Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 1

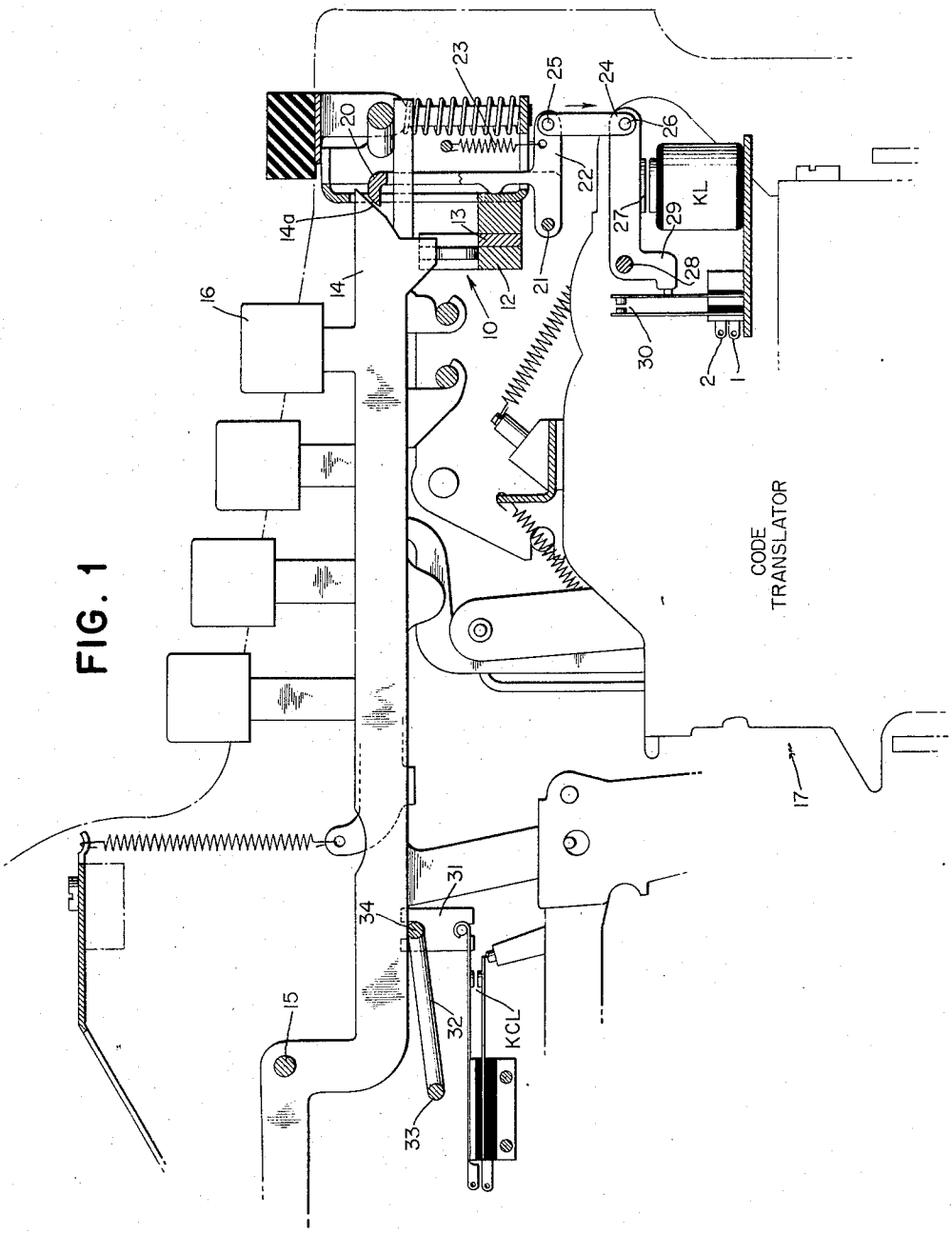


FIG. 1

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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 2

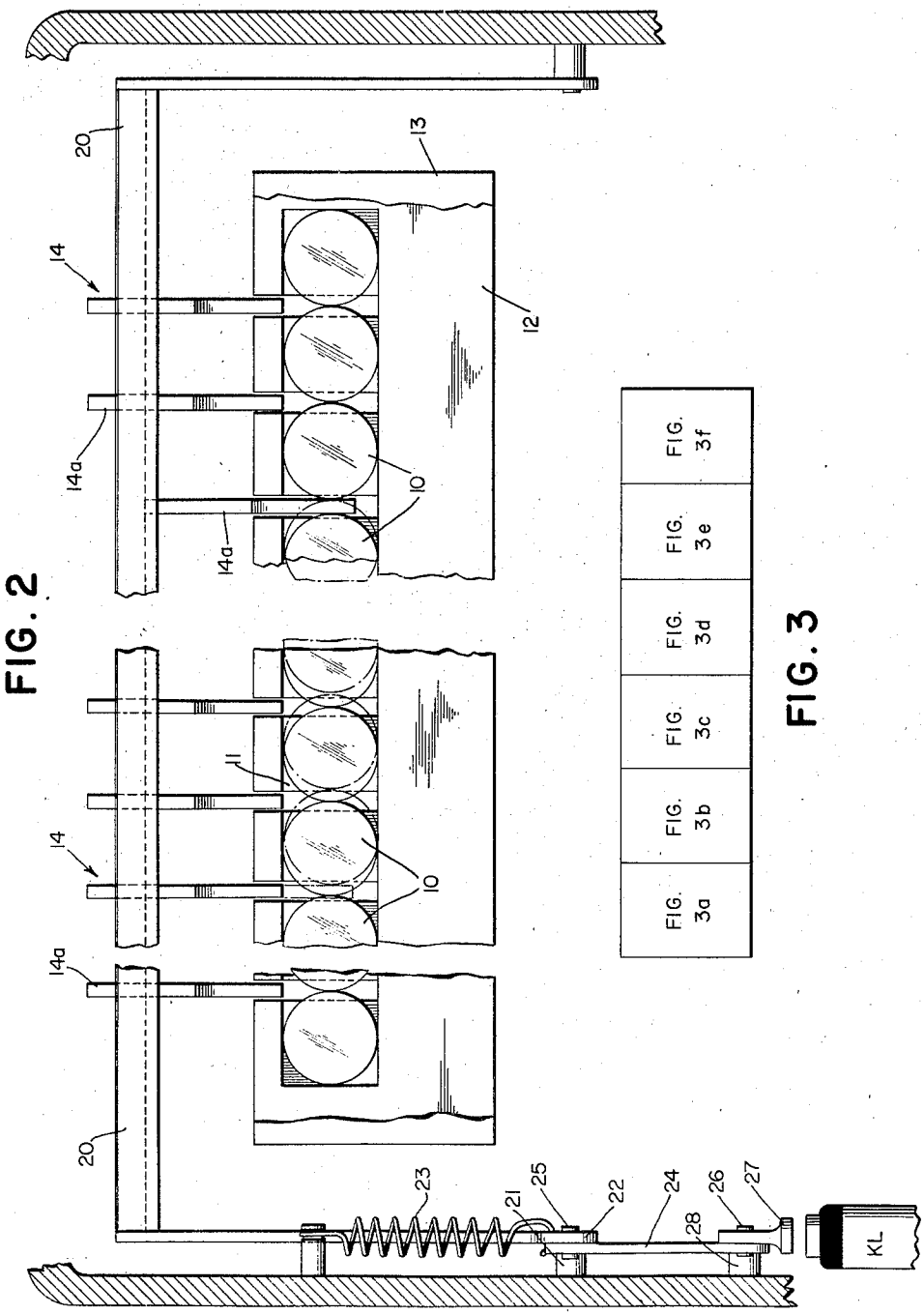


FIG. 2

FIG. 3a	FIG. 3f
FIG. 3b	FIG. 3e
FIG. 3c	FIG. 3d

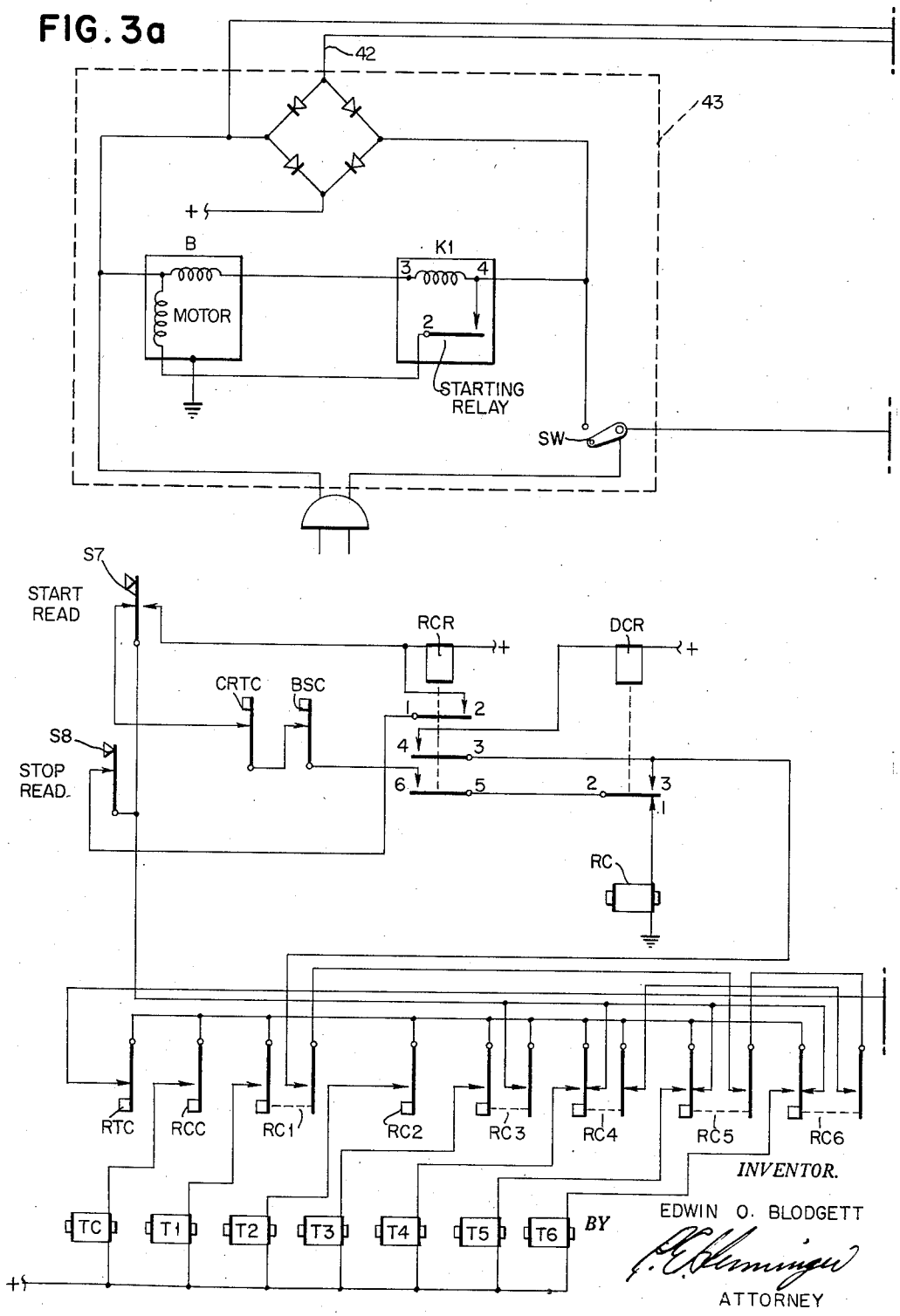
FIG. 3

Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 3

FIG. 3a



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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

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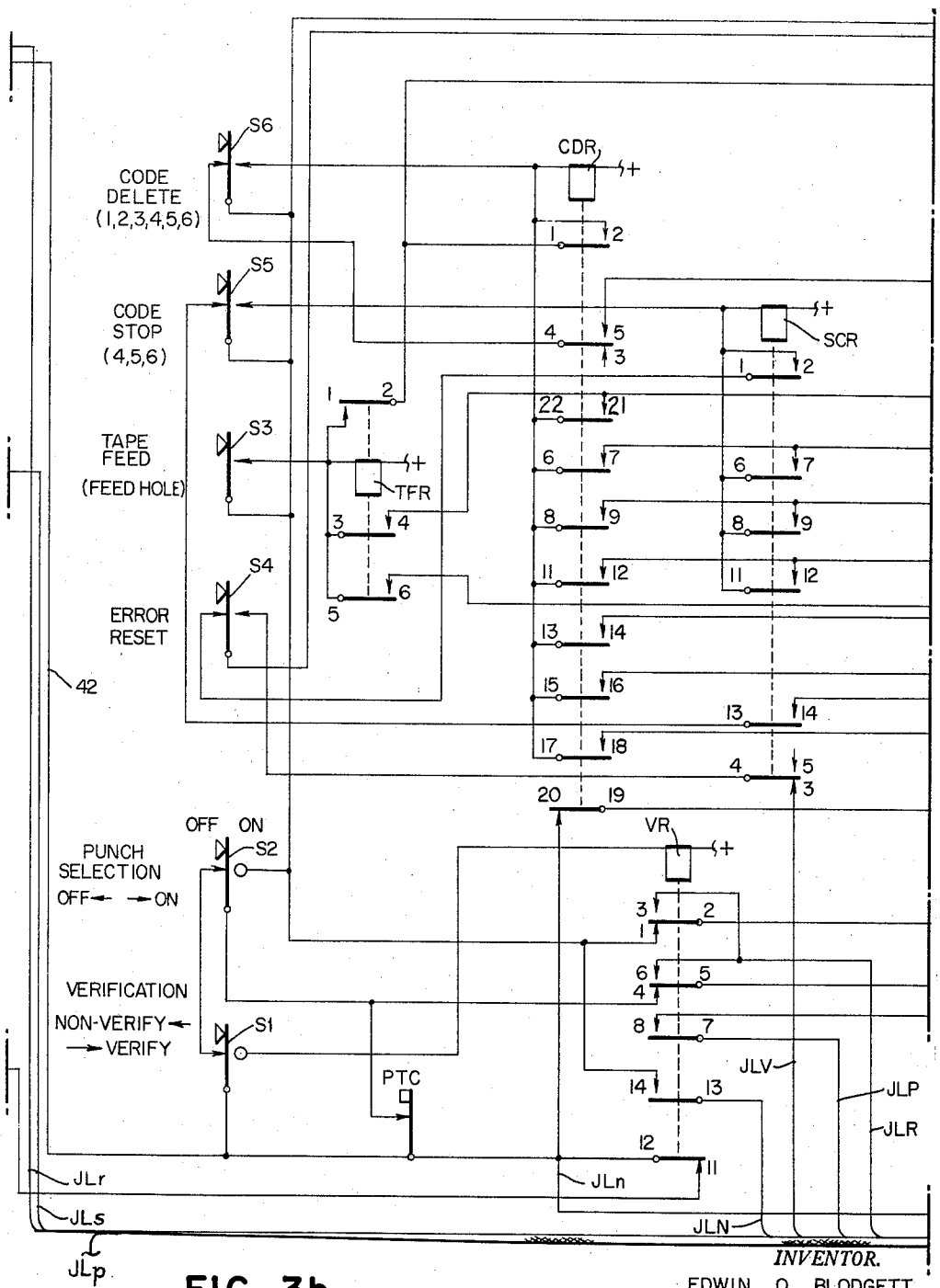


FIG. 3b

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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 5

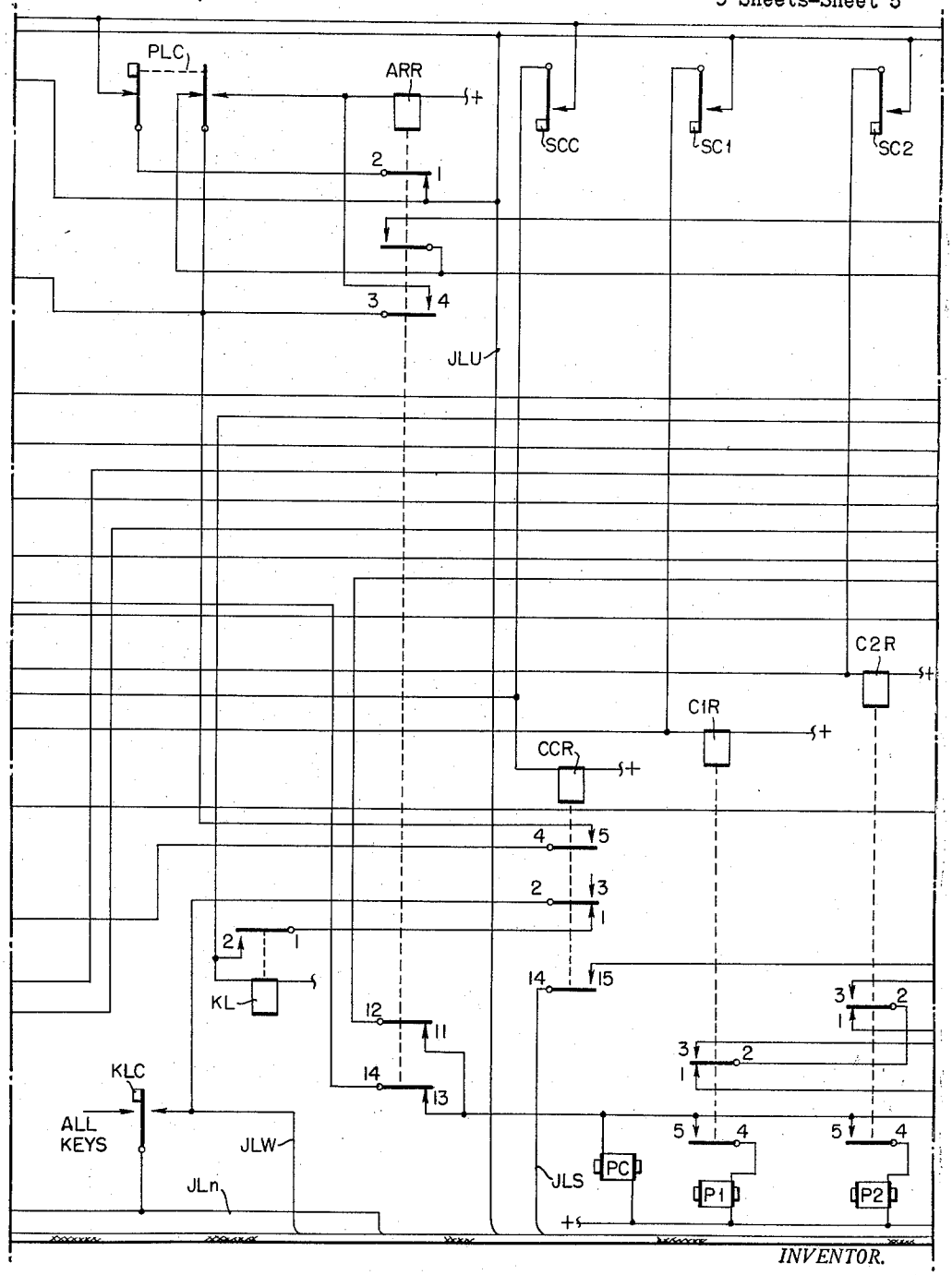


FIG. 3c

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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 6

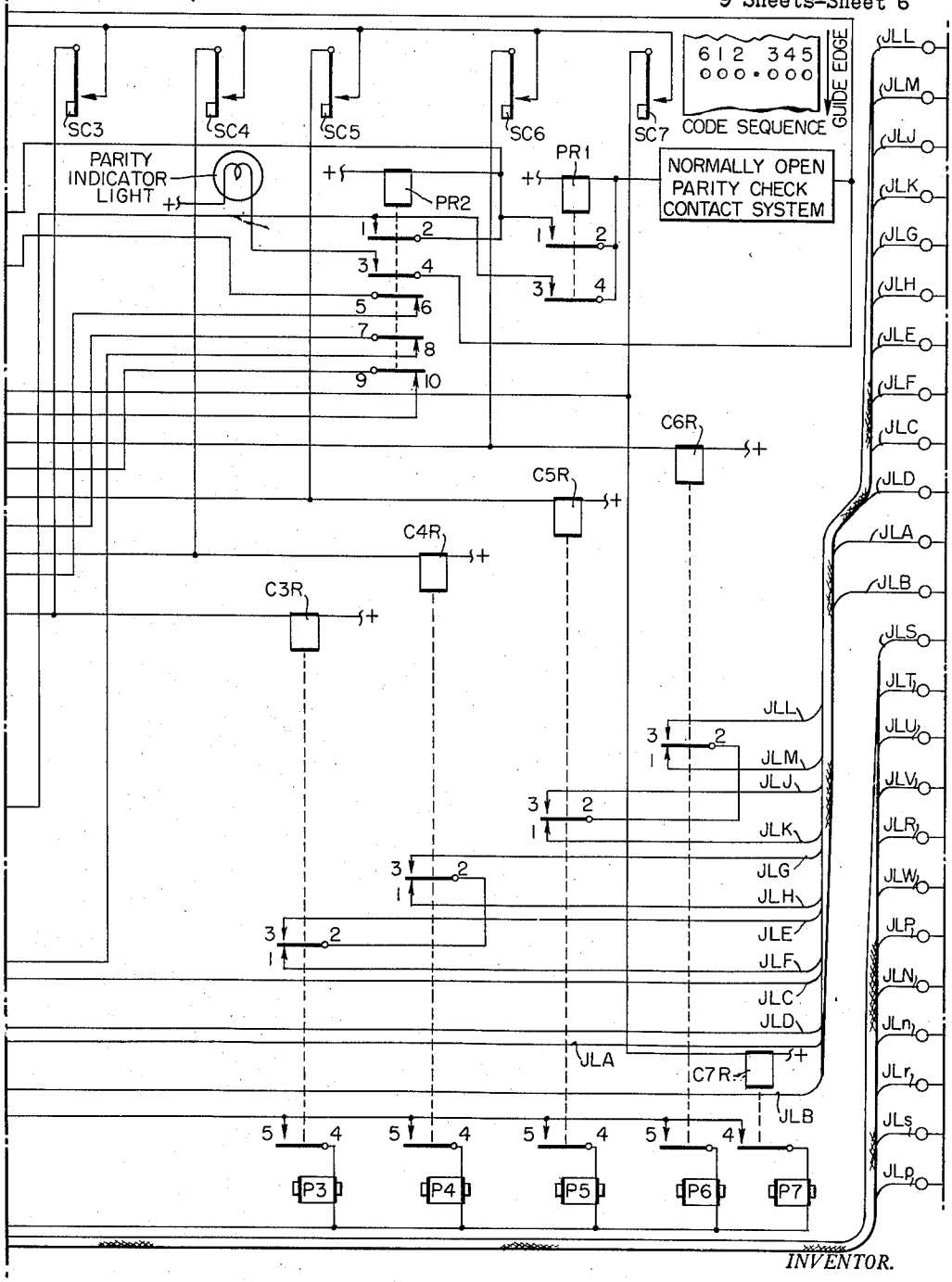


FIG. 3d

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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 7

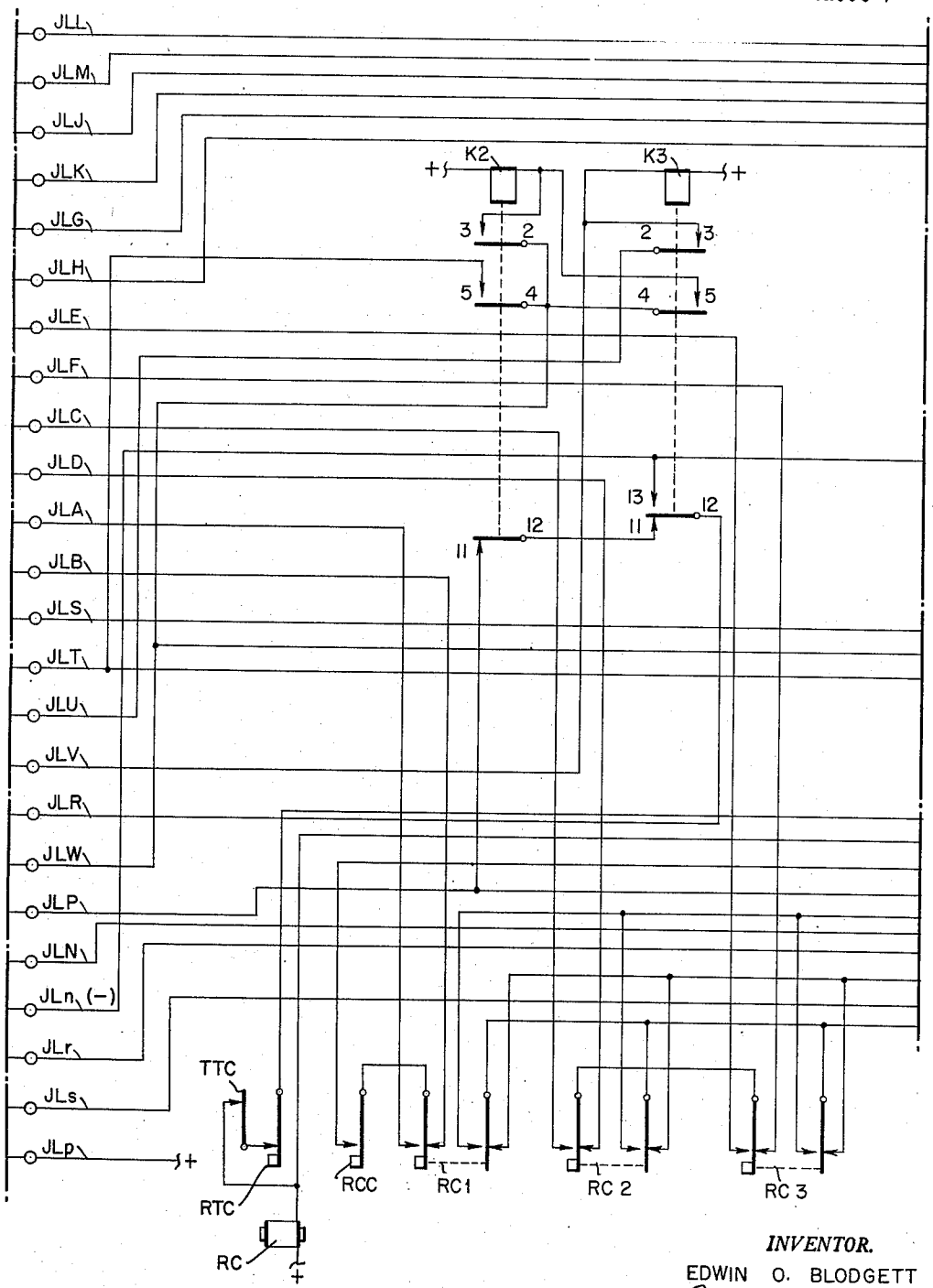


FIG. 3e

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Aug. 25, 1959 E. O. BLODGETT 2,901,042

VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 8

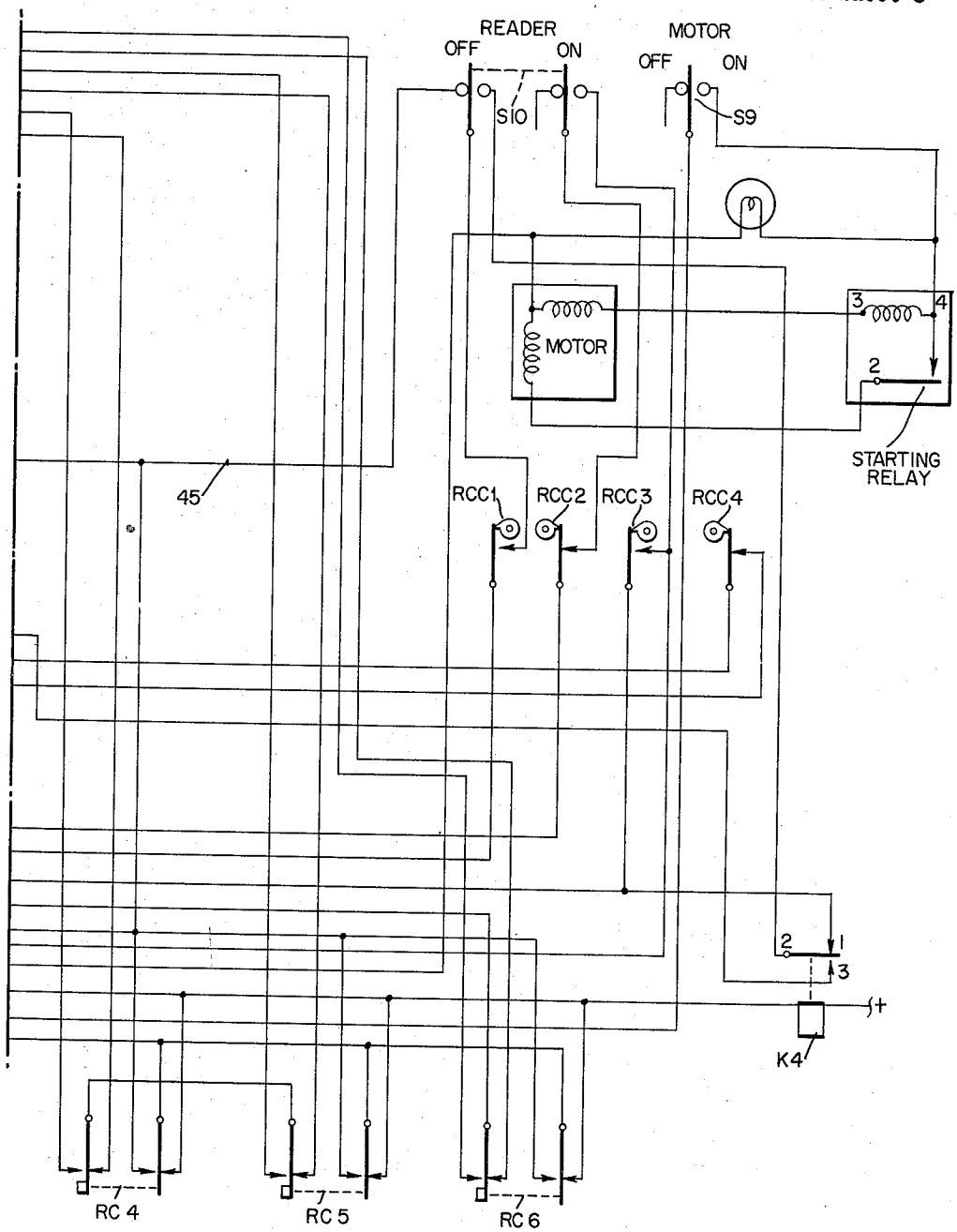


FIG. 3f

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VERIFYING PRINTING MACHINE

Filed Feb. 21, 1956 9 Sheets-Sheet 9

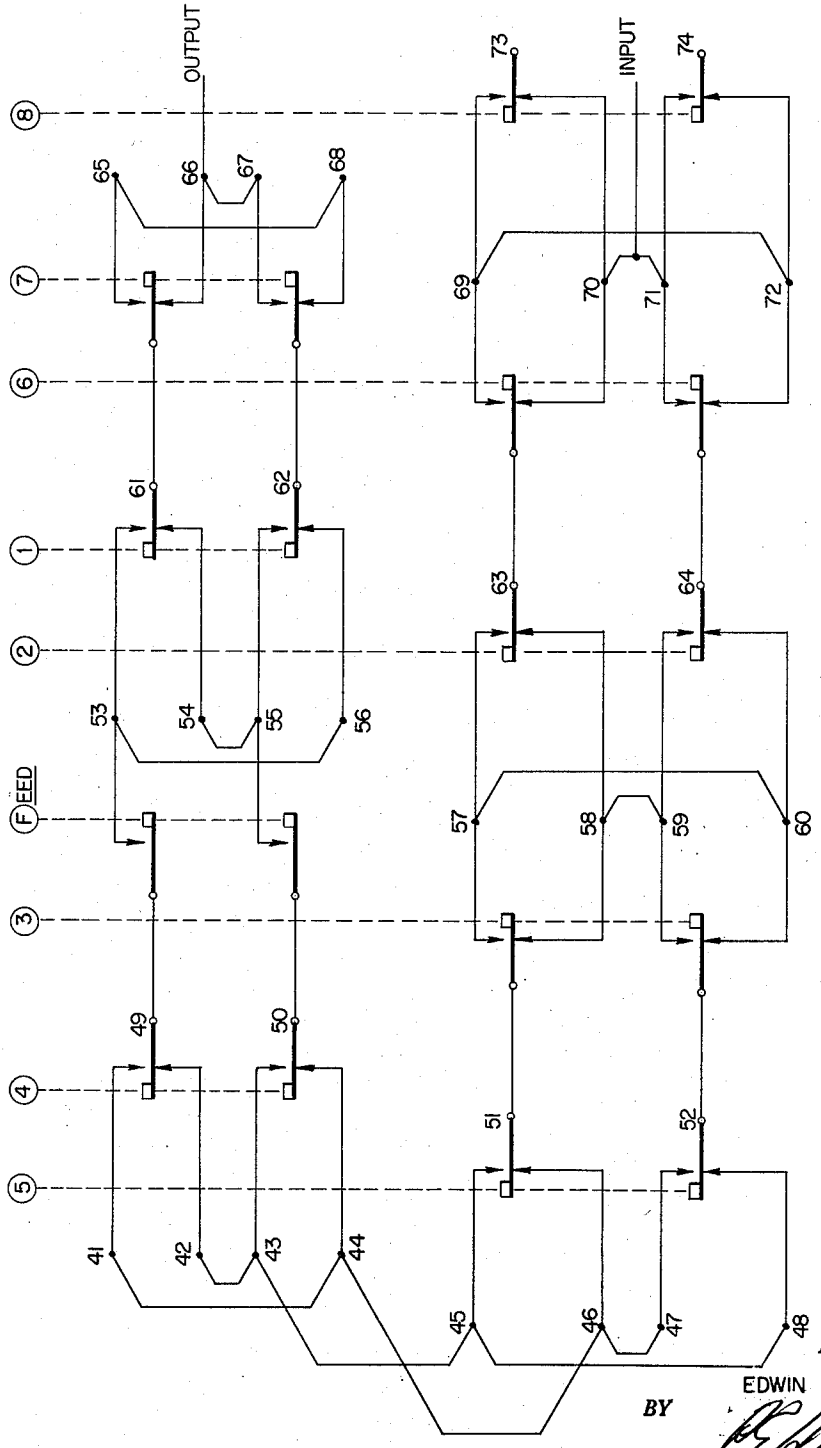


FIG. 4

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United States Patent Office 2,901,042 Patented Aug. 25, 1959

2,901,042

VERIFYING PRINTING MACHINE

Edwin O. Blodgett, Rochester, N.Y., assignor to Commercial Controls Corporation, Rochester, N.Y., a corporation of Delaware

Application February 21, 1956, Serial No. 567,034

34 Claims. (Cl. 164—113)

The present invention relates to printing machines and, particularly, to such machines wherein copy may be manually or automatically printed while concurrently creating a record of information necessary to duplicate the printed copy. While the invention is of general application, it is particularly suited for use in such machines operating with punched tape and will be described in that connection.

A printing machine which prints copy while concurrently automatically producing a punched tape recording of functional-control and character-print information required to duplicate the printed copy is disclosed in United States Patent No. 2,700,446, granted January 25, 1955 to Edwin O. Blodgett. An improved printing machine of this type is disclosed in copending application Serial No. 535,497, filed September 20, 1955, entitled Writing Machine. The punched tape so produced by the printing machine may later be used in a tape controlled printing machine which operates automatically to reproduce copy conforming to that recorded in the tape, or in certain applications the punched tape is used to provide data information for use by business machines such as tabulators or computers.

A printing machine operator often copies from handwritten or printed material, and it is frequently desirable in such instances that such copying be done without errors occasioned either by misreading the copied material or by erroneous manipulation of the printing machine. This is especially true where data is copied for later processing by a tabulator, computer, or like form of business machine. It has heretofore been the widespread practice in those cases requiring high accuracy in copying of material to have the copied material proof read or compared against the original by either one person working alone or two people working together, but while this accuracy check minimizes error it does not insure complete accuracy due to the human factors involved.

The present invention permits attainment of an exceptionally high degree of accuracy in copied material, and enables the probability of error to become so vanishingly small as to be entirely insignificant. Briefly considered, the invention contemplates that a first operator shall make a first copy of the original material while concurrently creating a byproduct punched tape in which is code recorded all information necessary to duplicate the copy. This byproduct tape is placed in a tape reader included in a verifying system, and a second operator then makes a second copy of the original material during which process every manual manipulation of the second operator must either verify against a corresponding manipulation of the first operator (as recorded in the byproduct tape) or the printing machine locks up until the reason for failure of verification is ascertained and appropriate action taken. Only verified information is recorded in the second byproduct punched tape produced by the second operator. Since two operators have performed the same copying taks independently,

the chance that both may commit the same identical error is quite remote. However, even this slight chance of error may be reduced to any desired degree of probability by repeating the copying process several times using the punched record byproduct tape last produced by an operator to verify the copy produced by a subsequent operator. The last produced byproduct tape is then known to record highly accurate error-free information and is the one used as the source of information supplied for processing by a tabulator, computer, or like form of business machine.

It is an object of the present invention to provide a new and improved printing machine so controlled in operation that printed copy produced by manual keyboarding operations may automatically be verified during and throughout the printing process.

It is a further object of the invention to provide an improved printing machine wherein manual keyboarding operations may be continuously verified, and any failure of verification immediately and positively indicated by automatically locking up the machine keyboard to halt further operation of the machine until such time as an operator has made a determination that an error does or does not exist and has either manually corrected the error if one exists or has manually bypassed that item of the verification information.

It is an additional object of the invention to provide a novel verified-copy printing machine which becomes automatically locked up against further manual operation whenever a verification operation is selected but a recorder of verified information is not concurrently selected or is selected but is or becomes devoid of a supply of record medium, thus automatically to insure proper recording of all verified information.

It is yet a further object of the invention to provide a verified-copy printing machine wherein a verification operation is always accompanied by a recording of verified information for subsequent use as desired, yet one wherein no information is recorded until after it has been successfully verified either automatically or after deliberation by the operator.

It is a further object of the invention to provide a verified copy printing machine in which each step of the printing operation is verified against information read from a record medium and indicating a desired printing operation, and one in which the reading of verification information is under step-by-step control of the printing machine and verification information is derived and effectively temporarily stored until such time as a successful step verification is completed.

It is an additional object of the invention to provide a novel printing machine selectably having several modes of operation as desired; namely, one which may be manually operated to perform normal printing operations without information recording or verification, one in which manual printing operations may be accompanied by automatic recording of information required to duplicate the printed copy, one in which recording of information corresponding to manual keyboarding may be verified against a source of verification information prior to recording, and one in which printing of copy alone or accompanied by concurrent recording of information may be accomplished entirely automatically under control of information read from a record medium. All of these several types of available operations are so intercontrolled, however, that all recording operations require the presence of record medium in the recorder or otherwise the machine becomes locked up against either manual or automatic operation, and each selection of a verification operation automatically terminates all automatic reproduction of copy and causes the machine to lock-up unless the recorder is concurrently selected.

Other objects and advantages of the invention will appear as the detailed description thereof proceeds in the light of the drawings forming a part of this application and in which:

Fig. 1 illustrates in elevational end view the general arrangement of key levers in a printing machine embodying the present invention and particularly illustrates a key lever mechanical interlock structure and a key lever latch structure embodied in the machine, and Fig. 2 illustrates in front elevational view the key lever interlock structure itself;

Figs. 3*a*–3*f* represent an electrical control system used in the printing machine of the invention, which figures should be considered together as a unitary structure in the manner shown in Fig. 3; and

Fig. 4 represents the electrical circuit arrangement of a parity check contact system used in association with the punch unit of the printing machine.

Key lever mechanical interlock and latch structure

In a printing machine embodying the present invention, all character-print and functional-control key levers are mechanically so interlocked that only one key lever may be operated at any given time. Each actuated key lever returns to its unactuated position unless a concurrent verification operation hereinafter described indicates that the operation of that key lever was an error in which event the key lever is latched in actuated position. Due to the mechanical interlocking of the key levers, any key lever so latched in actuated position terminates further operation of the printing machine. Such latched down key lever is released by a special manual operation, and the indicated error is thereupon corrected by the operator if an error actually exists or a second manual operation is performed by which to bypass that item of verification information if the latter should happen to be in error. Thereafter, automatic verification of the machine operation proceeds in normal manner until such time as a subsequent verification error is indictated and a key lever again becomes latched in actuated position.

The key lever mechanical interlock structure shown in Figs. 1 and 2 includes a plurality of circular disks **10** which are restrained to move in a longitudinally milled slot **11** of a base member **12** providing a form of raceway having a cover member **13**. The top edge of the base member **12** and cover **13** are slotted to receive the front end portion of each of plural key levers **14** which are pivoted at **15** in the frame structure of the writing machine and are provided with keys **16** for manual actuation. Each key lever **14** may also be actuated by a code translator **17** to effect automatic reproduction of copy recorded in a punched tape in the manner more fully shown and described in the Unted States Patent No. 2,700,446 granted January 25, 1955 to Edwin O. Blodgett.

The milled slot **11** of the key lever mechanical interlock structure has a length just sufficiently greater than the sum of the diameters of all of the disks **10** that one key lever **14**, but only one, may be inserted between the disks **10** at any one time. Such insertion of the key lever **14** occurs upon its manual or automatic actuation, and causes the disks on each side of the inserted key lever to be pushed sidewise to engage the end disks on each side with the ends of the slot **11**. Thus a second key lever cannot concurrently be inserted between the disks **10** and is accordingly mechanically locked against actuation. Upon return of this actuated key lever to its normal position above the disks, another key lever can then be inserted between the disks by manual or automatic actuation and in doing so will physically displace the disks of each side of it as indicated in broken lines again mechanically to lock against concurrent actuation any other key lever.

The key lever latch structure includes a lock bail **20** which extends across the ends of all of the key levers **14** and is engageable by the sloped end configuration **14***a* of any key lever for movement clockwise, as shown in Fig. 1, about a pivot point **21**. Affixed to the lock bail **20** is an arm **22** which moves with the bail but is normally biased by a spring **23** to maintain the end of the bail in a position where it either is positioned to be engaged by the sloped end portion **14***a* of an unactuated key lever or where it extends over the end portion **14***a* of an actuated key lever to latch the latter in actuated position. A link member **24** is pivoted at one end **25** to the arm **22** and is pivoted at its opposite end **26** to the end of an armature **27** which in turn is pivoted at a point **28** and may be actuated in a clockwise direction, as shown in Fig. 1, by an electromagnet KL. It will be apparent from the structure described that energization of the electromagnet KL attracts its armature **27** to move the latter clockwise against the action of the spring **23** exerted on the armature through the link **24** and arm **22**. This movement of the armature **27** operates through the arm **22** to move the lock bail **20** clockwise out of latching engagement with the end portion **14***a* of any of the key levers **14**. On the other hand, actuation of any key lever **14** at a time when magnet KL is not energized results in the key lever being locked in actuated position by action of the lock bail **20**. Due to the key lever mechanical interlock structure described above, it will be clear that only one key lever can be so latched in actuated position at any one time and all other key levers are thereupon locked against actuation.

The armature **27** of the key lever latch structure includes a depending arm **29** which actuates and effects closure of an associated pair of electrical contacts **30**, having terminals identified as **1** and **2**, whenever the armature **27** is attracted by the armature KL. A second pair of key lever latch contacts KLC shown in Fig. 1 is actuated through a link member **31** by a bail **32** which is pivoted at **33** and includes a bail portion **34** extending transversely under all of the key levers **14** for actuation by any thereof. The electrical contacts **30** and KLC have utility in the electrical control system of the printing machine now to be described.

Electrical control system

The electrical control system for the printing machine is shown in Figs. 3*a*–3*f* which should be considered together as a unitary structure as shown in Fig. 3. This control system has certain features which are shown and described in the aforementioned application Serial No. 535,497, to which reference is made for a detailed description of these features since they will be only generally described herein. As shown in Fig. 3, there is provided a manually operable "verify-nonverify" switch S1, a "punch off-on" switch S2, a tape feed switch S3, an error reset switch S4, a stop code switch S5, and a code delete switch S6. Whenever the punch control switch S2 is in its "off" position and the verify switch S1 is in its "nonverify" position, the key levers of the printing machine are continuously unlocked by energization of the key lock magnet KL through a circuit which may be traced from this magnet through normally closed contacts **9** and **10** of a parity relay PR2, the normally closed contacts **4** and **5** of a verify relay VR, the punch control switch S2 in its "off" position, and the verify switch S1 in its "nonverify" position to the negative terminal **42** of a power supply system **43**. The printing machine may be operated at this time by manual keyboarding to print copy as in any normal typewriter operation.

The printing machine may also be operated to effect automatic printing of copy, without verification, corresponding to information read from a punched tape. This is accomplished by operation of a tape reader which includes a reader tape contact RTC (the contacts of which are closed when tape is positioned in the reader), a reader common contact RCC, and reader contacts

RC1–RC6. These reader contacts are actuated during reading of combinations of code holes of a punched tape and respectively energize a translator common magnet TC and translator magnets T1–T6 which operate the code translator (identified as the unit 17 of Fig. 1) to effect automatic operation of the key levers of the printing machine. Energization for the reader contacts last mentioned is effected through the reader tape contact RTC and the normally closed contacts 11 and 12 of the verify relay VR, when the latter is deenergized during non-verified operations, from the negative terminal 42 of the power supply 43.

The reader includes a clutch magnet RC which is energized through contacts 1 and 2 of a delay control relay DCR and contacts 5 and 6 of a reader control relay RCR (when the latter is energized by manual actuation of a "start read" switch S7), a basket shift contact BSC, a carriage return and tabulation contact CRTC, the normally closed contacts of the start read switch S7 in manually released position, and any of normally closed contacts of the reader contacts RC4, RC5 and RC6 at least one of which remains closed except upon reading a 4-5-6 "stop" code. The reader control relay RCR upon becoming energized by actuation of the start read switch S7 establishes a hold circuit for itself through its contacts 1 and 2, the normally closed contacts of a "stop read" switch S8, and normally closed contacts of the reader contacts RC4, RC5 and RC6.

Thus upon actuation and release of the start read switch S7 to energize the reader control relay RCR, the reader clutch magnet RC is energized to place the reader in operation and the information which it reads from a punched tape effects automatic reproduction of the read information by the printing machine. The delay control relay DCR is energized through the contacts 3 and 4 of the reader control relay and normally open contacts of the reader contacts RC1, RC5 and RC6 upon reading either a "tabulation" code 1-5-6 or a "carriage return" code 1-3-5-6. Energization of the delay control relay DCR causes its contacts 1 and 2 to open and temporarily halt the reader operation for the short interval required to permit physical movement of the printing machine carriage to accomplish either a tabulation spacing or carriage return function. In this, the delay control relay DCR establishes a temporary hold circuit for itself through a circuit which includes the contacts 3 and 4 of the reader control relay RCR, the contacts 2 and 3 of the delay control relay DCR, the contacts 5 and 6 of the reader control relay RCR, the basket shift contact BSC, and the carriage return and tabulate contact CRTC to insure that the delay control relay DCR holds up until the carriage return and tabulation contact CRTC is opened by initiation of the tabulation function or carriage return function at which time the latter contacts open and do not again close until the function is completed. During the short interval required for completion of a tabulation or carriage return function, the delay control relay DCR becomes deenergized again to close its contacts 1 and 2 but the reader clutch magnet RC is not again energized to resume the reader operation until the contacts RCTC again close at the completion of the function. Reader operation is also temporarily halted by the basket shift contacts BSC to permit physical movement of the type basket between its upper-case and lower-case positions.

As in the aforementioned Blodgett et al. copending application, the present printing machine includes provision for recording in a punched tape functional-control and character-print information required to duplicate copy printed by the machine either during manual keyboarding of automatic operation. Thus there is provided a tape punch unit which includes a punch clutch magnet PC, punch magnets P1–P6, and a redundant-bit magnet P7 used for parity check purposes. These operate under control of a selector common code contact SCC and selector code contacts SC1–SC7 which are included in a code selector unit of the printing machine, but in the present machine the selector code contacts do not directly control the punch magnets as in the Blodgett patent but rather control the latter through a common control relay CCR and control relays C1R–C7R.

A punched tape operation is initiated by manually actuating the punch selection switch S2 to its "on" position. Assuming that the contacts of a punch tape contact PTC are closed by tape positioned in the punch unit in readiness for punching, actuation of the switch S2 as last described applies energizing potential from the power supply 43 through the punch tape contact PTC and the switch S2 to the selector common contact SCC which closes with each key lever actuation. The contact SCC directly energize a common control relay CCR, which closes its contacts 4 and 5 to energize the relay contact No. 5 of all of the control relays C1R–C6R. This energizing circuit includes the contacts 11 and 12 of an anti-repeat relay ARR, normally closed contacts 5 and 6 of the parity relay PR2, normally closed contacts of a punch latch contactor PLC, the contacts 4 and 5 of the common control relay CCR, the contacts 1 and 2 of the verify relay VR when the latter is deenergized to provide non-verified punch operation, the punch selection switch S2 with its "on" contacts now closed, and the punch tape contact PTC. The selector code contacts SC1–SC7 are energized in the same manner as the selector common contact SCC except that the former receive their energization through the contacts 1 and 2 of the anti-repeat relay ARR and normally closed contacts of the punch latch contactor PLC.

Thus as the key levers of the printing machine are actuated either manually or automatically to print copy, the selector common contact SCC is actuated and the selector code contacts SC1–SC7 are concurrently actuated in various code combinations to energize through the common control relay CCR and control relays C1R–C7R the energization of the punch clutch magnet PC and coded combinations of the punch magnets P1–P7 to effect code punching in a tape record medium of all functional-control and character-print information required to duplicate the printed copy. The redundant-bit magnet P7 does not perform any punch operation but only operates parity-check contacts as will be explained more fully hereinafter in connection with the parity operation. For the present it may be mentioned that parity checking is premised upon the use of an odd-bit code, and the code contact SC7 is operated (in turn to energize the relay C7R and magnet P7) by the code selector whenever a functional-control or character-print key lever involves the use of an even-bit code. In connection with the punch operation, the anti-repeat relay ARR is energized once each punch cycle by normally open contacts of the punch latch contactor PLC (this energizing circuit being that earlier traced through the contacts 4 and 5 of the common control relay CCR) and establishes in its energized condition its own hold circuit through its own contacts 3 and 4. When the anti-repeat relay ARR becomes and remains so energized, its contacts 11 and 12 deenergize the punch clutch magnet PC and punch magnets P1–P7. This requires that the common control relay CCR shall become deenergized before the end of the punch cycle to interrupt at its contacts 4 and 5 the hold circuit of the anti-repeat relay ARR, and further requires that the common control relay CCR be again energized by the selector common contact SCC to initiate the next punch cycle.

A tape feed switch S3 is provided for manual actuation by which to feed a short length of tape through the punch unit before a recording is initiated and after the recording is completed. Actuation of the switch S3 energizes a tape feed relay TFR, the contacts 1 and 2 of which provide a hold circuit for the relay through the contacts 1 and 2 of the anti-repeat relay ARR to insure completion of a punch cycle once initiated. The contacts 5 and 6 of this relay energize the punch clutch magnet PC through

a circuit which may be traced from the power supply 43 and includes the punch tape contact PTC, the punch selection switch S2, the tape feed switch S3, contacts 5 and 6 of the tape feed relay TFR, and the contacts 13 and 14 of the anti-repeat relay ARR. None of the punch magnets P1–P6 are energized by this operation, so that the punch clutch magnet PC continues to cycle the punch unit as long as the switch S3 is actuated and only a feed hole is punched into the tape by the punch unit. To maintain correct parity, the contacts 3 and 4 of the tape feed relay TFR energize the redundant-bit relay C7R to energize the redundant-bit punch magnet P7 for each punch cycle.

A "stop" code 4–5–6 may be manually punched into the tape by actuation of the stop code switch S5 to energize a stop code relay SCR. The latter through its contacts 6–12 energize the control relays C4R–C6R to close the contacts 4 and 5 of each. The punch clutch magnet PC and magnets P4–P6 are thereupon energized through the contacts 11 and 12 of the anti-repeat relay ARR, the contacts 5 and 6 of the parity relay PR2, the punch latch contactor PLC, and the contacts 4 and 5 of the common control relay CCR when the latter is energized through the contacts 13 and 14 of the stop code relay SCR upon manual release of the stop code switch S5 to close its normally closed back contacts. The energization of the common control relay CCR thus causes a "stop" code to be punched into the tape. To maintain pick-up of the stop code relay SCR after manual release of the stop code switch S5 and before initiation of the punch cycle, the relay SCR establishes a hold circuit through its contacts 1 and 2 and the normally closed contacts of the error reset switch S4, the contacts 1 and 2 of the anti-repeat relay ARR, normally closed contacts of the punch latch contactor PLC punch selector switch S2, and the punch tape contact PTC to the power supply system 43. This hold circuit for the stop code relay SCR is interrupted by opening of the punch latch contactor PLC upon initiation of the punch cycle, and a second successive stop code is accordingly not punched unless the stop code switch S5 is again manually actuated to reenergize the stop code relay SCR.

A "code delete" switch S6 may be manually actuated to effect punching of a delete code 1-2-3-4-5 into the tape for purposes of correcting an error in the recording or where a change of recording is desired. The code delete switch S6 energizes a code delete relay CDR which through its contacts 6–18 energizes the control relays C1R–C6R by which to energize through the contacts 4 and 5 of each the punch magnets P1–P6. The energizing circuit of the latter is completed through the punch tape contact PTC and punch selector switch S2 in its on position, the normally closed contacts of the code delete switch S6 when manually released, the now closed contacts 4 and 5 of the code delete relay CDR, normally closed contacts of the latch contactor PLC, contacts 5 and 6 of the parity relay PR2, and contacts 11 and 12 of the anti-repeat relay ARR. The punch clutch magnet PC is concurrently energized through the circuit last traced, and the code delete relay CDR establishes a hold circuit through its contacts 1 and 2 and normally closed contacts of the punch latch contactor PLC to retain the relay energized during manual release of the switch S6 and until initiation of a punch cycle.

The operation of the punch unit is continuously monitored by a parity check system to insure that each punch operation accurately conforms to a preestablished code system. The printing machine described herein by way of example uses a code in which recording is effected by code combinations involving both an even number and an odd number of code bits, and the redundant code punch magnet P7 is provided to enable all operations of the punch unit to be effectively that involving only an odd number of code bits to enable parity checking. The redundant-bit magnet controls a code bit mechanism in the tape punch which is identical to the code bit mechanisms controlled by each of the punch magnets P1–P6 except that the mechanism controlled by the punch magnet P7 does not include a punch pin and accordingly does not punch a code hole in the tape. The punch structure used may be that disclosed in the aforementioned copending application Serial No. 535,497, and as there shown includes a plurality of contact structures individual to and operated by the several punch mechanisms corresponding to the several code bits. As will be explained more fully hereinafter in connection with Fig. 4 these contact structures are included in an interconnecting electrical circuit of the parity check system having input and output terminals. The contact interconnections are such that the circuit between the input and output terminals of the parity system is interrupted so long as each code group (including a redundant code bit where necessary) involves an odd number of code elements but is completed in the event that the recording (including a redundant-bit as necessary) includes only an even number of code elements. The latter condition might prevail, for example, should the punch mechanism corresponding to one code bit fail to function properly so that the one code bit would fail to record in the punched tape. Thus the parity check contact system insures accuracy of recorded information by monitoring each punched code to ascertain that it fully conforms to the preestablished code system. Failure of parity check causes the printing machine to lock up until the erroneous code last punched has been deleted by a suitable manual operation.

As shown in the control system of Figs. 3*a*–3*f*, the parity check contact system energizes a fast acting relay PR1 whenever the normally open circuit of the parity check system becomes closed by a malfunctioning punch unit operation. The parity relay PR1 establishes through its contacts 3 and 4 a hold circuit which may be traced through the contacts 19 and 20 of the code delete relay CDR to the negative terminal 42 of the power supply system 43. The contacts 1 and 2 of the parity relay PR1 energize a slower acting parity relay PR2 which establishes through its contacts 1 and 2 a hold circuit which also extends through the contacts 19 and 20 of the code delete relay CDR.

The contacts 3 and 4 of the parity relay PR2 close to energize a parity indicator light to provide a visual indication of parity failure. It will be recalled that the contacts 5 and 6 of the parity relay PR2 are included in the energizing circuit of the punch clutch magnet PC and punch magnets P1–P7, so that energization of the parity relay PR2 prevents further operation of the punch unit. Since the erroneous code has already been punched in the record tape, the latter is manually moved back one step and the code delete switch S6 is then manually actuated to energize the code delete relay CDR and delete the erroneous code by over-punching it. The parity relay PR2 and parity relay PR1 are deenergized when the code delete relay CDR is energized, as last mentioned, and opens its contacts 19 and 20 in the hold circuit of the parity relays PR1 and PR2.

As will presently be explained in connection with the verification operation, the contacts 7 and 8 of the parity relay PR2 are included in the energizing circuit of a motorized tape reader included in the vertification system and providing information from which vertification may be effected. Thus energization of the parity relay PR2 automatically terminates further operation of the vertification tape reader. The contacts 9 and 10 of the parity relay PR2 are included in the energizing circuit of the key lock magnet KL as earlier explained, so that energization of the parity relay PR2 due to parity failure effects deenergization of the key lock magnet KL to lock up the printing machine should another key lever be actuated before the operator becomes aware of parity failure by observation of the lighted parity indicator light.

At rapid printing speeds parity failure ordinarily will be evidenced in practice by lock-up of the printing machine, rather than by observation of the parity indicator light which essentially is provided to indicate during a vertification operation whether lock up has occurred by reason of failure of parity or failure of verification. Once locked up, the printing machine remains locked up until the erroneous code has been deleted (in the manner explained above) to deenergize the parity relay PR2 whereupon the latter closes its contacts 9 and 10 immediately to energize the key lock magnet KL and release the last actuated key lever. It may be noted that the punch unit did not record information corresponding to the last actuated key lever, due to the opening of the contacts 5 and 6 of the parity relay PR2 just previous to lock-up of the printing machine, so that both that key lever upon which parity failed and the last actuated key lever should be manually reactuated to provide a proper recording.

Verification operation

The accuracy of manual keyboarding is verified by reading a punched tape inserted in a verification reader. The latter has a cyclic operation so controlled by the printing machine that the reader, after completing a partial-cycle reading operation to read a verification code, halts while reading the code and waits for verification to be completed. If the verification is successful, the reader advances through a complete cycle to halt again at the point where it reads the next verification code. This stepped operation, under control of the printing machine, continues until failure of vertification. When verification fails, the verification reader operation remains halted and the last actuated key lever is locked in actuated position by the latch structure described in connection with Figs. 1 and 2. The latched down key lever is released by manual actuation of an error reset switch, which permits a further manual operation of another key lever but does not restart automatic operation of the verification reader unless such next key lever actuation verifies with the information supplied by the verification reader thus to indicate that the initial key lever actuation was actually in error. If the second key lever actuation again fails to verify, or if it is determined that the initial key lever actuation was not in error, an error in the verification tape is indicated and in this event the erroneous verification information is bypassed and the verification reader again placed in operation by manual actuation of a switch to step the reader through one cycle of its operation.

The verification reader is conveniently provided as a separate motorized unit having a construction similar to that shown and described in the copending application Serial No. 546,902, filed November 15, 1955 in the name of Edwin O. Blodgett, entitled Code Form Converter, and assigned to the same assignee as the present application. The motorized unit is electrically connected to the printing machine through a multi-conductor flexible cable which may conveniently be terminated at its ends in plugs cooperating with suitable receptacles on the printing machine and on the motorized unit. The circuit arrangement of a motorized unit suitable for use with a printing machine embodying the present invention is particularly shown in Figs. 3*e*–3*f* and includes a drive motor which is energized from the power supply 43 of the printing machine through plug-receptacles JL*s* and JL*r* and a motor power switch S9.

In similar manner to that shown in the copending application last mentioned, the motor drives through a 180° clutch controlled by a reader clutch magnet RCM and actuates a plurality of cam operated contacts RCC1–RCC4 and a tape reader having a reader common contact RCC1 and reader contacts RC1–RC6. The motorized reader unit also includes an "off-on" switch S10, which on initial manual actuation to the "on" position causes the reader to advance and halt at the 180° point of its operating cycle where its reader pins project through code apertures of the verifying tape thus to read and temporarily store a verification code. This initial reader advance is effected by the cam actuated contact RCC2 having contacts which are closed at 250° of the reader cycle and open at 20° of the next reader cycle, the contacts thus being closed at the "home" or zero position of the reader cycle. To this end the cam actuated contacts RCC2 energizes the reader clutch magnet RCM through an energizing circuit which may be traced from the latter through a tight tape contact TTC (the contacts of which are normally closed but open in the event that excessive tension develops in the tape passing through the reader), a reader tape contact RTC having closed contacts when a verification tape is positioned in the reader for reading, the cam operated contacts RCC2, the reader off-on switch S10 in the "on" position, a plug-receptacle JLN, the contacts 13 and 14 of the verify relay VR of the printing machine (energized by manual actuation of the verify switch S1 to the "verify" position), the punch selection switch S2 in the "on" position, and the punch tape contact PTC to the power supply unit 43.

Upon energization of the reader clutch magnet RCM as last described, the reader leaves its home or zero position and initiates a reader cycle but does not continue past the 180° point of the cycle unless the reader clutch magnet RCM is again energized through the cam actuated contact RCC1 (having its contacts closed at 70° of the reader cycle and opened at 200° thereof) in a manner presently to be described more fully. Note in regard this further energization of the reader clutch magnet RCM that at the 180° point of the reader cycle the clutch magnet is no longer energized by the reader cam actuated contact RCC2 since the contacts of the latter open at 20° of the reader cycle.

If the first code read by the verification reader should be a "delete" code 1-2-3-4-5-6, the reader clutch magnet RCM is energized at the 180° point of the reader cycle by the operation of a cycle control relay CCR which is normally energized by normally closed contacts of any one of the reader contacts RC1–RC6 but not when all of these contacts are operated in response to the delete code. It will be noted that the energizing circuit for the cycle control relay CCR extends through a normally closed contact of any nonactuated one of the reader contacts RC1–RC6 and further extends through a normally open contact of any actuated one of the reader contacts to a circuit conductor 45 which through plug-receptacle JL*n* is always energized directly from the power supply source 43 of the printing machine. The deenergization of the cycle control relay CCR upon reading a delete code causes the reader clutch magnet RCM to be energized, and thereby cycle the reader past its 180° point, through a circuit which is traced from the reader clutch magnet RCM to the cam actuated contacts RCC1, the reader off-on switch S10 in its on position, the contacts 1 and 2 of the cycle control relay CCR, the cam actuated contact RCC3 (which closes at 65° of the reader cycle and opens at 220° thereof), and the plug-receptacle JLN to the power supply 43 of the printing machine through a circuit previously traced. The reader continues past its home or zero position by action of the cam operated contact RCC2 in energizing the reader clutch magnet RCM as previously described and continues on to halt at the 180° point of its cycle where it reads and stores the next recorded information of the verification tape.

It will be apparent that the same type of reader automatic skipping operation prevails where no information is recorded in verification tape since in this case also no one of the reader contacts RC1–RC6 is actuated to cause energization of the cycle control relay CCR.

A verification operation essentially involves a comparison of a verification code read by the verification reader

with the recording code established by selective energization of the control relays C1R–C6R by the selector code contacts SC1–SC6 in response to actuation of the key levers of the printing machine. If the verification is successful, the reader clutch magnet RCM is energized to cycle the reader past its 180° position, the cam actuated contact RCC1 continuing the reader past its home or zero position so that the reader stops again at its 180° position to read the next verification code. In considering the verification operation in greater detail, it will be assumed by way of example in the following description that the control relays C1R and C5R of the printing machine are energized by the respective selector code contacts SC1 and SC5 operated by a key lever actuation, and further that the verification tape actuates the reader contacts RC1 and RC5 to indicate a 1–5 verification code. The energization of the reader clutch magnet RCM, after a successful verification, is accomplished through an energizing circuit which may be traced from the reader clutch magnet RCM through the cam actuated contacts RCC1, the off-on switch S10 in its on position, the contacts 2 and 3 of the cycle control relay CCR (now energized through any of the nonactuated reader contacts RC2, RC3, RC4 or RC6 and either of the actuated reader contacts RC1 or RC5 as earlier described), plug-receptacles JLS, contacts 14 and 15 of the common control relay CCR (energized by the selector common contact SCC operated by the same key lever actuation which it was above assumed operated the contacts RC1 and RC5), contacts 7 and 8 of the parity relay PR2, contacts 7 and 8 of the verification relay VR (now energized by closure of the switch S1, to its "verify" position), plug-receptacle JLP, normally closed contacts of the reader contact RC6, plug-receptacle JLM, normally closed contacts 1 and 2 of the deenergized control relay C6R, now closed contacts 2 and 3 of the energized control relay C5R, plug receptacle JLJ, now closed contacts of the reader contact RC5 and normally closed contacts of the reader contact RC4, plug-receptacle JLH, normally closed contacts 1 and 2 of the deenergized control relay C4R, normally closed contacts 1 and 2 of the deenergized control relay C3R, plug-receptacle JLF, normally closed contacts of the reader contacts RC3 and RC2, plug-receptacle JLD, normally closed contacts 1 and 2 of the deenergized control relay C2R and now closed contacts 2 and 3 of the energized control relay C1R, plug-receptacle JLA, now closed contacts of the reader contact RC1, the now closed contacts of the reader common contact RCC (closed since the latter stands at the 180° point of its operating cycle), cam actuated contact RCC3, plug-receptacle JLN, now closed contacts 13 and 14 of the verification relay VR, punch selection switch S2 in its on position, and the punch tape contact PTC to the power supply system 43. Completion of this verification circuit to energize the reader clutch magnet RCM indicates successful verification with the results mentioned above that the verification reader advances and the actuated key lever returns to unactuated position.

Several aspects of the energizing circuit last traced merit comment. Firstly, it may be noted that the cam actuated contact RCC2 is not able to cycle the reader past its zero or home position in the event that the end of the verification tape is reached since the reader tape contact RTC thereupon opens to open the energizing circuit through contact RCC2 for the reader clutch magnet RCM. The same result obtains if excessive tension has developed in the verification tape, thereby to open the tight tape contact TTC. Secondly, it may be noted that the position of the transfer contacts of the verification reader contact RC1–RC6 must occupy the identical transfer positions as the transfer contacts 1, 2 and 3 of the control relays C1R–C6R or otherwise the energization circuit for the reader clutch magnet RCM is not established; in other words, the verification code must be identical to the recording code. Thirdly, the verification reader is not advanced by energization of its clutch magnet RCM unless the verify switch S1 is in the verify position to energize the verify relay VR, the punch selection switch S2 in its on position to select punch recording of verified information, and the punch is loaded with tape to effect closure of the punch tape contact PTC. Fourthly, the verification reader does not advance should the parity relay PR2 become energized due to failure of proper code punching by the punch unit of the printing machine as earlier explained in connection with the parity check operation.

A successful verification not only energizes the reader clutch magnet RCM as last described, but additionally effects completion of (1) an energizing circuit for the punch clutch magnet PC and punch magnets P1–P7 of the printing machine to effect punch recording of the verified information into the tape of the punch unit, and (2) energization of the key lock magnet KL to prevent latching of the actuated key lever in actuated position. In this regard, it will be recalled from the described energizing circuit of the reader clutch magnet RCM that a successful verification places negative potential from the power supply 43 upon the plug-receptacle JLP. This potential effects energization of the punch clutch magnet PC and punch magnets P1–P6 through a circuit which may be traced from the plug-receptacle JLP, the contacts 11 and 12 of an over-ride control relay ORCR, the contacts 11 and 12 of an over-ride relay ORR, a plug-receptacle JLR, the now closed contacts 2 and 3 of the verification relay VR, the now closed contacts 4 and 5 of the common control relay CCR, the normally closed contacts of the punch latch contactor PLC, the contacts 5 and 6 of the parity relay PR2, and the contacts 11 and 12 of the anti-repeat relay ARR to the punch clutch magnet PC as well as to the punch magnets P1–P7 through any of the contacts 4 and 5 of energized ones of the control relays C1R–C6R. In the energizing circuit last traced, the negative potential impressed upon the plug-receptacle JLR also is applied through the now closed contacts 5 and 6 of the verification relay VR and the contacts 9 and 10 of the parity relay PR2 to the key lock magnet KL which upon becoming energized prevents latching of the actuated key lever in actuated position as described in connection with Fig. 1. A hold circuit for the key lock magnet KL is established by its contacts 1 and 2 (operated by the armature of the latter as pointed out in connection with Fig. 1), a plug-receptacle JLT, the cam actuated contact RCC4 (which closed at 200° of the reader cycle, as the reader moves past its 180° position by reason of the energization of the reader clutch magnet RCM, and do not open again until the reader has reached 20° of its next reader cycle), a plug-receptacle JLW, and the key lock contact KLC (operated by all actuated keys as explained in connection with Fig. 1) to the power supply 43. A second hold circuit for the key lock magnet KL extends through its contacts 1 and 2, the contacts 1 and 2 of the common control relay CCR when the latter becomes deenergized, and the key lock contact KLC so that the key lock magnet KL remains energized so long as the printing machine itself is completing a printing operation.

Upon failure to effect proper verification, it will be apparent from the foregoing description of the verification operation that negative potential from the power supply system 43 does not appear at the plug-receptacle JLP with the results (1) that the reader clutch magnet RCM is not energized to advance the reader, (2) the punch clutch magnet PC and punch magnets P1–P6 are not energized to record the coded information corresponding to the actuated key lever, and (3) the key lock magnet KL is not energized so that the actuated key lever is latched in actuated position. The failure of verification thus indicates error by positively terminating further operation of the printing machine and also inhibits the recording of what appears to be erroneous

functional-control or character-print information. Note also that since the verification reader is not advanced the verification code which it reads remains available or temporarily "stored" for subsequent verification. Thus it may readily be determined whether the indicated error is by improper key lever actuation or by reason of an error appearing in the verification information.

The determination of just where an indicated verification error lies is initiated by manual actuation of the error reset switch S4 to energize the over-ride relay ORR through an energizing circuit which may be traced from this relay through a plug-receptacle JLV, the contacts 3 and 4 of the stop code relay SCR, the now closed contacts of the error reset switch S4, the contacts 1 and 2 of the anti-repeat relay ARR and the punch latch contactor PLC (neither the anti-repeat relay ARR or punch latch contactor PLC is actuated since the punch clutch magnet PC remains deenergized by reason of the indicated error of verification), the punch selection switch S2 in its on position, and the punch tape contact PTC to the power supply system 43. The over-ride relay ORR upon picking up establishes a hold circuit through its contacts 2 and 3, a plug-receptacle JLU, the contacts 1 and 2 of the anti-repeat relay ARR, the punch latch contactor PLC, and the punch selector switch S2 and punch tape contact PTC. The contacts 4 and 5 of the over-ride relay ORR close to energize an over-ride control relay ORCR through an energizing circuit which includes the plug-receptacle JLW and the key lock contact KLC (which remains closed as long as the actuated key is latched in actuated position). The contacts 12 and 13 of the over-ride relay ORR apply negative potential from the negatively energized conductor 45 through the plug-receptacle JRL, the now closed contacts 5 and 6 of the verification relay VR, and the contacts 9 and 10 of the parity relay PR2 to energize the key lock magnet KL and unlock the actuated key lever to permit it to return to nonactuated position. At the same time, the energizing circuit of the key lock magnet KL last mentioned also applies negative potential through the contacts 2 and 3 of the verification relay VR to the contact 4 of the common control relay CCR where it is available to energize the punch clutch PC and punch magnets P1–P7 when the common control relay CCR is next energized. The over-ride control relay ORCR establishes a hold circuit through its contacts 2 and 3 and 4 and 5, a plug-receptacle JLT, the now closed contacts 1 and 2 of the key lock magnet KL, the contacts 9 and 10 of the parity relay PR2, the contacts 5 and 6 of the verification relay VR, the plug-receptacle JLR, and the contacts 12 and 13 of the over-ride relay ORR to the negatively energized conductor 45. The hold circuit last described maintains the over-ride control relay ORCR energized as long as the over-ride relay ORR remains energized even though the actuated key lever upon becoming unlocked and returning to its unactuated position opens the key lock contact KLC.

The control system is now conditioned to determine just where the indicated error in verification lies. To this end, the next actuated key lever operation is not required to verify for the reason that the indicated error of verification may have been due to a wrong verification code in the verification tape. Thus the verification circuit is opened both at the contacts 11 and 12 of the now energized over-ride control relay ORCR and at the contacts 11 and 12 of the energized over-ride relay ORR. The information corresponding to the next actuated key lever is recorded in the punched tape by reason of the fact that energization for the punch clutch magnet PC and punch magnets P1–P7 is waiting at the contact 4 of the common control relay CCR as explained above, and recording is therefore effected upon closure of the contacts 4 and 5 of the common control relay CCR under control of the key lever actuated selector common contact SCC. This actuated key lever cannot be latched in actuated position for the reason that the key lock magnet KL remains energized through the hold circuit earlier described and which includes the contacts 12 and 13 of the over-ride relay ORR.

As the punch unit accordingly operates through its cycle to effect recording of information corresponding to the actuated key lever last mentioned, the anti-repeat relay ARR becomes energized by operation of the punch latch contactor PLC and this interrupts the hold circuit for the relay ORR which extends through the contacts 1 and 2 of the relay ARR. The relay ORR upon becoming thus deenergized opens its contacts 12 and 13 to deenergize the hold circuit for the key lock magnet KL so that the next key lever which fails to verify may be latched in actuated position as before. Deenergization of the key lock magnet KL, with resultant opening of its contacts 1 and 2, also deenergizes the hold circuit for the over-ride control relay ORCR which thereupon also becomes deenergized. The contacts 11 and 12 of the over-ride control relay ORCR now close to permit the next successful verification operation to energize the key lock magnet KL. If at the time of actuation of the last key lever the verification tape presents the proper verification code, and the previous indicated error accordingly resulted through improper initial key lever actuation, the key lever operation last mentioned results in a successful verification with resultant energization of the reader clutch magnet RCM and normal advance of the verification reader. If on the other hand the originally indicated error was not caused by improper key lever actuation but rather by an erroneous verification code in the verification tape, the verification reader must be advanced past the erroneous verification code by manually actuating the reader off-on switch S10 first to its "off" position and then to its "on" position to effect an automatic reader advance cycle in the manner earlier explained.

Upon parity failure and consequent energization of the parity relays PR1 and PR2 as above explained, the verification reader operation is terminated by interruption of the reader clutch magnet energizing circuit at the contacts 7 and 8 of the parity relay PR2. At the same time, the printing machine is locked up by interruption of the energizing circuit of the key lock magnet KL at the contacts 9 and 10 of the parity relay PR2. To restore proper verification operation, the tape in the punch unit of the printing machine is manually backed up one step and the code delete switch S6 manually actuated to overpunch with a delete code the erroneous code which caused parity failure. This causes deenergization of both of the parity relays PR1 and PR2 as previously explained, but does not unlock the printing machine since this must be effected by manual actuation of the error reset switch S4 to energize the key lock magnet KL and release the last actuated key lever. The correct key lever is then manually actuated and the information corresponding thereto is recorded by punch coding. Since lock-up of the machine was not due to an erroneous key lever actuation but rather to parity failure, the initial key lever actuation, at the time of parity failure provided correct verification and the verification reader advanced just previous to machine lock-up. Actuation of the error reset switch S4 as last mentioned followed by reactuation of the proper key lever effects a proper punch recording but does not further advance the verification reader due to operation of the over-ride relay ORR and over-ride control relay ORCR in the manner explained above. Further operation of the printing machine is accompanied by normal verification without further attention by the operator.

Parity check contact system

The electrical circuit arrangement of the parity check contact system of the printing machine is shown in Fig. 4. This system includes a plurality of single-pole single-throw switches or contacts and single-pole double-throw

switches or contacts having terminals 41–74. These switches are electrically interconnected as shown and are operated in pairs (indicated by the dash lines) by the punch pins of the punch unit as explained in detail in the aforesaid copending application Serial No. 535,497. The input conductor of the system is connected to the switch terminals 70 and 71, and the output conductor of the system is connected to the switch terminals 66 and 67. The normally open contacts operated by the feed hole punch pin maintains an open electrical circuit between the input and output conductors of the system except when the feed hole punch pin is moved into punching position. The feed hole punch operates each punch cycle. With the feed hole punch pin in punching position, its associated contacts complete the electrical circuit between the switch contacts 49 and 53 and between the switch contacts 50 and 55 and thereby effectively cause a "sampling" at this time of the nature of the electrical circuit established through the system by operation of the contacts associated with the punch pins controlled by the punch magnets PM1–PM6 and the redundant punch magnet PM7. If an odd number of punch pins (including the redundant-bit as necessary) are in punch position at the sampling time last mentioned, the electrical circuit between the input conductor and output conductor of the contact system is interrupted or open. Conversely, an even number of punch pins (including a redundant-bit if added) in punch position at the sampling time shows malfunctioning of the punch operation and causes the electrical circuit between the input and output conductors to be completed through the contact system and thus to lock-up the printing machine as earlier explained. By way of an illustrative example of the operation of the parity contact system, assume that the punch pins 2 and 5 and the parity bit 7 all operate their associated contacts in accordance with a proper code punch operation. The interrupted electrical circuit in this case may be traced through the contact system as follows: from the input switch terminal 70 and including in order the switch terminals 63, 57, 60, 52, 47, 46, 44, 50, 55 (the contacts 50 and 55 closing at sampling time by operation of the feed hole punch), 54, 61, and 65–68, so that no electrical circuit is thus completed to the output conductor circuit terminal 66. If, on the other hand, in the operation last assumed the punch pin 5 for example had erroneously failed for some reason to move to the punch position, a continuous electrical circuit is established through the contact system in the following manner: from the input switch terminal 70 to the switch terminals 63, 57, 60, 52, 48, 45, 43, 42, 49, 53 (when the contacts 49 and 53 close at sampling time by operation of the feed hole punch) 56, 62, 67 and 66 to the output conductor. Thus it will be seen from the foregoing examples of operation of the parity contact system that the latter maintains an open circuit between its input and output conductors so long as the punched code (including a redundant-bit as necessary) is odd but completes an electrical circuit between its input and output conductors in the event of an erroneous punch operation wherein the punched code (including a redundant-bit if added) is even.

The parity contact system shown in Fig. 4 is one suitable for a number of different code systems and for either open-circuit parity check control or closed-circuit parity check control as in the aforementioned copending application Serial No. 535,497. For example, it may be used with an 8-bit code by connecting the input conductor to switch terminal 73 and the output conductor to switch terminal 65 to provide a continuous electrical parity check circuit for an odd code system or an open electrical parity check circuit for an even code system. By connecting the input circuit as last mentioned but changing the output circuit to the switch terminal 66, an open electrical parity check circuit is provided for an odd code system or a completed electrical circuit for an even code system. When seven code bits are employed, the connection of the output circuit to the switch terminal 66 provides an open-circuit parity check as has been explained above, and connection of the output circuit of the switch terminal 65 provides a closed electrical circuit for an odd bit parity check or an open electrical circuit for an even bit parity check. Where a 6-bit code is used, the input circuit is connected to terminal 70 and the output circuit is connected to terminal 62 to provide a continuous electrical circuit for an odd bit parity check or to terminal 61 to provide an open electrical circuit for the odd bit parity check, or connection of the output circuit to the terminal 62 provides an open electrical circuit for an even bit parity check whereas terminal 61 provides a closed circuit for an even bit parity check. In similar manner, a 5-bit code requires connection of the input circuit to the terminal 63 with the output circuit connected to the terminal 62 to provide a closed electrical circuit for an odd bit parity check or an open electrical circuit for an even bit parity check whereas the connection of the output circuit to the switch terminal 61 provides an open circuit for an odd bit parity check and a closed circuit for an even bit parity check.

It will be apparent from the foregoing description of the present invention that a printing machine embodying the invention is characterized by unusual flexibility involving several selectable modes of operation as desired. Thus the machine may be manually operated to perform normal printing operations without information recording or verification, it may be manually operated to print copy while concurrently effecting recording of information required to duplicate the printed copy, it may be operated automatically to print copy under contral of information read from a record medium and this operation may if desired be accompanied by concurrent recording of information required to duplicate the printed copy, or it may be so operated that manual printing operations and the recording of information corresponding thereto may be accomplished only if verified against a source of verification information. All of these several types of available operations are to intercontrolled, however, that all recording operations require the presence of a supply of record media in the recorder or otherwise the machine becomes locked up against either manual or automatic operation, and each selection of a verification operation automatically terminates all automatic reproduction of copy and causes the machine to lock-up unless the recorder is concurrently selected. It will further be evident that a machine embodying the invention has the important advantage that any failure of verification is immediately and positively indicated by halting further operation of the machine until such time as the operator makes a determination that an error does or does not exist and has either manually corrected the error if one exists or has caused the error in the verification information to be bypassed. All recording operations are accompanied by an automatic parity check to insure that each recorded code conforms to a preestablished code system, and operation of the printing machine (and verification reader when used) is automatically halted upon parity failure and can be resumed only after deletion of the code last recorded thereby to insure a high degree of accuracy in all recorded information.

While a specific form of the invention has been described for purposes of illustration, it is contemplated that numerous changes may be made without departing from the spirit of the invention.

What is claimed is:

1. A verifying printing machine comprising, means operable in successive steps to print copy and including means for providing at each step thereof a first indi-

cation denoting the printing operation performed during said each step, means operable in successive steps controlled by said printing means for providing at each step thereof a second indication denoting a desired printing operation against which the identity of said first indication may be verified concurrently with said each printing step means for effecting concurrent step-by-step verification that said first indication is concurrently identical with said second indication, and means for providing an indication of departure from identity of said verified indications.

2. A verifying printing machine comprising, means operable in successive steps to print copy and including means for providing at each step thereof a first distinctive code identifying the printing operation performed during said each step, means operable in successive steps controlled by said printing means for providing at each step thereof a second distinctive code identifying a desired printing operation against which the identity of said first indication may be verified concurrently with said each printing step, means for effecting concurrent step-by-step verification that said first and second codes are concurrently identical, and means for providing an indication of departure from identity of said verified codes.

3. A verifying printing machine comprising, means operable in succesive steps to print copy and including plural coding elements providing at each operative step a selectable mechanical positioning of at least one thereof to identify by said selectable positioning the printing operation performed during said each step, means operable in successive steps controlled by said printing means and including plural code elements providing at each operative step an indication denoting a desired printing operation against which the identity of said printing operation may be verified concurrently with said each printing step, means for effecting concurrent step-by-step verification that the printing operation identified by said coding elements is concurrently identical wth the printing operation denoted by said code elements, and means for providing an indication of departure from identity of said verified operations.

4. A verifying printing machine comprising, means operable in successive steps to print copy and including plural electrical circuit control devices controlled at each operative step to provide a selectable binary state of each thereof to identify by the composite of said selectably established states the printing operation performed during said each step, means operable in successive steps controlled by said printing means and including plural electrical circuit control devices controlled at each operative step to provide a selectable binary state of each thereof to identify by the composite of said selectably established states a desired printing operation against which the identity of said first operation may be verified, means for effecting step-by-step verification that the printing operation identified by said first-mentioned devices is identical with the printing operation identified by said second-mentioned devices, and means for providing an indication of departure from identity of said verified operations.

5. A verifying printing machine comprising, means operable in successive steps to print copy and including plural electrical circuit control devices controlled at each operative step to provide a selectable binary state of each thereof to identify by the composite of said selectably established states the printing operation performed during said each step, means operable in successive steps controlled by said printing means and including plural electrical circuit control devices controlled at each operative step to provide a selectable binary state of each thereof to identify by the composite of said selectably established states a desired printing operation against which the identity of said first operation may be verified, and means for effecting step-by-step comparison of the established binary states of corresponding control devices of said printing and verifying means to verify that the printing operation of each step corresponds to that of said desired operation and for terminating the operations of said printing means upon failure of verification.

6. A verifying printing machine comprising, means operable in successive steps to print copy and including plural electrical circuit transfer devices establishing at each operative step a selectable transfer state of each thereof to identify by said selectable states the printing operation performed during said each step, means operable in successive steps controlled by said printing means and including plural electrical circuit transfer devices establishing at each operative step a selectable transfer state of each thereof to identify a desired printing operation against which the identity of said first operation may be verified, and means for effecting step-by-step comparison of the established transfer states of corresponding control devices of said printing and verifying means to verify that the printing operation of each step corresponds to that of said desired operation and for terminating the operations of said printing means upon failure of verification.

7. A verifying printing machine comprising, means operable in successive steps to print copy and including plural relays having electrical circuit control transfer contacts identifying at each operative step a selectable one of two states of energization of each of said plural relays corresponding to the printing operation performed during said each step, means operable in successive steps controlled by said printing means and including plural devices having electrical circuit control transfer contacts identifying by selectable positioning of each thereof a desired printing operation against which the operation of said printing means may be verified, and verifying means including electrical interconnecting circuits between said relay transfer contacts and control-device transfer contacts for effecting step-by-step verification that the printing operation of said printing means is identical with the printing operation identified by said last-mentioned means and for terminating the operation of said printing means upon failure of verification.

8. A verifying printing machine comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means having an operation synchronous with that of said printing means for reading a record medium to derive information against which said developed information may be verified, and means for effecting continuous verification that said developed information is identical with said derived information and responsive to any failure of identity verification for terminating the operation of said printing means.

9. A verifying printing machine comprising, means operable to print copy while concurrently developing at each step in the operation thereof functional-control and character-print information required to duplicate said printed copy, means having a cyclic operation synchronized in step with that of said printing means for reading a record medium to derive information against which said developed information may be verified, and means for effecting step-by-step verification that said developed information is identical with said derived information and responsive to any failure of identity verification for terminating the operation of said printing means.

10. A verifying printing machine comprising, key lever actuable means for printing copy while concurrently developing at each step in the operation thereof functional-control and character-print information required to duplicate said printed copy, means having a cyclic operation step-controlled by each key lever actuation for reading a record medium to derive information against which said developed information may be verified, and means

for effecting continuous verification that said developed information is identical with said derived information and responsive to any failure of identity verification for terminating the operation of said printing means.

11. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means energizable to record said information in a record medium, means operable under control of said printing means for deriving information denoting desired printing operations against which each printing operational step of said printing means may be verified, verifying means selectably operable to effect step-by-step verification that said developed and derived information denote identical printing operations and for providing an indication of failure of verification, and means responsive to selection of said verifying means for energizing said recording means under control of said verifying means to effect recording only of verified information but responsive to non-selection of said verifying means for permitting energization of said recording means independently of said verifying means to record nonverified information.

12. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means selectably energizable to record said information in a record medium, means operable under control of said printing means for deriving information denoting desired printing operations against which each printing operational step of said printing means may be verified, verifying means selectably operable to effect step-by-step verification that said developed and derived information denote identical printing operations and for providing an indication of failure of verification, means for terminating operation of said printing means upon selection of said verifying means without concurrent selection of said recording means, and means responsive to concurrent selection of said verifying and recording means for permitting operation of said printing means while energizing said recording means under control of said verifying means to effect recording only of verified information but responsive to selection of said recording means only for permitting operation of said printing means while energizing said recording means independently of said verifying means for recording unverified information.

13. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, selectable means energizable to record said information in a record medium, control means for terminating operation of said printing means upon selection of said recording means when devoid of said record medium, means operable under control of said printing means for deriving information denoting desired printing operations, verifying means selectably operable to effect step-by-step verification that said developed and derived information denote identical printing operations and for providing an indication of failure of verification, means for terminating operation of said printing means upon selection of said verifying means without concurrent selection of said recording means, and means responsive to concurrent selection of said verifying and recording means for permitting operation of said printing means while energizing said recording means under control of said verifying means to effect recording only of verified information but responsive to selection of said recording means only for permitting operation of said printing means while energizing said recording means independently of said verifying means for recording unverified information.

14. A machine for printing and recording information comprising, a plurality of relays each including means for indicating the state of energization of said each relay, means operable in steps to print copy while concurrently energizing said relays in coded combinations thereof denoting the printing operation performed at each step of said printing means, energizable means operating under control of said relays to record in a record medium functional-control and character-print information required to duplicate said printed copy, verification-information means operating in step synchronization with said printing means and including means indicating by coded combinations desired printing operational steps, verifying means selectably operable to effect step-by-step comparison of the indicating means of said relays with the indicating means of said last-mentioned means to verify that each operation performed during a step of said printing means corresponds to a desired operational step indicated by said verification-information means, and means responsive to selection of said verifying means for energizing said recording means under control of said verifying means to effect recording only of verified information but responsive to nonselection of said verifying means for permitting energization of said recording means independently of said verifying means to permit recording of unverified information.

15. A machine for printing verified copy and for effecting verified recording of information comprising, means operable to print copy while concurrently developing at each step in the operation thereof functional-control and character-print information required to duplicate said printed copy, means for receiving said developed information and responsive to actuating energization for recording said information in a first record medium, means having an operation synchronized with that of said printing means for reading a second record medium to derive information against which said developed information may be verified, and means responsive to verification that said developed information is identical with said derived information for providing said actuating energization of said recording means but responsive to any failure of identity verification for inhibiting said energization of said recording means and for terminating the operation of said printing means.

16. A machine for printing verified copy and for effecting verified recording of information comprising, means operable to print copy and including plural coding elements concurrently selectably actuated to predetermined interrelated positions individually indicative of functional-control and character-print information required to duplicate said printed copy, means controlled by said plural coding elements and responsive to actuating energization for recording said information in a first record medium, means having an operation synchronized with that of said printing means for reading a second record medium and including plural code-identifying elements selectably step actuated to predetermined interrelated positions identifying functional-control and character-print information read from said second medium, means for comparing at each operative step the actuated positions of said coding elements with the actuated positions of said code-identifying elements to verify at each said step that said information of said printing means corresponds to said information read from said second medium, and means responsive to each successful such verification for providing said actuating energization for said recording means but responsive to failure of verification for inhibiting said energization of said recording means and for terminating the operation of said printing means.

17. A machine for printing verified copy and for effecting verified recording of information comprising, means operable to print copy and including plural electrical circuit control devices controlled at each operative step to provide a selectable binary state of each thereof indicative of functional-control and character-print information required to duplicate said printed copy, means controlled by said devices and responsive to actuating energization for recording said information in a first rec-

ord medium, means operating in synchronized relation with said printing means for reading a second record medium and including plural electrical circuit control devices selectably step actuated to predetermined interrelated positions identifying functional-control and character-print information read from said second medium, means for comparing at each operative step the binary states of said first-mentioned control devices with the actuated positions of said second-mentioned devices to verify at each said step that said information of said printing means corresponds to said information read from said second medium, and means responsive to each successful such verification for providing said actuating energization for said recording means but responsive to failure of verification for inhibiting said energization of said recording means and for terminating the operation of said printing means.

18. A machine for printing verified copy and for effecting verified recording of information comprising, means operable to print copy and including plural relays having electrical circuit control transfer contacts actuated to identify at each operative step a selectable one of two states of energization of each of said relays corresponding to functional-control and character-print coded information required to duplicate said printed copy, means controlled by said relays and responsive to actuating energization for recording said information in a first record medium, means operable in successive steps controlled by said printing means for reading a second record medium and including plural devices having electrical circuit control transfer contacts actuated to identify by selectable positioning of each thereof functional-control and character-print information read from said second medium, verifying means including electrical interconnecting circuits between said transfer contacts of said relays and said devices for effecting step-by-step verification that said information of said printing means corresponds to said information read from said second medium, and means responsive to each successful such verification for providing said actuating energization for said recording means but responsive to failure of verification for inhibiting said energization of said recording means and for terminating the operation of said printing means.

19. A machine for printing verified copy and for effecting verified recording of information comprising, key lever actuable means for printing copy while concurrently developing at each step in the operation thereof functional-control and character-print information required to duplicate said printed copy, means for receiving said developed information and responsive to actuating energization for recording said information in a first record medium, means having a cyclic operation step-controlled by each key lever actuation for reading a second record medium to derive information against which said developed information may be verified, and means responsive to verification that said developed information is identical with said derived information for providing said actuating energization for said recording means but responsive to any failure of verification for inhibiting recording by said recording means of the information developed at the failure-of-verification step while concurrently locking said key levers against further actuation.

20. A machine for printing verifying copy and for effecting verified recording of information comprising, key lever actuable means for printing copy while concurrently developing at each step in the operation thereof functional-control and character-print information required to duplicate said printed copy, means controlling the interrelated operations of the key levers of said printing means to permit actuation of only one key lever at a time, means for receiving said developed information and responsive to actuating energization for recording said information in a first record medium, means having a cyclic operation step-controlled by each key lever actuation for reading a second record medium to derive information against which said developed information may be verified, and means responsive to verification that said developed information is identical with said derived information for providing said actuating energization for said recording means but responsive to any failure of verification for inhibiting recording by said recording means of the information developed at the failure-of-verification step while concurrently locking the actuated key lever in actuated position.

21. A machine for printing verified copy and for effecting verified recording of information comprising, means for printing copy and including manually actuable key levers intercontrolled to permit actuation of only one key lever at a time, means responsive to the operation of said printing means for developing and recording in a first record medium functional-control and character-print information required to duplicate said printed copy, means operating in step synchronization with said printing means for reading a second record medium to derive information against which said developed information may be verified, means for effecting continuous verification that said developed information is identical with said derived information and for controlling said recording means to permit recording thereby of verified information but responsive to any failure of verification for inhibiting recording of non-verified information while concurrently locking an actuated key lever in actuated position, and manually operable means for releasing said last-mentioned key lever to permit a further manual key lever actuation and effect recording by said recording means of information corresponding to said further key lever while concurrently verifying said further information to restore the control of said verifying means over the operation of said printing and recording means.

22. A machine for printing verified copy and for effecting verified recording of information comprising, means for printing copy and including manually actuable key levers mechanically interlocked to permit actuation of only one key lever at a time, means adapted in one position mechanically to latch any key lever in actuated position but controllable to a second nonlatch position, means responsive to the operation of said printing means for developing and recording in a first record medium functional-control and character-print information required to duplicate said printed copy, means operating in step synchronization with said printing means for reading a second record medium to derive information against which said developed information may be verified, means for verifying that said developed information is identical with said derived information, and means responsive to successful verification for controlling said recording means to permit recording thereby of verified information and for controlling said latching means to said nonlatch position thereof but responsive to failure of verification for inhibiting recording of nonverified information while permitting said latching means to latch an actuated key lever in actuated position.

23. A machine for printing verified copy and for effecting verified recording of information comprising, means for printing copy and including manually actuable key levers mechanically interlocked to permit actuation of only one key lever at a time, means adapted in one position mechanically to latch any key lever in actuated position but controllable to a second nonlatch position, means responsive to the operation of said printing means for developing and recording in a first record medium functional-control and character-print information required to duplicate said printed copy, means operating in step synchronization with said printing means for reading a second record medium to derive information against which said developed information may be verified, means for verifying that said developed information is identical with said derived information, means responsive to successful verificaiton for controlling said recording means to permit recording thereby of verified information and for controlling said latching means to said nonlatch posi-

tion thereof but responsive to failure of verification for inhibiting recording of nonverified information while permitting said latching means to latch an actuated key lever in actuated position, and manually operable means for actuating said latching means to nonlatch position to release said last-mentioned key lever and permit a further manual key lever actuation and for effecting recording by said recording means of information corresponding to said further key lever while concurrently verifying said further information to restore the control of said verifying means over the operation of said latching means and said recording means.

24. A verifying printing machine comprising, means for reading a record medium to develop control effects representative of functional-control and character-print information recorded in said medium, means selectably operable in the alternative by manual actuation and automatically in response to said developed control effects for printing copy while providing at each printing step thereof a first indication denoting the printing operation performed during said each step, means operable in successive steps controlled by said printing means for providing at each step thereof a second indication denoting a desired printing operation against which the identity of said first indication may be verified, verifying means selectably operable to effect step-by-step verification that said first and second indications denote identical printing operations and responsive to successful verification to permit continued operation of said printing means but responsive to an unsuccessful verification to terminate the operation of said printing means, and means responsive to selection of said verifying means for deactivating said reading means.

25. A verifying printing machine comprising, means for reading a record medium to develop control effects representative of functional-control and character-print information recorded in said medium, means selectably operable in the alternative by manual actuation and automatically in response to said developed control effects for printing copy while providing at each step thereof distinctively coded information identifying the printing operation performed during said each step, means operable in successive steps controlled by said printing means for providing at each step thereof distinctively coded verification information identifying a desired printing operation against which the identity of operation of said printing means may be verified, means for comparing said first coded information with said second coded information to verify at each step of said printing means that the operation thereof corresponds to said desired printing operation and to terminate the operation of said printing means upon failure of such verification, and means for rendering said reading means and said verifying means operable in the alternative.

26. A verifying printing machine comprising, means energizable to read a record medium to develop control effects representative of functional-control and character-print information recorded in said medium, means selectably operable in the alternative by manual actuation and automatically in response to said developed control effects for printing copy while concurrently developing at each step thereof functional-control and character-print information required to duplicate said printed copy, means energizable to be responsive to said duplicating information of said printing means for recording said duplicating information in a second record medium, means operable under control of said printing means for deriving information denoting desired printing operations against which each printing operational step of said printing means may be verified, verifying means selectably operable to effect step-by-step verification that said developed and derived information denote identical printing operations and responsive to successful verification to permit continued operation of said printing means but responsive to an unsuccessful verification to terminate the operation of said printing means, and means responsive to selection of said verifying means for transferring control of the energization of said recording means thereto and for deenergizing said reading means but responsive to nonselection of said verifying means for permitting selection of said recording and reading means by direct energizations thereof independently of said verifying means.

27. A verifying printing machine comprising, means operable in successive steps to print copy and including means for providing at each step thereof information denoting the printing operation performed during said each step, a record medium reader operable in cycles with respect to a quiescent home position but normally operable under control of said printing means to halt at a preselectable partial-cycle point in each operating cycle for reading and storing verifying information recorded in said record medium, means for effecting step-by-step verification that said first-mentioned information is identical with said last-mentioned information, and means responsive to each successful step verification for controlling said reader to effect release thereof past said partial-revolution halt position thereof.

28. A verifying printing machine comprising, means operable in successive steps to print copy and including means for providing at each step thereof information denoting the printing operation performed during said each step, a record medium reader operable in cycles with respect to a quiescent home position but normally operable under control of said printing means to halt at a preselectable partial-cycle point in each operating cycle for reading and storing verifying information recorded in said record medium, means for effecting step-by-step verification that said first-mentioned information is identical with said last-mentioned information, means for automatically cycling said reader past said partial-revolution halt and quiescent home positions thereof in response to lack of recorded information in said record medium, and means responsive to each successful step verification for controlling said reader to effect release thereof past said partial-revolution halt position thereof.

29. A verifying printing machine comprising, means operable in successive steps to print copy and including means for providing at each step thereof information denoting the printing operation performed during said each step, a record medium reader operable in cycles with respect to a quiescent home position but normally operable under control of said printing means to halt at a preselectable partial-cycle point in each operating cycle for reading and storing verifying information recorded in said record medium, means for effecting step-by-step verification that said first-mentioned information is identical with said last-mentioned information, means for automatically cycling said reader past information-deletion recordings of said record medium and past any portion of said record medium wherein no information is recorded, and means responsive to each successful step verification for controlling said reader to effect release thereof past said partial-revolution halt position thereof.

30. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means responsive to said developed information for recording said information in a record medium by use of a predetermined code-form system, verifying means responsive to a source of verification information for verifying each operation of said printing means and for providing an indication of failure of verification, and means responsive to the operation of said recording means for providing an indication of any deviation of recording by said recording means from said predetermined code-form system.

31. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print

information required to duplicate said printed copy, means responsive to said developed information for recording said information in a record medium by use of a predetermined code-form system, verifying means responsive to a source of verifying information for verifying each operation of said printing means and for terminating operation of said printing means upon failure of verification, and means responsive to the operation of said recording means for terminating operation of said printing means upon any deviation of recording by said recording means from said predetermined code-form system.

32. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means responsive to said developed information for recording said information in a record medium by use of a predetermined code-form system, verifying means responsive to a source of verifying information for verifying each operation of said printing means for terminating operation of said printing means upon failure of verification, means responsive to the operation of said recording means for terminating operation of said printing means upon any deviation of recording by said recording means from said predetermined code form system, and means responsive to a code deletion operation of said recording means following said termination of operation of said printing means for permitting restoration of said printing means to operative condition.

33. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means responsive to said developed information for recording said information in a record medium by use of a predetermined code-form system, means operable under control of said printing means for deriving information denoting desired printing operations, verifying means responsive to said derived and developed information for verifying each operation of said printing means and for terminating the operations of said printing means and said verification information deriving means upon failure of verification, and means responsive to the operation of said recording means for terminating operation of said printing means and said verification information deriving means upon any deviation of recording by said recording means from said predetermined code-form system.

34. A machine for printing and recording information comprising, means operable to print copy while concurrently developing functional-control and character-print information required to duplicate said printed copy, means responsive to said developed information for recording said information in a record medium by use of a predetermined code-form system, verifying means responsive to a source of verifying information for verifying each operation of said printing means and for terminating operation of said printing means upon failure of verification, means responsive to the operation of said recording means for terminating operation of said printing means upon any deviation of recording by said recording means from said predetermined code-form system, and means responsive to a code deletion operation of said recording means and to a subsequent manual operation of said printing means correcting said recording for automatically conditioning said printing and verification means to continue verified operations.

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