Dec. 6, 1966 G. MANUS 3,289,806

CONTROL SYSTEM FOR ELECTRIC TYPEWRITERS INCLUDING CURRENT LIMITING MEANS

Filed Feb. 18, 1965

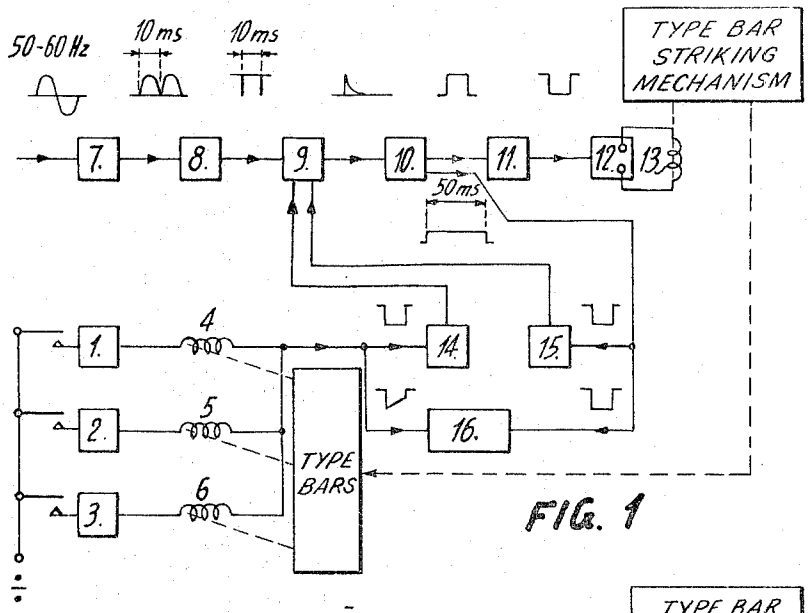


FIG. 1

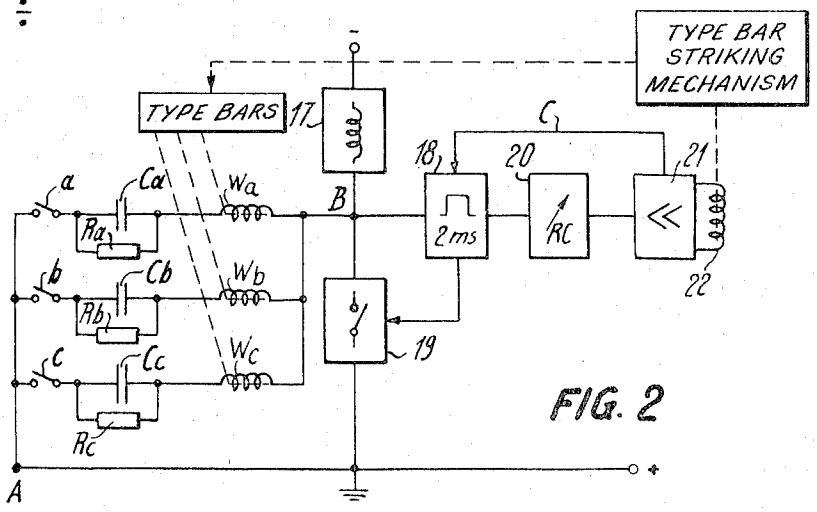


FIG. 2

INVENTOR

GEORGE MANUS

BY Emery L. Groff Jr.

ATTORNEY

United States Patent Office

3,289,806

Patented Dec. 6, 1966

3,289,806

CONTROL SYSTEM FOR ELECTRIC TYPEWRITERS INCLUDING CURRENT LIMITING MEANS

George Manus, Hammersborg Torg 1, Oslo, Norway

Filed Feb. 18, 1965, Ser. No. 433,609

Claims priority, application Norway, Feb. 29, 1964, 152,219

9 Claims. (Cl. 197—19)

The present invention has for its object a control system for the types of electric typewriters, data processing machines and the like wherein the types are controlled by a common electromagnetic striking mechanism and wherein each type is selected by means of an associated electromagnet energized by a key or switch, for example of the type described in my co-pending application Serial No. 277,424, filed April 30, 1963.

In equipments of the kind referred to, chiefly when operated from a distance, it is important to ensure that whenever the operative switches or keys are depressed in a rapid sequence, the machine cannot be blocked as a result of interengagement between type levers. The primary purpose of the present invention is to prevent such a blocking.

It has for its primary object a control arrangement for a machine including type bars, whereby each type bar to be struck is selected by a selecting electromagnet associated with said type bar, while the striking operation is controlled by a mechanism which is common to all type bars and is actuated by at least one striking electromagnet, said arrangement including selecting means supplying as required an electric pulse controlling selectively the electromagnets associated with the type bars, the windings of said electromagnets being all connected with a common current limiting system the maximum intensity of the current passing through which is larger than that required for the operation of one selecting electromagnet without reaching a value double said required value, further means feeding a control pulse to the striking electromagnet when a predetermined period has elapsed after the selecting pulse.

The accompanying drawing illustrates diagrammatically and by way of example, two preferred embodiments of the object of the invention. In said drawing:

FIG. 1 is a diagrammatic showing of a first embodiment;

FIG. 2 illustrates a second embodiment which is substantially simpler than the first one.

For the sake of simplicity, in the first embodiment of FIG. 1, only three operating key contacts of a plurality of operating contacts, such as on a keyboard, are shown for discharging their respective capacitors which, with their associate charging circuits, are designated 1, 2 and 3. The charging circuits 1, 2 and 3, while shown in schematic block form, may each consist of a capacitor bridged by a resistance, such as shown in the comparable circuits in FIG. 2, at *Ca*, *Ra*; *Cb*, *Rb*; and *Cc*, *Rc*. The discharge current flows through coil 4, 5 or 6 energizing the electromagnet which selects the type, the coils being joined to a common conductor which, via an impedance transformer 14, well known in the art supplies a control pulse to a coincidence or AND gate 9, well known in the art which results in the discharge current passing through a current limiter 16, such as an induction coil, which is adjusted to pass a discharge current which is sufficient to energize only one coil. On account of the action

of the current limiter, the control device will not cause the striking mechanism to strike if two or more operating contacts are closed simultaneously. The coincidence gate 9 is also supplied with continuous control pulses from a full-wave rectifier 7, of well known construction, fed from the mains, from which the ripple voltage having a frequency of 100 cycles, is differentiated in a differentiating circuit 8, well known in the art, to supply the required trigger pulses. The output signal from the coincidence gate 9 triggers a single pulse multivibrator 10, of standard known construction, which, via a delay circuit 11, of any of the well known types, controls an amplifier 12 which supplies energy to the coil energizing the electromagnetic striking mechanism 13. A control pulse is taken from the multivibrator 10 which is fed to a pulse lengthener 15 which lengthens the pulse from 10 ms. to 50 ms. This pulse is fed to the coincidence gate 9 to block this for a required period of time in the event of two operating contacts being closed in too rapid succession. The control pulse from the multivibrator 10 is also fed to the current limiter 16 to initiate the discharge through the energizing coil and to ensure that the discharge occurs only for the length of one pulse, i.e. 10 ms.

The method of operation is as follows:

By closing an operating contact, by operating a key on the keyboard a charged capacitor, for example the capacitor in unit 1, is connected to the energizing coil 4. As the impedance transformer has a high input impedance and the current limiter 16 is blocked, the capacitor will not yet be discharged. The closing of the operating contact does however result in the voltage on the capacitor being impressed over the input of the impedance transformer 14, resulting in this supplying a control pulse to the coincidence gate 9 which is continuously receiving control pulses from units 7 and 8. The output signal thus produced from the coincidence gate 9 being unblocked by the control pulse from 14, triggers the single pulse multivibrator 10 which supplies a pulse 10 ms. in length. This pulse is lengthened to 50 ms. in the pulse lengthener 15. The lengthened pulse is fed to the coincidence gate 9 and blocks this for 50 ms., in such a way that no new pulse from the units 7 and 8 can pass through until 50 ms. have elapsed since the operating pulse. The control pulse from the multivibrator 10 is also fed to the current limiter 16 enabling the discharging of the capacitor through coil 4 to take place during the length of one pulse, that is to say 10 ms. The coil 4 then energizes the appropriate electromagnet for selection of type. As the capacitor is now discharged, the control voltage across the input of the impedance transformer 14 will disappear, again blocking the coincidence gate 9, even after the cessation of the lengthened pulse from unit 15. After the capacitor has emptied its full charge, a new key may be depressed before the previous one is released without the first key initiating action afresh. The capacitor is not recharged until the operating contact is released to the rest position.

If a second operating contact is depressed less than 50 ms. after the first, the control voltage impressed across the impedance transformer 14 will open or unblock the coincidence gate 9 enabling a further control pulse from units 7 and 8 to pass through the coincidence gate 9 as soon as the blocking pulse from the pulse lengthener 15 ceases. In this manner, the operation of the striking mechanism is delayed with relationship to the operation of the operating contact, resulting in the striking mechanism

not acting until 50 ms. have elapsed since the previous strike.

If two or more operating contacts are closed simultaneously, none of the coils will receive sufficient current to energize their respective electromagnets, because the current limiter **16** passes only enough current to energize one electromagnet. In this way the danger of two or more type levers being operated simultaneously, colliding and fouling the machine, is avoided. If an operating contact is closed immediately after two or more operating contacts have been closed simultaneously, these being held down in the closed position, the remaining charge across the two first mentioned capacitors will discharge itself together with the new capacitor in such a way that the current also to this energizing coil will be too small. This prevents letters from coming in the wrong places.

The single pulse multivibrator **10** supplies, through the delay circuit **11**, a control pulse to the amplifier which in turn supplies sufficient energy to operate the striking mechanism. The delay circuit **11** delays the control pulse to the energizing coil about 2 ms. in relationship to the control pulse from the impedance transformer **14**, enabling the selected type to move into its initial position before the striking mechanism is energized. The strength of the strike can be adjusted by adjusting the length of the control pulse with the help of a potentiometer (not shown) in the multivibrator **10**.

For repetition, the selected energized coil receives current from the capacitors charging circuit. The repetition frequency will thus be equal to the length of the blocking pulse from the pulse lengthener **15**. The duration can be varied by means of a potentiometer (not shown) in the pulse lengthener **15**. This potentiometer is connected to the circuit only in connection with repetition.

FIG. 2 illustrates the second embodiment wherein only three type selecting arrangements have been illustrated, similar to FIG. 1, with each arrangement including a switch or key respectively *a, b, c*. Each key is connected on the one hand with the input point A and on the other hand with a condenser C*a*, C*b* or C*c* as the case may be, each condenser being shunted by a resistance R*a*, R*b* or R*c*.

Each condenser is connected with the output point B through a winding W*a*, W*b* or W*c* respectively forming part of the type bar selecting means. Said point B is connected with the negative terminal of a supply of D.C. through a current limiter **17**, for example through an induction coil the inductance of which is much larger than that of any winding of the selecting means. The positive terminal of the same supply is connected with the point A which is also grounded.

The voltage at the point B forms the input signal feeding a chain of electronic circuits including a monostable multivibrator **18** of known construction, the time constant of which is equal to 2 ms., and an adjustable time constant circuit **20** controlled by said multivibrator **18** and producing for each impulse of **18** a longer pulse of approximately 15 ms., an amplifier **21** adapted to supply said pulse into a winding **22** energizing electromagnetic strike-controlling means. Said amplifier **21** forms at the same time a signal adapted to return through conductor C towards the multivibrator **18** to lock the latter in its stable position and to render it non responsive to an input signal. Said multivibrator **18** controls an electronic switch means **19** adapted to transiently provide a direct connection between the points A and B.

The operation of the circuit described is as follows:

The inscription of a symbol is controlled by the closing of the switches *a, b, c*, for instance through manual actuation by the typist of the corresponding key on the keyboard of a typewriter or else by an automatic arrangement controlling the typewriter, chiefly in the case where the machine serves for recording the results of the operations executed by a calculating machine.

Before the closing of a switch, the point B is subjected to the negative voltage of the supply since it is connected with the latter through the induction coil **17**. At the moment at which one of said switches, say the switch *b*, is closed, the potential of the point A is suddenly applied to the point B since the condenser C*b* was not charged.

Said positive pulse reaching the point B produces a rocking of the multivibrator **18** into its non-stable position and simultaneously a pulse is produced thereby which closes the switch **19** during the 2 ms. period during which said multivibrator remains in its non-stable position. During the closing of the switch **19**, the voltage at the point B is necessarily equal to that at the point A, so that no current flows through the winding W*b* controlling the selection of the selected type bar. During the closing of the switch **19**, the current begins flowing through the winding **17** without rising beyond a very low intensity by reason of the comparatively large inductance of said winding **17**.

After a period of 2 ms. reckoned from the closing of the switch *b*, the multivibrator **18** returns into its original stable position which opens again the switch **19** and sends a negative pulse into the input of the adjustable time constant circuit **20**. The latter produces a pulse of about 15 ms. which pulse is fed into the amplifier **21**. The duration of the output pulse of the circuit **20** is adjusted so as to modify the energy of said pulse after amplification in the amplifier **21** and consequently the striking force obtained by the passage of said pulse through the winding **22** may be modified as desired.

At the moment at which the negative pulse is applied at the input of the circuit **20** and simultaneously the switch **19** opens, the condenser C*b* can be charged by the supply of current and the charging current passes through the winding W*b* with an intensity which is sufficient for producing the desired electromagnetic selection of the type bar associated with said winding. The striking pulse supplied by the circuit **20** and the amplifier **21** begins together with the current charging the condenser C*b*, but due to the inertia of the striking mechanism, actual striking occurs only after the selection of the typing bar is completed.

When the switch *b* opens, for instance when the keyboard key is released by the typist, the condenser C*b* is discharged speedily through the resistance R*b* shunting it.

The circuit illustrated cuts out any risk of locking the machine by the striking of two keyboard keys simultaneously or in a too speedy sequence. As a matter of fact, if two switches for instance *a* and *b* are closed simultaneously, the operation is started as disclosed without any modification, that is the multivibrator **18** operates and the switch **19** is closed during 2 ms. However, after the operation of the switch **19**, the charging current is limited by the induction coil **17** which allows the passage only of a current larger than that necessary for producing the operation of one selecting electromagnet, which is however lower than twice the minimum selecting control current; therefore, the current passing through the winding **17** is subdivided into two elementary currents passing through the windings W*a* and W*b*, each of these elementary currents being insufficient for the selection of the corresponding type bar.

Similarly, if two switches *a* and *b* are closed one after the other too speedily, the charging current, at least in the selecting winding corresponding to the switch which has been closed last, is too weak for the selection of the corresponding type bar. Therefore, the closing of a second switch after a period ranging between 0 and 17 ms. reckoned from the closing of a first switch cannot produce in any case the striking of the type controlled by said second switch. If the lapse of time between the closing of the first and second switches is comparatively large, in principle at least equal to 10 to 12 ms., the striking of the

type controlled by the switch closed in the first place may nevertheless be obtained.

During the current pulse sent by the amplifier **21** into the winding **22**, which pulse starts 2 ms. after the closing of a switch, the multivibrator **18** is locked by the control signal or conductor C in its stable position. If a second switch is closed the selection controlled by said second switch can be obtained only if the switch is held closed after the end of the pulse controlling the striking in the winding **22**.

It should be remarked that the switch **19** produces a further useful safety in the case where the selection of a type bar is controlled through a catch carried by said type bar and attracted magnetically by one of the windings W*a*, W*b* . . . . In such a case, it may in fact occur that at the end of the striking operation the type bar returns into its inoperative position and the catch is subjected to a rebound movement which causes it to engage the cooperating maget even if the feeding current is much weaker than that required for control purposes. As a matter of fact, if a switch, for instance *a*, remains closed after the striking operative current continues flowing through the corresponding winding W*a* by reason of the presence of the resistance R*a*, this current having an intensity ranging between the third and one half the peak selecting current. Said current is sufficient for holding in its attracted position a catch which may have rebounded back against the electromagnet armature. By reason of the closing of the switch **19** during 2 ms. after each further selection, the residual current obtained by reason of the precedingly closed switch *a, b* or *c* being kept closed, is practically returned to zero. As a matter of fact, the closing of said switch **19** produces the discharging of the condenser, for instance C*a*, which had been charged to a potential corresponding to the drop in voltage across the resistance R*a* produced by the above-mentioned residual current. Now, the discharging current of C*a* passes through the winding W*a* in a direction opposed to that of the residual current, in a manner such that the current is practically wiped out and the electromagnetic action of said winding is cut out. If a selecting catch has engaged the magnetized bar carrying the winding W*a* as a consequence of its rebound, the wiping out of the current in said winding ensures automatically the return of said catch into its inoperative position.

It should also be remarked that the circuit described can serve readily for the repeated striking of a same symbol by cutting off the connection between the terminals of the switches *a, b, c* . . . with the point A and by connecting all said terminals with the line C receiving the pulses supplied by the amplifier **21**. At the same time, the multivibrator **18** should be transformed into an astable multivibrator through mere switching. Thus, the switches *a, b, c* . . . will no longer be subjected to a voltage which is continuously equal to zero, but are connected with a point at an alternatingly negative and zero voltage. At each change of voltage, the selecting current passes through the winding associated with the closed switch.

I claim:

1. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a common current-limiting device, charge storage circuits, a plurality of different parallel circuits, each of which comprises a said charge storage circuit and a said selecting winding in series, connected for insertion in series with said common current-limiting device, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the said electromagnetic windings to be operative, electromagnetic means connected for controlling the striking mechanism, individual operating means connected in series with each charge storage circuit and selecting winding to energize selectively the said selecting electromagnetic windings with the current in the respective charge storage circuits to produce an energizing pulse in the latter and circuit means connected to said selecting windings and said current-limiting device to energize the electromagnetic means controlling the striking mechanism whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized by said charge storage circuits to select without delay corresponding type bars for control by said striking mechanism.

2. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a condenser inserted in series with each selecting electromagnetic winding, a resistance inserted across each condenser, a common current-limiting device, a plurality of different parallel circuits, each of said parallel circuits constituted by a said winding, condenser and resistance, connected for insertion in series with said common current-limiting device, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the windings to be operative, electromagnetic means controlling the striking mechanism, operating means connected in series with each of said parallel circuits to energize selectively the selecting electromagnetic windings to produce an energizing pulse in the latter with the current in the respective condenser, and delaying means fed by each pulse and adapted to energize the electromagnetic means controlling the striking mechanism at a predetermined moment following the production of said pulse whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized by the current stored in said condensers to select without delay corresponding type bars for control by said striking mechanism.

3. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a condenser inserted in series with each selecting electromagnetic winding, a resistance inserted across each condenser, a common current-limiting device with which different parallel circuits, each constituted by a winding, condenser and resistance, are inserted in series, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the said electromagnetic windings to be operative, electromagnetic means controlling the striking mechanism, operating means connected in series with each parallel circuit to energize selectively the selecting electromagnetic windings to produce an energizing pulse in the latter with the current stored in the respective condenser, and a delay circuit subjected to the pulses upon operation of the operating means and adapted to feed a pulse controlling the operation of the electromagnetic means controlling the striking mechanism at a predetermined moment following the production of the pulse by the selecting electromagnet whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized by the current stored in said condensers to select without delay corresponding type bars for control by said striking mechanism.

4. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a common current limiting device with which the different parallel windings are in-

serted in series, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the windings to be operative, electromagnetic means controlling the striking mechanism, operating means energizing selectively the selecting electromagnetic windings to produce an energizing pulse in the latter, a coincidence gate fed with the pulses passing out of the windings, means continuously feeding periodical pulses to said coincidence gate to produce in association with the pulses from the energizing windings output signals, a circuit controlled by said signals and connected to said current-limiting device, adapted to energize the electromagnetic means controlling the striking mechanism and a feed-back circuit between said circuit and the coincidence gate and adapted upon reception of the signal to block the latter against operation during a predetermined time whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

5. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a common current-limiting device with which the different selecting windings are inserted in series, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the windings to be operative, electromagnetic means controlling the striking mechanism, operating means energizing selectively the selecting electromagnetic windings to produce an energizing pulse in the latter, a coincidence gate fed in parallel with the current-limiting device, means continuously feeding periodical pulses to said coincidence gate to produce in association with the pulse from the energizing winding an output signal, a single pulse multivibrator controlled by said signal, means for adjusting the duration of the pulse produced by the multivibrator and means whereby the pulse fed by the multivibrator energizes the electromagnetic means controlling the striking mechanism and a feed-back circuit inserted between the multivibrator and the coincidence gate and adapted upon reception of the signal to lock the latter against operation during a predetermined time and a circuit between the multivibrator and said current-limiting device, whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

6. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a common current-limiting device with which the different parallel connected selecting windings are inserted in series, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the windings to be operative, electromagnetic means controlling the striking mechanism, operating means energizing selectively the selecting electromagnetic windings to produce an energizing pulse in the latter, a coincidence gate fed in parallel with the current-limiting device, means continuously feeding periodical pulses to said coincidence gate to produce in association with the pulse from the energizing winding an output signal, a single pulse multivibrator controlled by said signal, said multivibrator producing an output pulse of adjustable duration, an amplifier feeding said output pulse to the electromagnetic means controlling the striking mechanism to energize the latter, and a feed-back circuit between the multivibrator and the coincidence gate and adapted upon reception of said signal to block the latter against operation during a predetermined time and a circuit between the multivibrator and said current-limiting device, whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

7. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a common current limiting device with which the different parallel windings are inserted in series, said device being adapted to limit the current passing through it to a value ranging between values above once and below twice that required for one of the windings to be operative, electromagnetic means controlling the striking mechanism, operating means energizing selectively the selecting electromagnetic windings to produce an energizing pulse in the latter, a coincidence gate fed in parallel with the current limiting device, means continuously feeding periodical pulses to said coincidence gate to produce in association with the pulse from the energizing winding an output signal, a single pulse multivibrator controlled by said signal, a delay circuit adapted to delay the pulse fed by said multivibrator, an amplifier feeding the delayed pulse to the electromagnetic means controlling the striking mechanism to energize the latter, and a pulse lengthening feed-back circuit between the multivibrator and the coincidence gate and adapted upon reception of the signal to block the latter against operation during a predetermined time beyond the delay produced by the delay circuit in the striking mechanism and a circuit between the multivibrator and said current-limiting device, whereby upon consecutive operation of a first and second operating means without release of the first operating means corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

8. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a condenser inserted in series with each selecting electromagnetic winding, a resistance inserted across each condenser, a common current-limiting system inserted in series with the parallel circuits constituted by the different windings and associated condensers and resistances, a supply of electrical energy feeding said common current-limiting system and parallel circuits, a switch controlling each parallel circuit, a monostable multivibrator, an adjustable time constant circuit fed by said multivibrator, said multivibrator being connected to said current-limiting system and to the output of said selecting windings, electromagnetic means through which the signals produced with a predetermined delay by said time constant circuit upon energization of any parallel circuit operate the striking mechanism whereby upon consecutive operation of a first and second switch in different parallel circuits without release of the first switch corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

9. In a machine, such as a typewriter, including type bars and a striking mechanism controlling any selected bar, the provision of a control arrangement comprising selecting electromagnetic windings adapted to select the corresponding type bars, a condenser inserted in series with each selecting electromagnetic winding, a resistance inserted across each condenser, a common current, limiting induction coil inserted in series with the parallel circuits constituted by the different windings and associated

condensers and resistances, a supply of electrical energy feeding said induction coil and parallel circuits, a switch controlling each parallel circuit, a monostable multivibrator in parallel with the induction coil, a time constant circuit fed by the multivibrator, electromagnetic means through which the signals produced with a predetermined delay by the time constant circuit upon energization of any parallel circuit operate the striking mechanism, a switch means controlled by the multivibrator and adapted to short-circuit transiently the parallel circuits upon energization of said multivibrator and a feed-back circuit connecting the electromagnetic means with the first multivibrator to lock the latter in its inoperative position upon energization of the electromagnetic means whereby upon consecutive operation of a first and second switch in different parallel circuits without release of the first switch corresponding selecting windings are consecutively energized to select corresponding type bars for control by said striking mechanism.

References Cited by the Examiner

UNITED STATES PATENTS

920,940	5/1909	Ferry	197—19 X
1,374,152	5/1921	Krum	197—107 X
1,455,112	5/1923	Crawley	197—17
1,678,492	7/1928	Lambert	197—19
1,753,991	8/1930	Langford	197—19
2,869,703	1/1959	Hebel	197—107 X
2,891,649	6/1959	Peterson	197—14
2,942,253	6/1960	Pederson	197—107 X
3,017,978	1/1962	Schulz	197—17
3,091,320	5/1963	Mertn	197—13
3,151,722	10/1964	Salto	197—17

ROBERT E. PULFREY, *Primary Examiner.*

E. S. BURR, *Assistant Examiner.*