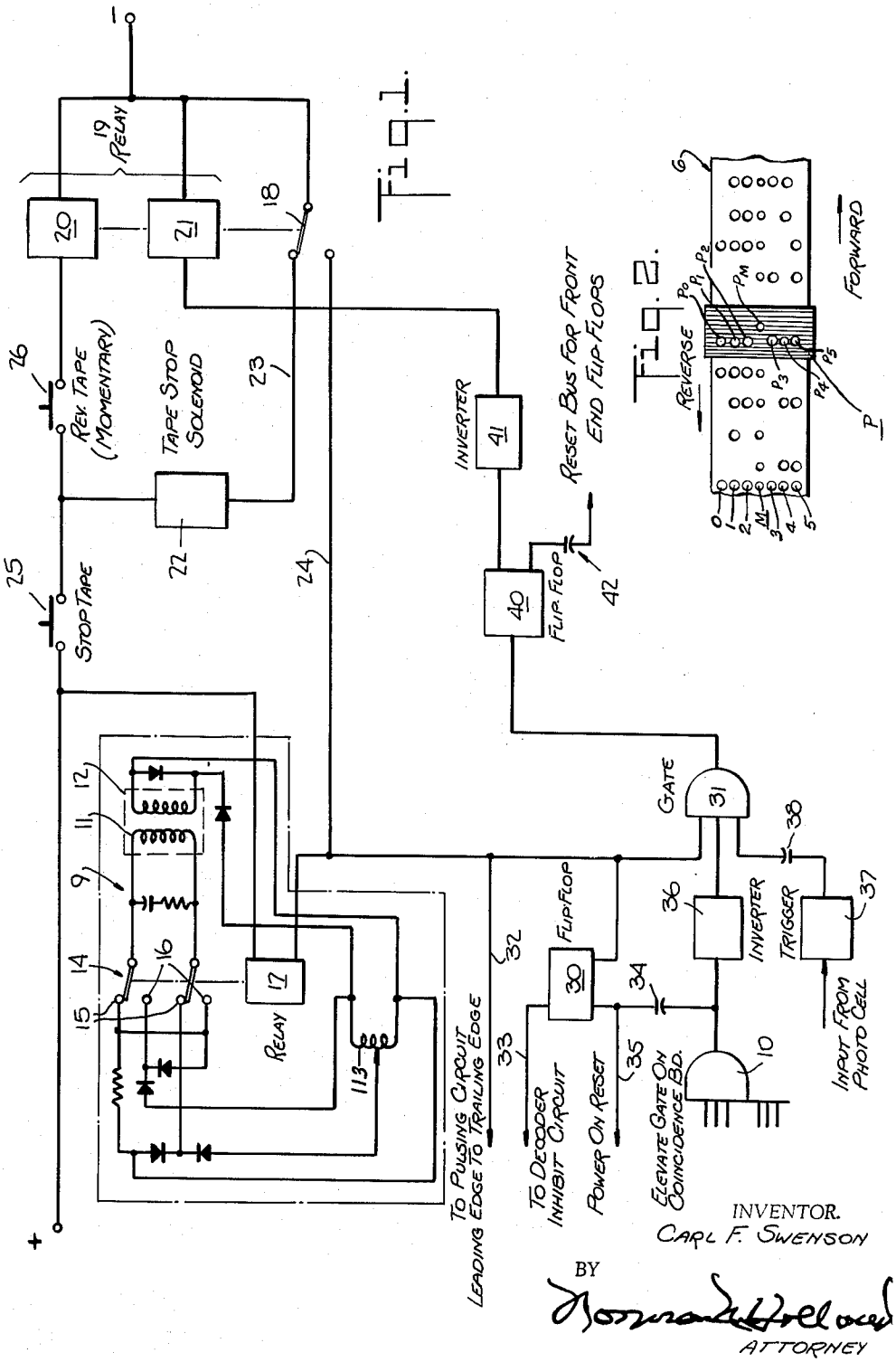
Sept. 21, 1965 C. F. SWENSON 3,208,041

LINE-CASTING MACHINE

Filed Sept. 30, 1963 3 Sheets-Sheet 1



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LINE-CASTING MACHINE

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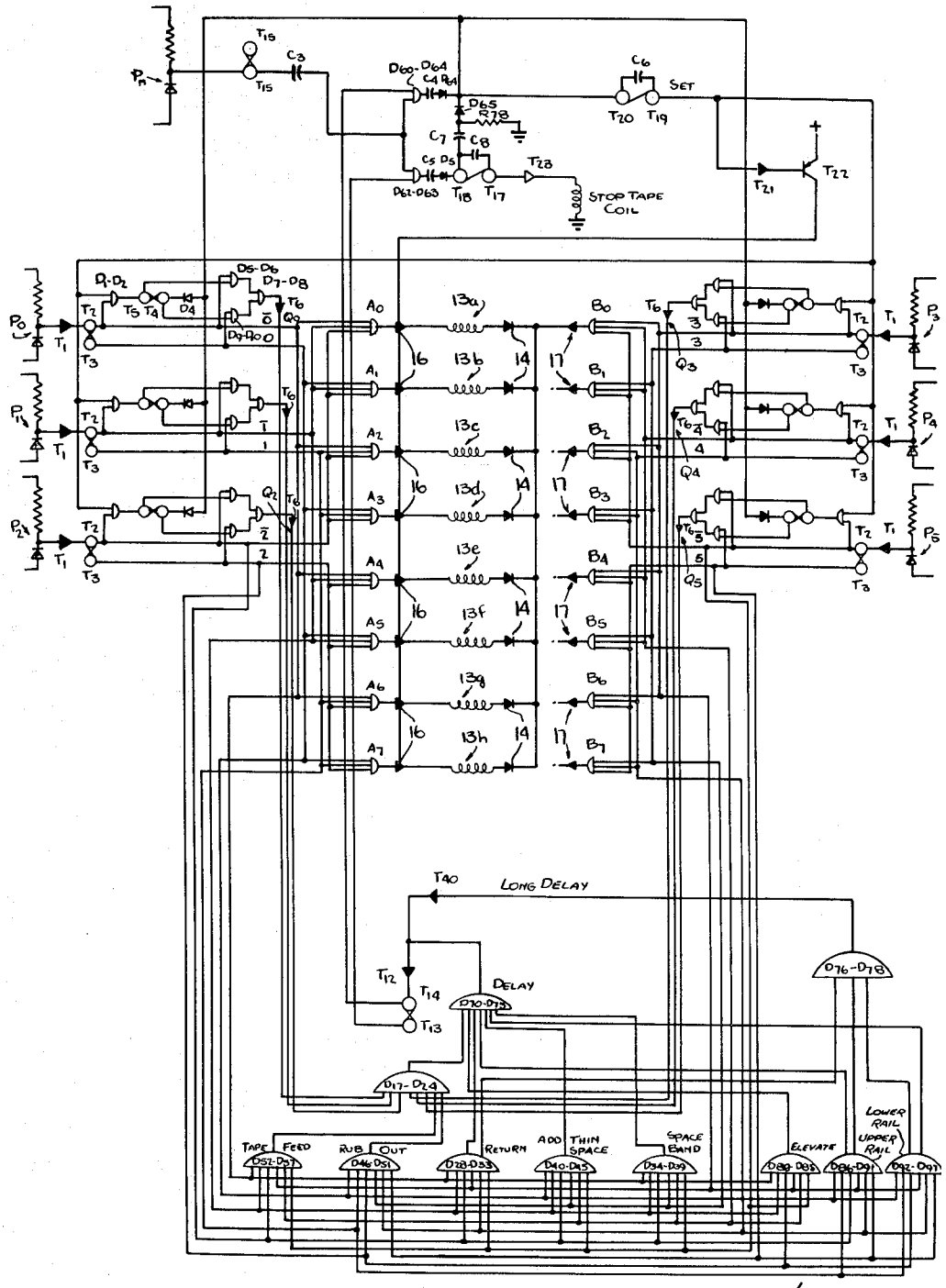


Fig. 3.

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LINE-CASTING MACHINE

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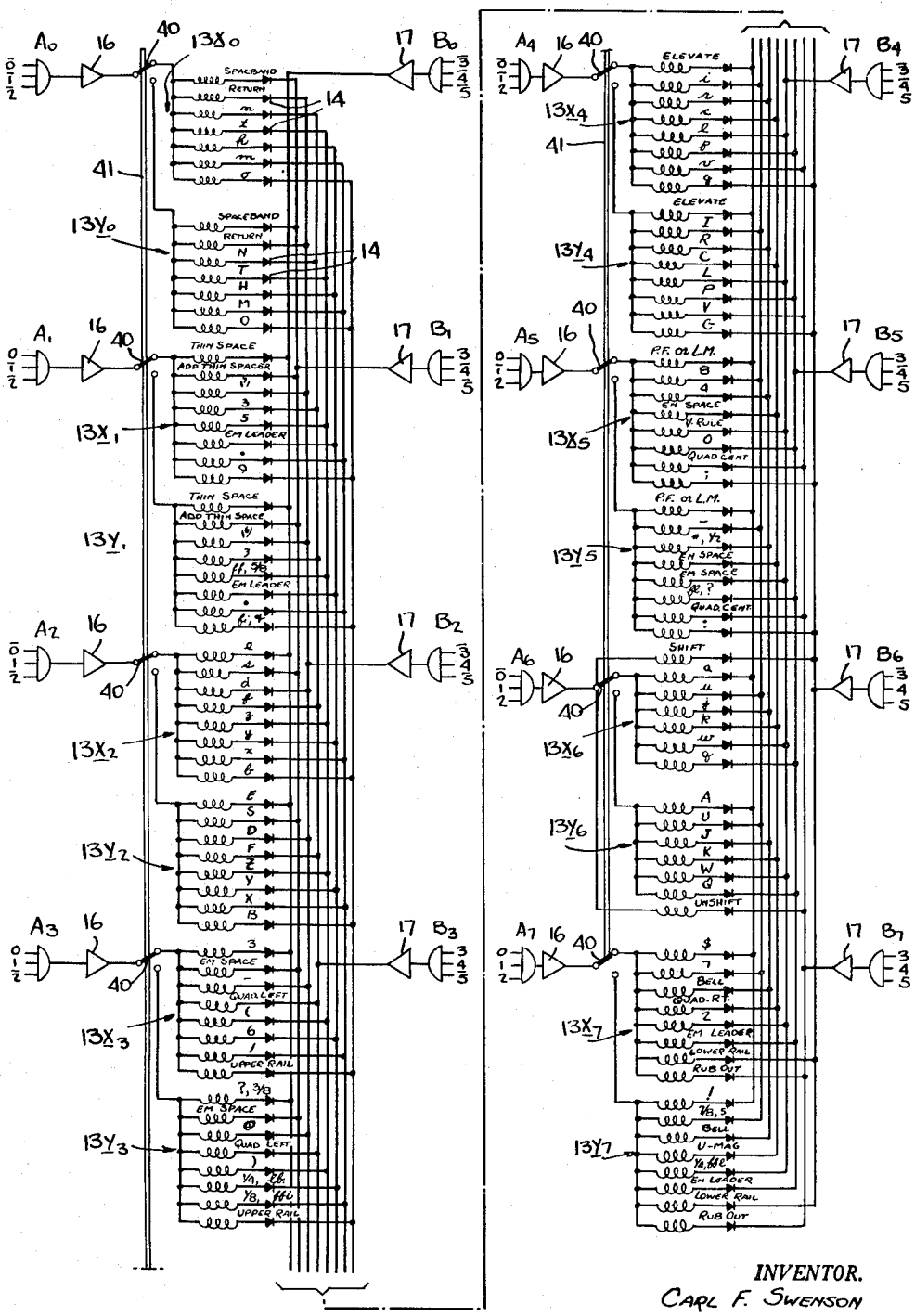


Fig. 4.

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3,208,041

LINE-CASTING MACHINE

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Filed Sept. 30, 1963, Ser. No. 312,698
18 Claims. (Cl. 340—147)

The present invention relates to an improved line-casting machine and more particularly to an improved control mechanism for automatic line-casting machines.

The present invention is an improvement over my co-pending United States Patent application Serial No. 95,577, filed in the United States Patent Office on March 14, 1961.

Automatic line-casting machines, as described in said co-pending application, are controlled by perforated tape which is moved through a tape reader. The tape reader senses the perforations or code openings on the tape as it passes therethrough and energizes certain circuits which cause the machine to perform predetermined functions.

As well-known, a line-casting machine operates by releasing a plurality of matrices from a magazine and depositing them on an elevator. When a complete line of matrices has been assembled on the elevator, the elevator is raised to a position where the assembled matrices are cast into a line of type.

In automatic line-casting machines which are controlled by a perforated tape, the code openings in the tape cause the mats to be dropped from the magazine and assembled on the elevator and also cause the machine to go through its various functions, such as raising the elevator, lowering the elevator, etc.

In the operation of such automatically-controlled line-casting machines, it sometimes becomes necessary to repeat a line, as, for example, when a malfunction of the line-casting machine prevents a particular line from being cast.

In such situations, the operator of the machine must first stop the machine and remove the defective line. He then removes the tape from the tape reader, searches for the code opening in the tape which energized the last elevate circuit, and replaces the tape in the tape reader at the proper position. He then starts the machine again so that the defective line can be recast. As will be obvious, such an operation is both time consuming and expensive.

The present invention eliminates these disadvantages and provides an improved control mechanism for a line-casting machine whereby the line will be automatically reassembled on the elevator.

Another object of the present invention is the provision of an improved control mechanism for a line-casting machine in which the perforated tape is automatically moved back to the proper position.

Another object of the present invention is the provision of an automatic control mechanism for line-casting machines which permits the tape reader to be removed from the close proximity of the line-casting machine.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a logic diagram showing the improved control mechanism for permitting the tape to back-up automatically to the beginning of the line to be recast;

FIG. 2 is a schematic plan view of the perforated tape and tape reader adapted to be used in the present invention;

FIG. 3 is a schematic simplified diagram showing an automatic control circuit for line-casting machines; and

FIG. 4 is a schematic diagram showing the solenoids for releasing individual matrices.

As more fully described in said application Serial No. 95,577, a line-casting machine comprises a keyboard having a plurality of individual keys. Each key has a letter or other symbol on its face and when depressed is adapted to release a matrix from a magazine.

In automatic line-casting machines, each key is depressed by a solenoid which may be located beneath the keys. When a particular solenoid is energized by a circuit which will be described hereinafter, its armature is moved to depress a key which in turn actuates the matrix-releasing mechanism to release a particular matrix from a storage magazine.

The automatic control circuit for solenoids **13***a* to **13***h* which actuates a particular key is closed by the perforated code tape **6**. The tape has six code openings designated 0, 1, 2, 3, 4, 5 which will open a particular path in the circuit depending upon the particular combination of code holes which is read by a tape reader, which will be described in greater detail hereinafter. The tape **6** has a central smaller opening M to permit a signal to be pulsed through the circuit to energize a particular solenoid **13***a* to **13***h* and release a particular matrix.

As shown in FIG. 2, the openings have been designated "0," "1," and "2" on one side of the central pulsing hold M and "3," "4," and "5" on the other side of the central pulsing opening M. By a combination of these code holes it will be noted that a number of paths through the circuit can be opened, each of the paths leading to one of the solenoids **13***a* to **13***h* which is controlled thereby.

In addition to releasing matrices from the magazine, the tape **6** also controls all of the other functions of the machine, such as "elevate," "upper rail," "lower rail," etc. In all, through a shift and unshift circuit, hereinafter described, the perforated tape **6** is capable of 128 combinations to operate the line-casting machine fully automatically.

The coded tape **6** is read by a photo-electric mechanism which comprises a light source and a photo-diode housing P comprising photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5 overlying the paths of openings, 0, 1, 2, 3, 4 and 5, respectively, and a centrally located photo-diode P_m overlying the path of the central pulsing opening M.

The photo-diodes P_0 to P_5 are adapted to read the tape **6** to determine whether there is a hole present therebeneath or whether there is a no-hole (absence of a hole) therebeneath. In either case, a circuit is closed to the particular solenoid **13***a* to **13***h*.

Referring to FIG. 3 shows eight solenoids **13***a* to **13***h* only, for clarity, the signals from the photo-diodes P_0 to P_5 are amplified by an amplifier T_1 and by means of the flip-flop T_2 and T_3 a "hole" line is closed or the "no-hole" line is closed. In each case, the particular "hole" line or "no-hole" line closed corresponds to the particular combination of code holes 0 to 5 appearing on the tape **6** when it is read by the photo-diodes P_0 to P_5 in the photo-diode housing P. For this reason, the "hole" lines in FIG. 1 have been designated 0, 1, 2, 3, 4 and 5 corresponding to the designations of the code holes 0 to 5 in tape **6**, to indicate that if a particular code hole is read the corresponding "hole" line is closed and the "no-hole" lines in FIG. 1 have been designated $\bar{0}$, $\bar{1}$, $\bar{2}$, $\bar{3}$, $\bar{4}$ and $\bar{5}$ to indicate that if a particular code hole in the tape does not appear, the corresponding "no-hole" line will be energized.

Each "hole" line "0" to "2" and each "no-hole" line $\overline{0}$ to $\overline{2}$ is connected to a plurality of gates A_0 to A_7 connected through amplifying circuits **16** to one side of solenoids **13***a* to **13***h* and each "hole" line 3 to 5 and each "no-hole" line $\overline{3}$ to $\overline{5}$ is connected to a plurality of gates B_0 to B_7 connected through amplifying circuits **17** to the other side of the solenoids **13***a* to **13***h*. Each of these gates are "and" gates so that all the conditions of the gate must be satisfied before the gate will open.

The "hole" line 0 is connected to gates A_1, A_3, A_5 and A_7 and corresponding "hole" line 3 on the other side is connected to gates B_1, B_3, B_5 and B_7. The "no-hole" lines $\overline{0}$ and $\overline{3}$ are connected to gates A_0, A_2, A_4 and A_6 and to gates B_0, B_2, B_4 and B_6, respectively. The "no-hole" lines $\overline{1}$ and $\overline{4}$ are connected, respectively, to gates A_0, A_1, A_4 and A_5 and B_0, B_1, B_4 and B_5 whereas the "hole" lines 1 and 4 are connected to gates A_2, A_3, A_6 and A_7 and to B_2, B_3, B_6 and B_7. Finally, "no-hole" lines $\overline{2}$ and $\overline{5}$ are connected to gates A_0, A_1, A_2 and A_3 and B_0, B_1, B_2 and B_3 while "hole" lines 2 and 5 are connected to gates A_4, A_5, A_6 and A_7 and B_4, B_5, B_6 and B_7.

With this arrangement, a particular gate on each side of the solenoids **13***a* to **13***h* will be opened each time the tape is read by the photo-diodes P_0 to P_5. The example, gate A_0 will only operate if codes $\overline{0}$, $\overline{1}$ and $\overline{2}$ (i.e., holes 0, 1, 2 do not appear on the tape) are read by the photo-diode and B_0 will be opened when codes $\overline{3}$, $\overline{4}$ and $\overline{5}$ are read by the photo-diodes. On the other hand, gates A_7 and B_7 will only be operated if the codes 0, 1, 2, 3, 4 and 5 (i.e., all the holes) appears on the tape.

Since the solenoids **13** are between the two sets of gates A_0–A_7 and B_0–B_7, a path through a single solenoid only is opened depending on which gates have been opened responsive to the code combination on the tape.

This is shown in the simplified version of the solenoid bank shown in FIG. 3. Each gate A_0–A_7 is shown as being connected to the solenoids **13***a* to **13***h*, respectively. The gate B_0 is shown connected to all the solenoids **13***a* to **13***h*. For clarity, gates B_1 to B_7 have been shown as being unconnected to any solenoids.

With this arrangement if the photo-diodes read the code 0, 1, 2, $\overline{3}$, $\overline{4}$, $\overline{5}$, the gates A_7 and B_0 are opened and the path through solenoid **13***a* is opened. Similarly, if the code is $\overline{0}$, 1, 2, $\overline{3}$, $\overline{4}$, $\overline{5}$, then gates A_6 and B_0 would be opened to close the circuit to solenoid **13***g*. The paths through the other solenoids **13***a* to **13***f* are opened in a similar manner.

It will thus be seen that depending upon the code combination in the tape which is read by the tape reader, a predetermined path will be opened through a particular solenoid and that when the central hole M on the tape is then read by the photo-diode P_m, the signal will be pulsed through the predetermined path in the circuit to energize that solenoid only which will release a matrix or perform another function of the machine.

Inherent within the basic design of a type-casting machine, it takes longer for two successive matrices to be selected from the same channel or a magazine than it does for two successive matrices from different channels of the same magazine. When operating at higher speeds it is necessary to slow the reader down when dual characters are sensed so that the second character of the dual would not be left in the magazine.

In order to avoid this, the present invention introduces a delay in the machine which will stop the tape reader for a predetermined amount of time so that after the first character is released, the machine can catch up before the second character will be released.

As shown in FIG. 3, the gate D_1–D_2 has a positive "set" signal from the pulsing circuit, described more fully hereinafter, and receives a signal from the transistor T_2 each time a code is read by the photo-diodes. If a hole appears under the same photo-diode in successive code combinations in the tape, the points Q_0 to Q_5 are at a negative potential indicating coincidence. If, on the other hand, the first and second holes were different points, Q_0 to Q_5 would be at ground potential for no coincidence.

Each of the points Q_0 to Q_5 are connected to the D_{17}–D_{22} portion of "and" gate D_{17}–D_{24}. If all the Q_0 to Q_5 are at a negative potential, indicating coincidence of two successive codes, the gate D_{17}–D_{24} is opened and the "or" delay gate D_{70}–D_{76} is opened which places flip-flop T_{13}–T_{14} in condition to insert a delay in the pulsing circuit and to stop the tape reader.

If there is no coincidence, the collector of T_{14} is at ground potential and that of T_{13} is at a negative potential and the opposite occurs if there is coincidence. Transistors T_{13} and T_{14} lead to "and" gates D_{62}–D_{63} and D_{60}–D_{61}, respectively, and each of these gates also receives a signal from the central pulsing photo-diode P_m through flip-flop T_{15}–T_{16} and condenser C_3. If there is no coincidence, flip-flop T_{20}–T_{19} will operate the pulsing transistor T_{22} to send a pulse through the path which has been opened by photo-diodes P_0 to P_5 to energize a particular solenoid or to perform some function of the machine.

However, if there is coincidence, the oscillator T_{17}–T_{18} will introduce a delay in the pulsing of the signal through flip-flop T_{19}–T_{20} to allow the second matrix to reach its releasing position and at the same time will stop the tape from being fed to prevent other matrices from being released. After a predetermined amount of time, the signal is released through the transistor T_{22} to release the second matrix and the tape is again allowed to move.

After each cycle, a signal from the pulsing circuit resets the flip-flop of T_4–T_5 of the memory circuit to its normal state so that the cycle can start again.

Delays are also introduced in a similar manner for "return, "space band" and "add thin space" signals. For "elevate," "lower rail" and "upper rail" signals, extra long delays are introduced to permit these functions to be completed.

Referring to the drawings and more particularly to FIG. 2, control of the function of a line-casting machine (not shown) is accomplished by a perforated tape **6** having a series of perforations or code openings 0, 1, 2, 3, 4, 5, therein and a central pulsing opening M. The tape **6** is moved through a tape reader P which has means for sensing the code openings 0, 1, 2, 3, 4, 5, in the tape **6**. In the preferred embodiment of the invention, as shown in the drawings, the tape reader P has a plurality of photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5 which are adapted to respond to light passing through the code openings 0, 1, 2, 3, 4, 5, in the tape **6** as the tape **6** is moving through the tape reader.

The sensing of light from the code opening by the photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5 will open a predetermined path in a circuit of the automatic line-casting machine.

The tape reader P is provided with a central pulsing photo-diode cell P_m which is adapted to pulse a signal through the path previously opened by the sensing of the code openings 0, 1, 2, 3, 4, 5, to cause the machine to perform a function.

As fully described in said co-pending application Serial No. 95,577 described above, the photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5 are coupled to a decoder circuit. The decoder circuit comprises a front end amplifier which amplifies the signal from each photo-diode P_0, P_1, P_2, P_3, P_4 and P_5. Depending on whether a "hole" or "no-hole" appears, a flip-flop will open a circuit to either the "no-hole" line or the "hole" line of both an upper and lower decoder now to be described.

Each line is connected to several "and" gates of a first set of three photo-diodes which constitute the upper decoder and another set of "and" gates are connected to the lines of the lower decoder comprising a second set of three photo-diodes. A particular code opening combination in the tape will open a single path through the circuit which will cause the machine to perform a predetermined func-

tion. As the tape continues to move, the central pulsing opening M is sensed by the central pulsing photo-diode P_m and a signal is pulsed through the open path to perform a function of the machine.

Each new signal from each of the photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5 is compared with the old signal by means of a memory circuit and is transferred to a coincidenc gate through a memory flip-flop. The coincidence gate will be conditioned by the signals so that if the two are identical, it will actuate a delay mechanism which will stop the feeding of the tape for a predetermined time interval in order to give the second matrix time to move to the release position before the actual signal is pulsed through the path.

An elevate "and" gate **10** (D_{80}–D_{85} in FIG. 3) is provided and is in circuit with the front end amplifiers which receive the signals from the photo-diodes P_0, P_1, P_2, P_3, P_4 and P_5. After the matrices have been assembled on the elevator, an elevator code opening is sensed by the tape reader. This elevator code opening satisfies the elevator gate **10** so that a circuit is closed to the elevator-raising mechanism. When the next pulsing opening is sensed by the pulsing photo-diode, a signal is pulsed through the elevate circuit to raise the elevator to the casting position.

In order to move the tape back in the reverse direction when a malfunction occurs so that the tape will be at the beginning of a line to be recast, the movement of the tape in the forward direction must first be stopped. The tape must then be moved in the reverse direction. While moving in the reverse direction, the reading of the code openings P_0, P_1, P_2, P_3, P_4 and P_5 by the photo-diodes M must be inhibited. However, the elevate code opening should be recognized so that the mechanism will sense when the beginning of the line to be recast has been reached. However, instead of raising the elevator, this elevate code opening is used to stop the movement of the tape in the reverse direction. The tape must then be moved in the forward direction but the first elevate signal which the tape reader will sense must also be inhibited since there are no matrices on the elevator. All subsequent openings must be recognized by the reader.

The motor unit **9** for driving the tape reader P for moving the tape in the forward direction comprises the usual windings **11** and **12** and a third winding **113** adapted to apply full power when the motor is reversed. A double throw two-position reverse motor contact arm **14** movable from a normal position in circuit with contacts **15** to a position in circuit with contacts **16** is controlled by a reversing relay **17**.

The reversing relay **17** is controlled by a control contact arm **18** of a latching-type control relay **19** having a set coil **20** and a reset coil **21**. The control contact arm **18** is normally in circuit with a stop tape solenoid **22** through lead **23** and is movable into circuit with reversing relay **17** through lead **24** when the set coil **20** of the relay **19** is energized.

The stop tape solenoid **22** is controlled by a stop tape switch **25** which is a "push-on–push-off" switch. The latch-type relay **19** is controlled by a reverse tape switch **26** (which is a momentary switch) through the stop tape solenoid and control contact arm **18**.

With the position of the parts as in FIG. 1, the stop tape switch **25** is depressed to close the circuit to the stop tape solenoid **22** which is energized to stop the feeding of the tape **6**. The tape then remains stopped until the reverse tape switch **26** is depressed. Upon depression of the reverse tape switch **26** the set coil **20** of the latching-type control relay **19** is energized to move the control contact arm **18** to a position in circuit with lead **24**. This movement of the control contact arm **18** breaks the circuit to the stop tape solenoid **22**, thus freeing the tape for movement.

When the control contact arm **18** closes the circuit with lead **24**, the reversing relay **17** is energized to move the reverse main contact arm **14** into contact with contacts **16** to reverse the direction of the power so that the motor now operates in the reverse direction and the tape moves in the reverse direction. In addition the winding **113** is now in the circuit so that maximum voltage is applied and the tape moves in the reverse direction at full speed.

It will be noted that lead **24** is in circuit with the pulsing circuit through lead **32** to change the logic from leading edge to the trailing edge of the pulsing opening P_m in the tape **6**. Since the tape is moving in the reverse direction, the logic must be changed.

The lead **24** is also connected to one side of a flip-flop **30**. The flip-flop **30** is connected to the decoder circuit through lead **33** and has its other side coupled to the elevate gate **10** through a capacitor **34** and to the circuit for supplying power on reset through lead **35**.

The lead **24** also feeds into a control "and" gate **31**. The control gate **31** is also fed by the elevate gate **10** through an inverter **36** and by the photo-diodes of the tape reader through a trigger **37** (which may be a so-called "Schmit trigger") and a capacitor **38**.

The output of the "and" gate **31** is in circuit with a monostable flip-flop **40** having a timed output. One side of said flip-flop **40** is in circuit with the reset coil **21** of the control relay **19** through inverter **41** and the other side of flip-flop **40** is in circuit with the resetting circuit for the front end flip-flops through capacitor **42**.

With this arrangement, when control contact arm **18** is moved into circuit with lead **24**, power is directed on one side of flip-flop **30** to hold it in the set position. This immediately places a negative bias on the decoder circuit to inhibit the reading of the code openings in the tape **6**.

At the same time, the logic of the pulsing circuit is reversed since power is supplied to the pulsing circuit through lead **32** so that the trailing edge of the pulsing opening is read by the pulsing photocell P_m rather than the leading edge. This is necessary since the tape is in the reverse direction and the logic is also reversed.

Simultaneously, power is fed to the control gate **31** so that one of the three conditions of gate **31** is met.

The tape **6** now is moving in the reverse direction, however, the decoder circuit which would ordinarily analyze the code openings in the tape is inhibited by the flip-flop **30**. Hence no matrices will be released from the magazine. The tape **6** continues to move in the reverse direction until an elevate code opening appears on the tape **6**.

When an elevate code opening appears on tape **6** (at the beginning of the line which is to be recast) elevate gate **10** is satisfied and a signal is pulsed through the capacitor **34** into the other side of the flip-flop **30**. However, flip-flop **30** is not reset since it is still coupled to a negative voltage through lead **24**, as discussed above.

A signal from the elevate gate **10** is also pulsed to the control gate **31** through the inverter **36**. When the next pulsing opening is sensed by the central photo-diode P_m (at this point the tape is still moving in the reverse direction), the trigger **37** fires through capacitor **38** into the control gate **31** so that all the conditions of the control gate **31** are satisfied.

Once satisfied the control gate **31** fires a pulse into the flip-flop **40**. This energizes the reset coil **21** of the latching-relay **19** through the inverter **41** and, simultaneously, flip-flop **40** sends pulse to reset the front end flip-flops of the decoder circuit through capacitor **42**.

Because of the fact that it takes longer for the reset coil **20** to be energized than for the front end flip-flops to be reset, elevate gate **10** is reset before the control contact arm **18** is returned to its normal position in circuit with stop tape solenoid **22**. When the latching-relay **19** is reset, the stop tape solenoid **22** is again energized to stop the tape and the circuit to reverse relay **17** is broken so that the reverse contact arm **14** again returns to the normal position in circuit with contacts **15** so as to put the motor into the forward position.

In addition, the logic is again reversed so that the leading edge of the pulsing opening is again read.

The tape has been stopped and will not move until the operator again moves the stop tape switch **25**. When this occurs, the stop tape solenoid **22** is released so that the tape moves in the forward direction. The elevate code opening (this is the same code opening that originally satisfied elevate gate **10** when the tape was moving in the reverse direction) is then read by the tape reader and the elevate gate **10** again is satisfied and pulses a signal through capacitor **34** to reset the flip-flop **30**. This releases the inhibit on the decoder circuit so that the operation resumes its normal sequence.

It will be seen that the present invention provides an improved control mechanism for line-casting machines whereby a defective line will be automatically reassembled and whereby the tape will be automatically moved back to the proper position.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be intrepreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. A control mechanism for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening adapted to cause the elevator of the line-casting machine to elevate, means for stopping the forward movement of the tape, control means for reversing the movement of the tape through the reader and for inhibiting said function-performing means when the tape is moving in the reverse direction, means responsive to a predetermined elevate code opening in said tape for stopping the movement of the tape in the reverse direction, means for moving the tape in the forward direction, said control means preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening for releasing the inhibit on said function performing means.

2. A control circuit for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape, for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate circuit adapted to be closed by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, means for stopping the forward movement of the tape, control means for simultaneously releasing the tape for reverse movement and operable for reversing the movement of the tape through the reader, means operable by said control means for inhibiting said function-performing means when the tape is moving in the reverse direction, said control means preventing said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse direction, said control means being operable by the elevate pulse to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening for releasing the inhibit on said function-performing means.

3. A control circuit for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate circuit adapted to be closed by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, means for stopping the forward movement of the tape, control means in circuit with said stopping means and operable to open a circuit to said stopping means and close a circuit to means for reversing the movement of the tape through the reader, means energized by said operation of said control means for inhibiting said function-performing means when the tape is moving in the reverse direction, said control means preventing said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse direction, means for causing said elevate pulse to operate said control means to close the circuit to said stopping means to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening for releasing the inhibit on said function-performing means.

4. A control circuit for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate circuit adapted to be closed by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, means for stopping the forward movement of the tape, a control relay in circuit with said stopping means and adapted to be energized to opening a circuit to said stopping means and close a circuit to means for reversing the movement of the tape through the reader, means energized by said control relay for inhibiting said function-performing means when the tape is moving in the reverse direction, said control relay adapted to prevent said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse direction, means for causing said elevate pulse to operate said control relay to close the circuit to said stopping means to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening for releasing the inhibit on said function-performing means.

5. A control mechanism for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate circuit adapted to be closed by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, a stop tape solenoid for stopping the forward movement of the tape, a control relay in circuit with said stop tape solenoid and adapted to be energized to open a circuit to said stop tape solenoid and close a circuit to means for reversing the movement of the tape through the reader, means energized by said control relay for inhibiting said function-performing means when the tape is moving in the reverse direction, said control relay adapted to prevent said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse

direction, means for causing said elevate pulse to operate said control relay to close the circuit to said stop tape solenoid to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening to release the inhibit on said function-performing means.

6. A control mechanism for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate circuit adapted to be closed by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, a stop tape solenoid for stopping the forward movement of the tape, a control relay in circuit with said stop tape solenoid and adapted to be energized to opening a circuit to said stop tape solenoid and close a circuit to means for reversing the movement of the tape through the reader, a flip-flop activated by operation of said control relay for inhibiting said function-performing means when the tape is moving in the reverse direction, said control relay adapted to prevent said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse direction, means for causing said elevate pulse to operate said control relay to close the circuit to said stop tape solenoid to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening to release the inhibit on said function-performing means.

7. A control mechanism for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, means responsive to the code openings in said tape for performing a function of said line-casting machine, said code openings including an elevate code opening, an elevate gate, an elevate circuit adapted to be closed by the satisfaction of said elevate gate by an elevate code opening, pulsing means for pulsing a signal through said elevate circuit to cause the elevator of the line-casting machine to elevate, a stop tape solenoid for stopping the forward movement of the tape, a control relay in circuit with said stop tape solenoid and adapted to be energized to open a circuit to said stop tape solenoid and close a circuit to means for reversing the movement of the tape through the reader, a flip-flop activated by operation of said control relay for inhibiting said function-performing means when the tape is moving in the reverse direction, said control relay adapted to prevent said elevate pulse from raising the elevator when a predetermined elevate code opening is read by the reader while the tape is moving in the reverse direction, means for causing said elevate pulse to operate said control relay to close the circuit to said stop tape solenoid to stop the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said predetermined elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening to release the inhibit on said function-performing means.

8. A control mechanism for a line-casting machine comprising a tape reader, means for moving a tape having code openings therein through said tape reader, said code openings including an elevate code opening adapted to cause the elevation of the line-casting machine to elevate, a control circuit for said line-casting machine, said circuit including means responsive to the code openings in the tape for performing a function of said line-casting machine, said circuit including an elevate gate responsive to an elevate code opening in the tape to cause the elevator of the line-casting machine to elevate, a motor controlled by said circuit for moving the tape in the forward direction, a stop tape solenoid in said circuit for stopping the forward movement of the tape, a control relay in circuit with said stop tape solenoid and adapted to be energized to open a circuit to said stop tape solenoid and close a circuit to means for reversing said motor to move the tape in the reverse direction, a flip-flop activated by said control relay for inhibiting the function-performing means when the tape is traveling in the reverse direction, means for causing a predetermined elevate code opening in said tape to energize said elevate gate, means responsive to said elevate gate to operate said control relay to close the circuit to said stop tape solenoid for stopping the movement of the tape in the reverse direction, means for moving the tape in the forward direction, means for preventing the elevator from elevating when said elevate code opening is read by the tape reader when the tape is traveling in the forward direction, and means responsive to said predetermined elevate code opening to release the inhibit on said function-performing means.

9. A line-casting machine, a control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, means in circuit with said stop tape solenoid and operable to energize said stop tape solenoid, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, means in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor controlling means, a control relay adapted to control said control contact arm, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with the control relay and in circuit with said decoder circuit.

10. A line-casting machine, control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, means in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position con-

tact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and re-set coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with the reset coil of the latching-type contact relay and in circuit with said decoder circuit.

11. A line-casting machine control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction and to a second position to supply power to the winding of said motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second postion contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with a reset coil of the latching-type control relay and in circuit with said decoder circuit.

12. A line-casting machine control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction and to a second position to supply power to the winding of said motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position of said reverse motor contact arm, a control main contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit wth said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, a flip-flop in circuit with said control gate, said flip-flop in circuit with the reset coil of the latching-type control relay and in circuit with said decoder circuit.

13. A line-casting machine, control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energize to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position of said reverse contact arm, a main contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said main contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set of coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the main contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop through a capacitor, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate through a capacitor, said elevate gate feeding into said control gate through an inverter, a monostable flip-flop having a timed output in circuit with said control gate, said monostable flip-flop in circuit with the reset coil of the latching-type relay through an inverter and in circuit with said decoder circuit through a capacitor.

14. A tape-operated control circuit for a line-casting machine, a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, means in circuit with said stop tape solenoid and operable to energize said stop tape solenoid, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the

winding of said motor in the reverse direction, means in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor controlling means, a tape control relay adapted to control said control contact arm, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with the control relay through an inverter and in circuit with said decoder circuit.

15. A tape-operated control circuit for a line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, means in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with the reset coil of the latching-type control relay in circuit with said decoder circuit.

16. A tape-operated control circuit for a line-casting machine, control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position of said reverse motor contact arm, a control contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, said control gate in circuit with the reset coil of the latching-type control relay and in circuit with said decoder circuit.

17. A tape-operated control circuit for a line-casting machine, control circuit for said line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said tape reader, a normally open stop tape switch in circuit with said stop tape solenoid adapted to energize said tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position of said reverse motor contact arm, a control main contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said control contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the control contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate, said elevate gate feeding into said control gate, flip-flop in circuit with the reset coil of the latching-type control relay and in circuit with said decoder circuit.

18. A tape-operated control circuit for a line-casting machine comprising a motor for moving a tape through a tape reader, said tape having code openings therein, a stop tape solenoid in said circuit adapted to be energized to prevent said tape from moving through said stop tape solenoid adapted to energize said stop tape solenoid when said stop tape switch is closed, a reverse motor contact arm movable from a first position to supply power to the winding of said motor in one direction to a second position to supply power to the winding of said

motor in the reverse direction, a motor reversing relay in said circuit adapted to control the position, said reverse contact arm, a main contact arm adapted to move from a first position contact in circuit with said stop tape solenoid to a second position contact in circuit with said motor reversing relay, a latching-type control relay adapted to control said main contact arm, said latching-type relay having a set and a reset coil, a normally open reverse tape switch in circuit with the set coil of said control relay, a decoder circuit adapted to analyze the code openings in the tape to open a path to a function-performing mechanism of said line-casting machine, a pulsing circuit for pulsing a signal through said path, an inhibiting flip-flop in circuit with said decoder circuit and having one side thereof in circuit with said second position contact of the control contact arm, said pulsing circuit connected to said second position contact of the main contact arm, an elevate gate in the circuit, said elevate gate connected to the other side of said inhibiting flip-flop through a capacitor, a trigger circuit connected to the pulsing circuit, a control gate in said circuit, said second position contact of said main contact arm feeding into said control gate, said trigger circuit feeding into said control gate through a capacitor, said elevate gate feeding into said control gate through an inverter, a monostable flip-flop having a timed output in circuit with said control gate, said monostable flip-flop in circuit with the reset coil of the latching-type relay through an inverter and in circuit with said decoder circuit through a capacitor.

References Cited by the Examiner

UNITED STATES PATENTS

1,953,072	4/34	Casper	340—147
2,386,482	10/45	Leathers et al.	340—147
2,500,150	3/50	Bullard et al.	318—466
2,834,928	5/58	Carter	318—466
2,989,590	6/61	De Boo	178—17
3,003,094	10/61	Gough	318—162

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