero" position. When the main control shaft reaches its "zero" position, the switches 431, 485, and 494 are all established in their original operating conditions as illustrated in FIG. 20. The closing of the switch 485 to its original condition, however, does not energize the time delay relay TDR3, since the relay CR7 is still energized and the contacts 459 are open. The return of the switch 431 to its original position, on the other hand, effectively opens the circuit to the terminal 506 and thereby opens the operating circuit to the time delay relay TDR1. Moreover, this action is also effective to open the operating circuit through the pawl pulse reverse switch 472, so that the pawl solenoid 396 cannot again be energized through this circuit. The time delay relay TDR1 does not operate immediately, however, but rather maintains the contacts 426 and 427 closed for a predetermined but relatively short interval. Subsequently, however, the contacts of the time delay relay TDR1 open, thereby effectively opening the operating circuit to the coil 413 of the drive motor relay DMR. As soon as the relay DMR is de-energized, the entire machine stops, being returned completely to the initial operating condition. The next operating run of the machine, therefore, is initiated by the operator as described hereinabove, the printing machine operating automatically to carry out the full sequence of automatic steps set forth in detail hereinbefore.

Although separate switches are shown and described for the pawl pulse switches 472, 473, these can obviously be replaced by one single-pole double-throw switch, since the two switches have a common terminal and are closed at different times during the operating cycle of the machine. The illustration of two switches has been used only to facilitate presentation of this part of the control circuit, since explanation of the operation of the energizing circuit for the pawl solenoid 396 is simpler and more easily understandable on this basis.

Automatic Sequence Timing

FIG. 22 illustrates a typical timing cycle for automatic operation of the printing machine 30, and also affords an illustration of the variable time settings which may be effected for a number of different operations. In the timing chart of FIG. 22, the shaded portions of the bar

chart represent the normal interval, in machine cycles, for each operation. Typical variations which may be effected by modification of the time delay characteristics of the various relays in the circuit of FIG. 20 are shown by the unshaded portions of the bar chart, as is the adjustable setting for the counter 44. In the timing chart, the various operations are correlated with the corresponding operational positions of the main control shaft 262.

As shown in FIG. 22, the plate-etching operation is effected with the shaft 262 in its initial or "zero" position. No definite timing for this operation is shown, in terms of machine cycles, since this operation is left under control of the machine operator, being carried out manually by means of the operating handle 37 of the plate-etch applicator 36 (see FIG. 1). Upon completion of the plate-etch operation, the control shaft 262 is advanced to its "one" position, at which the application of repellent solution to the master cylinder is initiated.

One cycle after initiation of application of repellent solution to the master, the control shaft 262 is moved to its "two" position, thereby initiating inking of the master on the master cylinder. In the next succeeding cycle of operation, the blanket cleaner 41 is actuated to apply a cleaning solution to the blanket cylinder, an operation which normally requires a number of cycles of machine operation. As indicated in the timing chart of FIG. 22, this operation can be adjusted by adjusting the time delay interval afforded by one of the relays of the control circuit of FIG. 20; in this instance, the relay to be adjusted is the time delay relay TDR3.

The blanket drying operation is also effected with the control shaft 262 in its "two" position, and this operation is also subject to adjustment over a range comprising a number of machine cycles. Thus, and as shown in FIG. 22, the blanket drying operation can be adjusted over a range of approximately eleven cycles, the effective operating range being determined by adjustment of the time delay interval afforded by the relay TDR4.

The blanket imaging operation is effected upon movement of the control shaft 262 to its "three" position. It is desirable to build up a substantial ink image on the blanket before the feeder is started and initiates the printing operation. Adjustment of the time delay interval controlling the blanket imaging operation is effected by adjustment of the time delay relay TDR5. Control of the number of sheets fed through the printing machine, on the other hand, is effected by adjustment of the counter 44, provided the machine is conditioned for control by the counter as described hereinabove. If the switch 446 (FIG. 20) is set for system feed operation, however, the printing operation is controlled by the paper-no paper switch 103 instead of the counter 44. The printing operation takes place, of course, with the shaft 262 in the "three" position.

Near the end of the printing operation, the control shaft 262 is rotated back to its "two" position. As described hereinabove, this operation takes place before interruption of the paper feed, the time delay being controlled by adjustment of the relay TDR6. The resulting blanket run-down operation is desirable because it reduces the amount of ink present on the blanket and therefore substantially facilitates the blanket cleaning operation in the subsequent use of the printing machine 30. The material printed during the blanket run-down stage of operation is not adversely affected by the fact that blanket imaging has been stopped, since sufficient ink remains on the blanket to complete a few printing operations.

Thereafter, the control shaft 262 is returned to its "one" position, interrupting the feeding of sheets through the printing machine and also interrupting inking of the master on the master cylinder 32 (see FIG. 1). In the next cycle of machine operation, the control shaft 262 is returned to its "zero" position, thereby interrupting the application of the repellent solution to the master

cylinder. The machine is then shut off, there being an adjustable interval between the return of the control shaft 262 to its original or "zero" position and final interruption of machine operation. This final adjustable delay interval is provided in order to afford a means for accurately controlling the ultimate position of the master cylinder upon interruption of operation of the machine, thereby assuring accurate and effective initiation of all operations the next time the machine is placed in operation.

FIG. 23 illustrates a typical time delay relay structure which may be employed to achieve the adjustable time relationships shown in FIG. 22. Specifically, FIG. 23 shows the construction of the relay TDR5 used to control the blanket-imaging operation. The operating coil 491 of the relay is connected in series with a diode 521 between the main bus 411 and the terminal 493 of the switch 494. A capacitor 522 is connected in parallel with the coil 491 to afford the charge storage necessary to delay operation. A fixed resistor 523 is connected in series with a variable resistor or potentiometer 524, the resistance circuit being connected in shunt relation to the coil 491 and the capacitor 522.

The time delay in return of the relay TDR5 to its original operating condition upon being de-energized (in this instance the re-closing of the normally closed contacts 492) is adjusted by adjusting the potentiometer 524 to change the resistance of the discharge path for the capacitor 522. The internal resistance of the coil 491 must be substantial, of course; it cannot represent a short circuit for direct current. If desired, the capacitor 522 may also be made adjustable to afford a further means for varying the time delay interval of the relay. If two such adjustments are provided, it may be desirable to construct one to provide a gross adjustment, the other a fine adjustment of the time interval.

Modifications of Automatic Sequence Control

The preceding operational description of the automatic sequence control circuit of FIG. 20 is based upon substantially complete automatic control of all operations of the machine, other than the application of plate-etch solution to the master cylinder. To achieve such automatic operation, with shut-off of the machine controlled by the counter 44, it is necessary that the switches 433, 446, 452, and 462 be in the operating position illustrated in the drawing. On the other hand, each of these switches may be actuated to an alternate position to change the mode of operation of the printing machine 30. Thus, by actuating these particular switches, the printing machine 30 may be conditioned for varying degrees of automatic and manual control.

Perhaps the simplest change which may be made in the operating condition of the circuit of FIG. 20 is effected by actuation of the counter on-off switch 452. This particular switch may be moved to its alternate operating position, thereby opening the operating circuit to the count coil 439 in the counter 44. When this is done, the counter is effectively rendered inactive and cannot initiate shut down of the printing machine as described hereinabove. Accordingly, if the switch is thrown to its "off" position, it is necessary for the operator to stop the operation of the printing machine by using the sequence stop switch 463. When this is done, the pump motor relay PMR is de-energized, and the relay TDR6 is also de-energized, with the result that feeding of paper through the printing machine is interrupted. The control relay CR7 also is de-energized, due to the opening of the contacts 478 in the pump motor relay PMR. The operating circuit of the drive motor relay DMR, however, does not become de-energized by operation of the sequence stop switch 463. Hence, in order to interrupt machine operation completely, the operator may actuate the stop switch 421 to open the operating circuit to the relay DMR.

A more substantial change may be effected by actuation of the ganged control switch 446 to its alternate position. In the position illustrated in FIG. 20, the switch 446 conditions the operating circuit of the machine for control by the counter 44. When actuated with alternate position, however, the switch 446 conditions the machine for automatic control in accordance with the presence or absence of paper in the systems chute 49 of the machine.

Thus, actuation of the switch 446 to its system feed position connects the operating coil 428 of the relay TDR1 directly to the terminal 506 of the cam-controlled switch 431, bypassing the contacts 441 of the counter 44 completely. Accordingly, energization of the relay TDR1 is now made independent of the counter, and the counter does not control operation of this relay. The switch section 447, on the other hand, when actuated to its second or system feed position, connects the vacuum valve solenoid 466 directly to the terminal 468 of the paper-no paper switch 103. Consequently, the vacuum valve solenoid can be energized only when there is paper in the systems chute 49, so that it is no longer possible to feed paper from the main stack 37 of the feeder 34 (see FIGS. 4-8). Accordingly, this portion of the paper-feeding apparatus is rendered completely independent of control by the counter 44.

Actuation of the switch section 448 of the switch 446 to its alternate or system feed position is effective to establish an alternate energizing circuit for the pawl pulse reverse switch 472, this alternate circuit being independent of the contacts 442 of the counter 44. Thus, the pawl pulse reverse switch 472 is now connected in a circuit through the switch section 448 to the paper-no paper switch 103, and is energized when the switch 103 reverts to its normal position, as illustrated in FIG. 20, upon emptying of the systems chute 49. The switch section 449, on the other hand, when actuated to its system feed position from that shown in FIG. 20, is effective to establish an energizing or operating circuit for the reset coil 438 of the counter 44, this circuit including, in series therewith, the paper-no paper switch 103. Consequently, when the systems chute 49 is emptied of paper, and the switch 103 reverts to the no-paper position illustrated in FIG. 20, the reset coil 438 of the counter is energized, with the result that the contacts 443 are open. Opening of the contacts 443 is effective to de-energize the time delay relay TDR6 and hence to open the operating circuit of the feeder solenoid 133, thereby de-energizing this portion of the paper-feed mechanism. It is thus seen that the switch 446, when moved to its system feed position, permits substantial automatic operation of the printing machine 30, with interruption of machine operation being controlled by the paper-no paper switch 103 instead of the counter 44.

The pump motor switch 462 provides for independent control of the paper feeding operation in the printing machine 30. When this switch is actuated to its alternate position, from that shown in FIG. 20, the pump motor relay PMR is energized directly through an operating circuit including the switch 462, the normally closed contacts 425 of the relay CR2, and the main bus 410. Similarly, the time delay relay TDR6 is energized through substantially the same circuit, the normally closed contacts 443 of the counter 44 being included in the series with the operating circuit of the coil 461 of this relay. Actuation of the relay TDR6 is effective to close the contacts 465, establishing an operating circuit for the feeder solenoid 133 through these contacts and the switch 462. Similarly, the vacuum valve solenoid 466 is energized through substantially the same circuit as the feeder solenoid 133, this circuit also including the switch section 447 of the switch 446. Thus, the pump motor switch 462 effectively provides for feeding of paper through the machine, independently of the automatic sequence control previously described.

The switch 433, when actuated from the "automatic" position illustrated in FIG. 22 the alternate "manual" position, effects a substantially complete change in the mode of operation of the printing machine 30. When the switch 433 is actuated to its "manual" position, automatic operation of the printing machine 30 is no longer possible. Instead, it is now necessary for the machine operator to control virtually all of the machine operations, in essentially the same manner as with a conventional manual-operated offset duplicating machine.

Thus, actuation of the switch section 432 from its "automatic" to its "manual" position is effective to open the machine starting circuit through the switches 38 and 227 of the plate-etch applicator. Consequently, under these conditions the machine can only be started by actuation of the manual pushbutton start switch 419. Actuation of the switch section 434 to its alternate position, on the other hand, is effective to open the normal energizing circuit for the pawl pulse reverse switch 472, this being the circuit through the contacts 442 of the counter 44. It is still possible to energize the pawl solenoid 396 through the reverse switch 472 if the switch 446 is in its system feed position rather than the counter control position in which the switch is shown in FIG. 20.

Actuation of the switch section 435 as of the manual-automatic switch 433 to the "manual" position is effective to energize the control relay CR7 upon the initiation of machine operation, through essentially the same circuit as the DMR relay, since closing of the switch section 435 to the contact 498 connects the operating coil 455 of the control relay CR7 directly back to the terminal 418 on the relay DMR. With the control relay CR7 energized immediately upon starting of the machine, it is not possible to energize the time delay relays TDR3, TDR4 or TDR5 in the manner described hereinabove to carry out the necessary sequence of electrical operations for actuation of the pawl solenoid 396 to drive the machine from its "zero" to its "three" control shaft position. Furthermore, it is no longer possible to energize the time delay relay TDR6 in accordance with the automatic sequence described hereinbefore. Instead, it is now necessary to use the pump motor switch 462 to initiate the complete feeder operation.

Actuation of the switch section 436 to the alternate "manual" position effectively opens the normal operating circuit through the sequence start switch 232 of the plate-etch applicator. Consequently, the pawl control solenoid 396 cannot be energized, in the manner described hereinbefore, through the pawl pulse forward switch 473. Accordingly, the normal operating circuit for the actuation of the pawl solenoid 396 to advance the control shaft 262 through its various control positions is effectively and positively disabled. Thus, it is now necessary for the operator to utilize the manual control handle 43 (see FIG. 1) to advance the control shaft 262 through its positions "one" (repellent application), "two" (inking of master cylinder and cleaning and drying of blanket cylinder) and "three" (blanket imaging and printing).

We claim:

1. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate operating position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position and back through said intermediate position to said initial position; a control mechanism

for moving said main control shaft between the aforesaid positions, comprising a notched wheel mounted on said shaft, a drive pawl engageable with the notches in said wheel, drive means for continuously reciprocating said drive pawl, a pawl control member for normally holding said drive pawl out of engagement with said wheel, and an electrically actuated control device operatively connected to said pawl control member for actuating said control member to permit said drive pawl to engage said wheel in driving relationship; and electrical control means, connected to said control device, for energizing said control device in predetermined time relation to reciprocal movement of said pawl to permit said pawl to drive said wheel and said shaft toward said final position at the beginning of a printing operation and for energizing said control device in a different time relation to said reciprocal movement to permit said pawl to drive said wheel and said shaft back toward said initial position at the end of a printing operation.

2. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, rotatably movable between an initial position, at least one intermediate operating position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position and back through said intermediate position to said initial position; a control mechanism for moving said main control shaft between the aforesaid positions, comprising a notched ratchet wheel mounted on said shaft, a drive pawl engageable with said ratchet wheel, drive means for continuously reciprocating said drive pawl, a pawl control member for normally holding said drive pawl out of engagement with said ratchet wheel, and an electrically actuated control device operatively connected to said pawl control member for actuating said control member to permit said drive pawl to engage said ratchet wheel in driving relationship; electrical control means, connected to said control device, for energizing said control device in predetermined time relation to reciprocal movement of said pawl to permit said pawl to drive said ratchet wheel and said shaft toward said final position at the beginning of a printing operation and for energizing said control device in a different time relation to said reciprocal movement to permit said pawl to drive said ratchet wheel and said shaft back toward said initial position at the end of a printing operation; and means, comprising a single manual operating member connected to said shaft, for manually controlling the movement of said control shaft to the exclusion of said control mechanism and said electrical control means.

3. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate operating position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; a control mechanism for moving said main control shaft between the aforesaid positions, comprising a notched ratchet wheel mounted on said shaft, a drive pawl engageable with said ratchet wheel, drive means for continuously reciprocating said

drive pawl, a pawl control member for normally holding said drive pawl out of engagement with said ratchet wheel, and an electrically actuated control device operatively connected to said pawl control member for actuating said control member to permit said drive pawl to engage said ratchet wheel in driving relationship; electrical control means, connected to said control device, for energizing said control device in predetermined time relation to reciprocal movement of said pawl to permit said pawl to drive said wheel and said shaft toward said final position at the beginning of a printing operation and for energizing said control device in a different time relation to said reciprocal movement to permit said pawl to drive said ratchet wheel and said shaft back toward said initial position at the end of a printing operation; and at least one time delay device, incorporated in said control means, for maintaining said control shaft in said intermediate position for a predetermined time interval before advancement to said final position, said device being ineffective to delay return movement of said shaft to said initial position.

4. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, and first, second, and third operating positions; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means; means operatively connecting each of the aforesaid means to said main control shaft to actuate said repellent applicator means whenever said main control shaft is in any of said three operating positions, to actuate said inking means whenever said shaft is in said second and third operating positions, to actuate said blanket cleaner means only when said shaft is in said second operating position, and to actuate said sheet feeder in response to movement of said shaft to said third operating position; a control mechanism for moving said main control shaft between the aforesaid positions, comprising a notched wheel mounted on said shaft, a drive pawl engageable with said wheel, drive means for continuously reciprocating said drive pawl, a pawl control member for normally holding said drive pawl out of engagement with said wheel, and an electrically actuated control device operatively connected to said pawl control member for actuating said control member to permit said drive pawl to engage said wheel in driving relationship; and electrical control means, connected to said control device, for energizing said control device in predetermined time relation to reciprocal movement of said pawl to permit said pawl to drive said wheel and said shaft toward said final position at the beginning of a printing operation and for energizing said control device in a different time relation to said reciprocal movement to permit said pawl to drive said wheel and said shaft back toward said initial position at the end of a printing operation.

5. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a rotatable main control shaft; detent means for establishing an initial position, at least one intermediate operating position, and a final operating position for said shaft; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; a control mechanism for moving said main control shaft between the aforesaid positions, comprising a notched ratchet wheel mounted on said shaft, a drive

pawl engageable with said ratchet wheel, drive means for continuously reciprocating said drive pawl, a pivotal pawl control lever normally holding said drive pawl out of engagement with said ratchet wheel, and a solenoid operatively connected to said pawl control lever for pivoting said control lever out of engagement with said drive pawl to permit said drive pawl to engage said ratchet wheel in driving relationship; and electrical control means connected to said control device, for energizing said solenoid in predetermined time relation to reciprocal movement of said pawl to permit said pawl to drive said ratchet wheel and said shaft toward said final position at the beginning of a printing operation and for energizing said solenoid in a different time relation to said reciprocal movement to permit said pawl to drive said ratchet wheel and said shaft back toward said initial position at the end of a printing operation.

6. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate operating position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; an electrical control circuit, connected to said control mechanism, for energizing said control mechanism to drive said shaft toward said final position at the beginning of a printing operation and for energizing said control mechanism to drive said shaft back toward said initial position at the end of a printing operation; a main electrical drive circuit; a plate-etch applicator for applying an etching solution to a planographic master mounted on said master cylinder, said applicator having a control member movable from an initial position to an operating position; a first control switch, electrically connected to said drive circuit and operatively connected to said control member, for starting said machine in response to movement of said plate-etch applicator control member to said operating position; and a second control switch, electrically connected to said control circuit and operatively connected to said control member, for actuating said control circuit in response to movement of said control member from said operating position toward said initial position.

7. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; inking means for applying ink to a planographic master mounted on said master cylinder; repellent applicator means for applying an ink repellent solution to a planographic master mounted on said master cylinder; blanket imaging means for moving one of said master and blanket cylinders from an initial position displaced from the other to a blanket-imaging position in which a planographic master mounted on said master cylinder engages said blanket cylinder in ink-transferring relation; a blanket cleaner device for applying a cleaning solution to said blanket cylinder; a sheet feeder device for feeding sheets into print-receiving relation to said blanket cylinder; control means, operatively connecting said inking means, said repellent applicator means, said blanket imaging means, said blanket cleaner device and said sheet feeder device

to said main control member for actuation in predetermined sequence in response to movement of said main control member from said initial position through said intermediate position to said final position and back through said intermediate position to said initial position; a single manual control member for moving said main control member to said positions; and an electrically actuated automatic mechanism for advancing said main control member between said positions.

8. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, a first intermediate operating position, a second intermediate operating position, and a final operating position; inking means for applying ink to a planographic master mounted on said master cylinder; repellent applicator means for applying an ink repellent solution to a planographic master mounted on said master cylinder; blanket imaging means for moving one of said master and blanket cylinders from an initial position displaced from the other to a blanket-imaging position in which a planographic master mounted on said master cylinder engages said blanket cylinder in ink-transferring relation; a blanket cleaner device for applying a cleaning solution to said blanket cylinder; a sheet feeder device for feeding sheets into print-receiving relation to said blanket cylinder; and means, operatively connecting said inking means, said repellent applicator means, said blanket imaging means, said blanket cleaner device, and said sheet feeder device to said main control shaft to actuate said repellent applicator means, said inking means, and said blanket cleaner device upon movement of said shaft through said first intermediate position, and into said second intermediate position and to actuate said blanket-imaging means and said sheet feeder device in response to movement of said shaft to said final operating position.

9. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; inking means for applying ink to a planographic master mounted on said master cylinder; repellent applicator means for applying an ink repellent solution to a planographic master mounted on said master cylinder; blanket imaging means for moving one of said master and blanket cylinders from an initial position displaced from the other to a blanket-imaging position in which a planographic master mounted on said master cylinder engages said blanket cylinder in ink-transferring relation; an electrically actuated blanket cleaner device for applying a cleaning solution to said blanket cylinder; an electrically actuated sheet feeder device for feeding sheets into print-receiving relation to said blanket cylinder; means, mechanically connecting said inking means, said repellent applicator means, and said blanket imaging means to said main control member for actuation in predetermined sequence in response to movement of said main control member from said position through said intermediate position to said final position; electrical control means, electrically connected to said blanket cleaner and sheet feeder devices and operatively connected to said main control member, for actuating said devices in predetermined sequence in response to movement of said main control member from said initial position through said intermediate position to said final position; and a single manual control member for actuating said main control member to said positions.

10. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member between the aforesaid positions; an electrically actuated blanket cleaner device for applying a cleaning solution to the external surface of said blanket cylinder; first electrical control means, electrically connected to said blanket cleaner, and responsive to movement of said main control member, for actuating said blanket cleaner upon movement of said main control member from said initial position to an intermediate operating position; and further electrical control means, electrically connected to said control mechanism, for maintaining said main control member in said intermediate operating position, without energizing said first electrical control means, for a predetermined interval to permit drying of the exterior of said blanket cylinder before said main control shaft is moved to said final operating position.

11. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member between the aforesaid positions; an electrically actuated blanket cleaner device for applying a cleaning solution to the external surface of said blanket cylinder; electrical control means, electrically connected to said blanket cleaner, and responsive to movement of said main control member, for actuating said blanket cleaner upon movement of said main control member from said initial position to an intermediate operating position, said control means including an adjustable time control device for interrupting actuation of said blanket cleaner after a predetermined adjustable time interval; and further electrical control means, electrically connected to said electrical control mechanism, for maintaining said main control member in said intermediate operating position for a predetermined adjustable time interval to permit drying of the exterior of said blanket cylinder before said main control member is moved to said final operating position.

12. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, rotatable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for rotating said main control shaft between the aforesaid positions; an electrically actuated blanket cleaner device, including at least one solenoid, for applying a cleaning solution to the external surface of said blanket cylinder; first electrical control means, comprising an energizing circuit electrically connected to said blanket cleaner solenoid and including a cam-actuated control switch responsive to movement of said main control shaft, for actuating said blanket cleaner upon movement of said main control shaft from said initial position to an intermediate operating position, said control means further comprising an adjustable time control device for interrupting actuation of said blanket cleaner after a predetermined adjustable time interval; and second electrical control

means, comprising a second adjustable time control device electrically connected to said control mechanism, for actuating said control mechanism to advance said main control shaft from said intermediate operating position to said final operating position after a predetermined adjustable time interval to permit drying of the exterior of said blanket cylinder before said main control shaft is moved to said final operating position.

13. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member between the aforesaid positions; an electrically actuated blanket cleaner device for applying a cleaning solution to the external surface of said blanket cylinder; electrical control means, electrically connected to said blanket cleaner, and responsive to movement of said main control member, for actuating said blanket cleaner upon movement of said main control member from said initial position to an intermediate operating position, said control means including an adjustable time control device for interrupting actuation of said blanket cleaner after a predetermined adjustable time interval; further electrical control means, electrically connected to said electrical control mechanism, for maintaining said main control member in said intermediate operating position for a predetermined adjustable time interval to permit drying of the exterior of said blanket cylinder before said main control shaft is moved to said final operating position; a main electrical drive circuit; a plate etch applicator for applying an etching solution to a planographic master mounted on said master cylinder, said applicator having a control member movable from an initial position to an operating position; a first control switch, electrically connected to said drive circuit and operatively connected to said control member, for starting said machine in response to movement of said control member to said operating position; and a second control switch, electrically connected to both of said electrical control means and operatively connected to said control member, for actuating said control circuit means in response to movement of said control member from said operating position toward said initial position.

14. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member between the aforesaid positions; an electrically actuated blanket cleaner device for applying a cleaning solution to the external surface of said blanket cylinder; first electrical control means, electrically connected to said blanket cleaner, and responsive to movement of said main control member, for actuating said blanket cleaner upon movement of said main control member from said initial position to an intermediate operating position, said control means including an adjustable time control device for interrupting actuation of said blanket cleaner after a predetermined adjustable time interval; second electrical control means, electrically connected to said electrical control mechanism, for maintaining said main control member in said intermediate operating position for a predetermined adjustable time interval to permit drying of the exterior of said blanket cylinder before said main control

shaft is moved to said final operating position; an electrically actuated sheet feeder for feeding print-receiving sheets into printing engagement with said blanket cylinder; means, operatively connected to said main control member, for engaging said master and blanket cylinders in ink-transferring relation in response to movement of said main control member to said final operating position; and additional electrical control means, electrically connected to said sheet feeder and responsive to movement of said main control member, for actuating said sheet feeder a predetermined time interval after said main control member reaches said final operating position, said control means including an adjustable time control device for adjusting said time interval to control pre-imaging of said blanket cylinder.

15. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member between the aforesaid positions; an electrically actuated sheet feeder for feeding print-receiving sheets into printing engagement with said blanket cylinder; means, operatively connected to said main control member, for engaging said master and blanket cylinders in ink-transferring relation in response to movement of said main control member to said final operating position; and electrical control means, electrically connected to said sheet feeder and responsive to movement of said main control member to said final operating position, for actuating said sheet feeder a predetermined time interval after said main control member reaches said final operating position, said control means including an adjustable time control device for adjusting said time interval to control pre-imaging of said blanket cylinder.

16. An offset printing machine of the kind including a main frame, a master cylinder upon which a planographic master may be mounted and a blanket cylinder mounted on said main frame for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said master cylinder being mounted in an auxiliary frame pivotally mounted on said main frame, said printing machine comprising: a main control shaft, mounted on said auxiliary frame and rotatably movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; an electrically actuated sheet feeder for feeding print-receiving sheets into printing engagement with said blanket cylinder; means, comprising a cam mounted on said shaft and a cam follower linkage connected to said frames, for pivoting said auxiliary frame to move said master cylinder into ink-transferring relation to said blanket cylinder in response to movement of said shaft to said final operating position; and electrical control means, electrically connected to said sheet feeder and responsive to movement of said shaft, for actuating said sheet feeder a predetermined adjustable time interval after said main control member reaches said final operating position, said control means including an adjustable time delay relay connected in the operating circuits for said sheet feeder and switching means, operatively connected to said control shaft, for actuating said relay in response to movements of said shaft.

17. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet,

said printing machine comprising: a main control member, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control member from said initial position to said final operating position during initiation of a printing operation and for returning said main control member to said initial position at the end of a printing operation; an electrically actuated sheet feeder for feeding print-receiving sheets into printing engagement with said blanket cylinder; means, operatively connected to said main control member, for engaging said master and blanket cylinders in ink-transferring relation in response to movement of said main control member into said final operating position; first electrical control means, electrically connected to said sheet feeder and responsive to movement of said main control member, for actuating said sheet feeder a predetermined time interval after said main control member reaches said final operating position, said control means including an adjustable time control device for adjusting said time interval to control pre-imaging of said blanket cylinder; and second electrical control means for shutting off said sheet feeder after said control member has been moved from said final operating position back to said intermediate position to provide for blanket run-down.

18. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate operating position, and a final operating position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; an electrically actuated sheet feeder for feeding print-receiving sheets into printing engagement with said blanket cylinder; means, operatively connected to said main control member, for engaging said master and blanket cylinders in ink-transferring relation in response to movement of said main control shaft to said final operating position; electrical control means, electrically connected to said sheet feeder and responsive to movement of said main control shaft, for actuating said sheet feeder a predetermined time interval after said main control shaft reaches said final operating position, said control means including an adjustable time control device for adjusting said time interval to control pre-imaging of said blanket cylinder; a main electrical drive circuit; a plate etch applicator for applying an etching solution to a planographic master mounted on said master cylinder, said applicator having a control member movable from an initial position to an operating position; a first control switch, electrically connected to said drive circuit and operatively connected to said plate etch applicator control member, for starting said machine in response to movement of said control member to said operating position; and a second control switch, electrically connected to said control mechanism and to said electrical control means, operatively connected to said plate etch applicator control member, for actuating said control circuit means in response to movement of said control member from said operating position toward said initial position.

19. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main electrical drive circuit; a plate etch applicator for applying an etching solution to a planographic master mounted on said master cylinder, said applicator having a control member movable from an initial position to an operating position; a first control switch, electrically connected to said drive circuit and operatively connected to said control member, for starting said machine in response to movement of

said control member to said operating position; automatic sequence control circuit means for controlling operation of said printing machine after etching of said master; and a second control switch, electrically connected to said control circuit means and operatively connected to said control member, for actuating said control circuit means in response to movement of said control member from said operating position toward said initial position.

20. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main electrical drive circuit; a plate etch applicator for applying an etching solution to a planographic master mounted on said master cylinder, said applicator having a manual operating handle movable from an initial position to an operating position; a first control switch, electrically connected to said drive circuit and operatively connected to said handle, for starting said machine in response to movement of said control member to said operating position; a manually operable safety switch, mounted on said handle and connected in series with said first control switch, for preventing starting of said machine due to accidental displacement of said handle to said operating position; automatic sequence control circuit means for controlling operation of said printing machine after etching of said master; and a second control switch, electrically connected to said control circuit means and operatively connected to said control member, for actuating said control circuit means in response to movement of said control member from said operating position toward said initial position.

21. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; electrical control means, connected to said control mechanism, for actuating said mechanism to move said shaft and actuate said inking, repellent applicator, blanket cleaner, and sheet feeder means in predetermined sequence to initiate a printing operation; a counter for counting print-receiving sheets fed through said machine; circuit means for connecting said counter to said control means to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position; and manual control means, including an operating handle connected to said shaft, for overriding and superseding said control mechanism, control means, and counter to permit fully manual control by a machine operator.

22. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means including a systems feed sheet storage magazine, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from

said initial position through said intermediate position to said final position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; electrical control means, connected to said control mechanism, for actuating said mechanism to move said shaft and actuate said inking, repellent applicator, blanket cleaner, and sheet feeder means in predetermined sequence to initiate a printing operation; a sensing device for sensing the absence of sheets in said systems storage magazine; circuit means for connecting said sensing device to said control means to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position; and manual control means, including operating handle connected to said shaft, for overriding and superseding said control mechanism, sensing device, and control means to permit fully manual control by a machine operator.

23. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means including a systems feed sheet storage magazine, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; electrical control means, connected to said control mechanism, for actuating said mechanism to move said shaft and actuate said inking, repellent applicator, blanket cleaner, and sheet feeder means in predetermined sequence to initiate a printing operation; a counter for counting print-receiving sheets fed through said machine; first circuit means for connecting said counter to said control means to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position; a sensing device for sensing the absence of sheets in said systems storage magazine; second circuit means for connecting said sensing device to said control means to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position; and switching means, incorporated in said first and second circuit means, for conditioning said printing machine for either counter stop or systems feed stop.

24. An offset printing machine of the kind including a master cylinder upon which a planographic master may be mounted and a blanket cylinder for receiving an ink image from a master mounted on the master cylinder and for transferring that ink image to a print-receiving sheet, said printing machine comprising: a main control shaft, movable between an initial position, at least one intermediate position, and a final operating position; master inking means, repellent applicator means, blanket cleaner means, and sheet feeder means including a systems feed sheet storage magazine, and a main sheet feed storage magazine, all operatively connected to said main control shaft for actuation in predetermined sequence in response to movement of said shaft from said initial position through said intermediate position to said final position; an electrically actuated control mechanism for moving said main control shaft between the aforesaid positions; electrical control means, connected to said control mechanism, for actuating said mechanism to move said shaft and actuate said inking, repellent applicator, blanket cleaner, and sheet feeder means in predetermined sequence to initiate a printing operation; a counter for counting print-receiving sheets fed through said machine; a sensing device for sensing the absence of sheets in said systems storage magazine; first circuit means for connecting said sensing device and said counter to said control means to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position upon feeding of a given member of sheets from said main storage magazine; second circuit means for connecting said sensing device to said control means substantially independently of said counter to stop said printing machine by actuating said control mechanism to return said main control shaft to said initial position upon emptying of said systems storage magazine; and switching means, incorporated in said first and second circuit means, for conditioning said printing machine for either counter stop or systems feed stop.

References Cited in the file of this patent

UNITED STATES PATENTS

2,275,455	Neal	Mar. 10, 1942
2,306,044	Davidson	Dec. 22, 1942
2,421,824	Allen et al.	June 10, 1947
2,660,113	Gullixson et al.	Nov. 24, 1953
2,753,795	Bruns	July 10, 1956
2,756,672	George	July 31, 1956
2,813,484	Pratt	Nov. 19, 1957
2,916,988	Cragg	Dec. 15, 1959