

July 1, 1930.

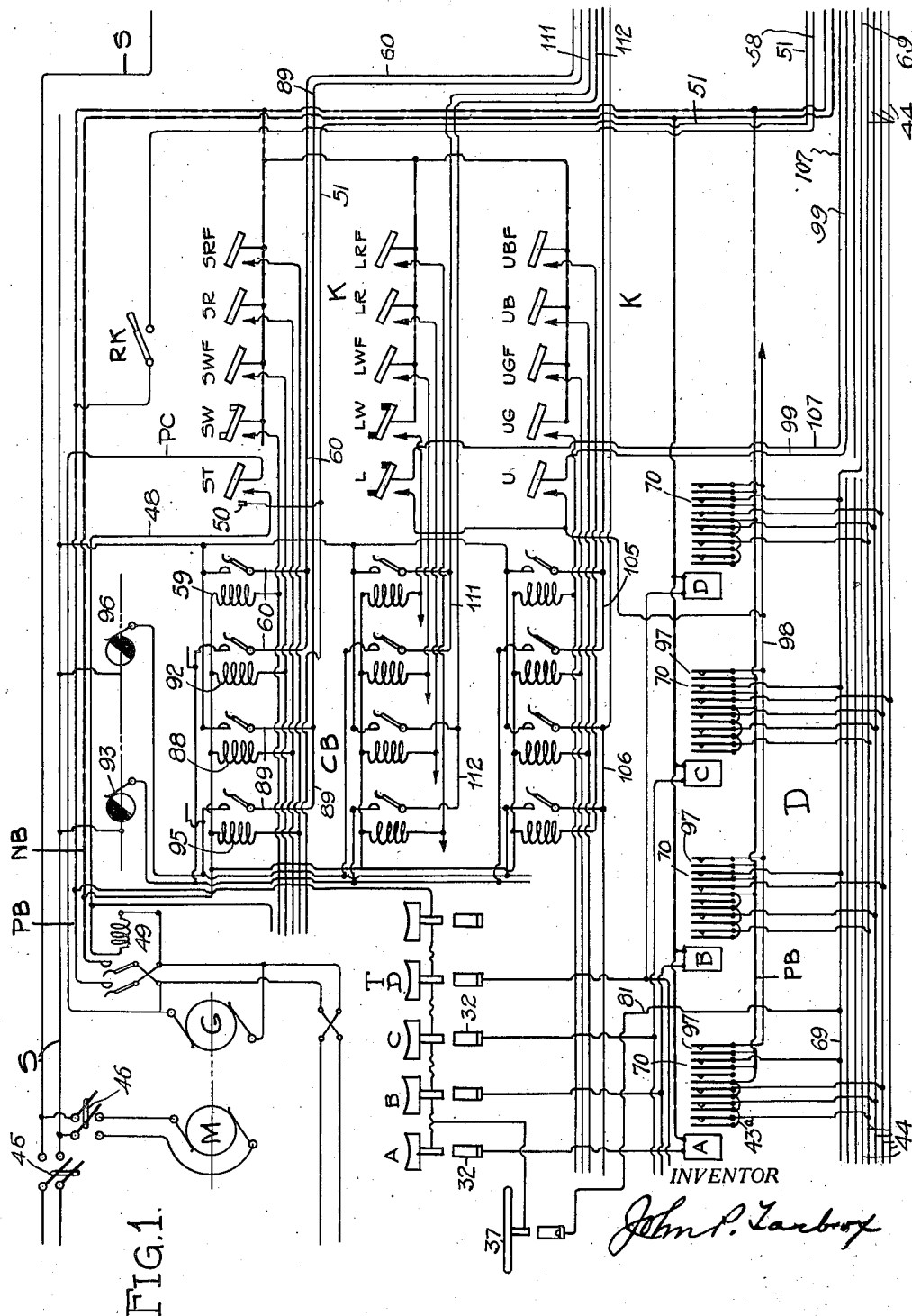
J. P. TARBOX

1,769,554

ELECTRIC DISPLAY SYSTEM

Filed Feb. 9, 1924

4 Sheets-Sheet 1



July 1, 1930.

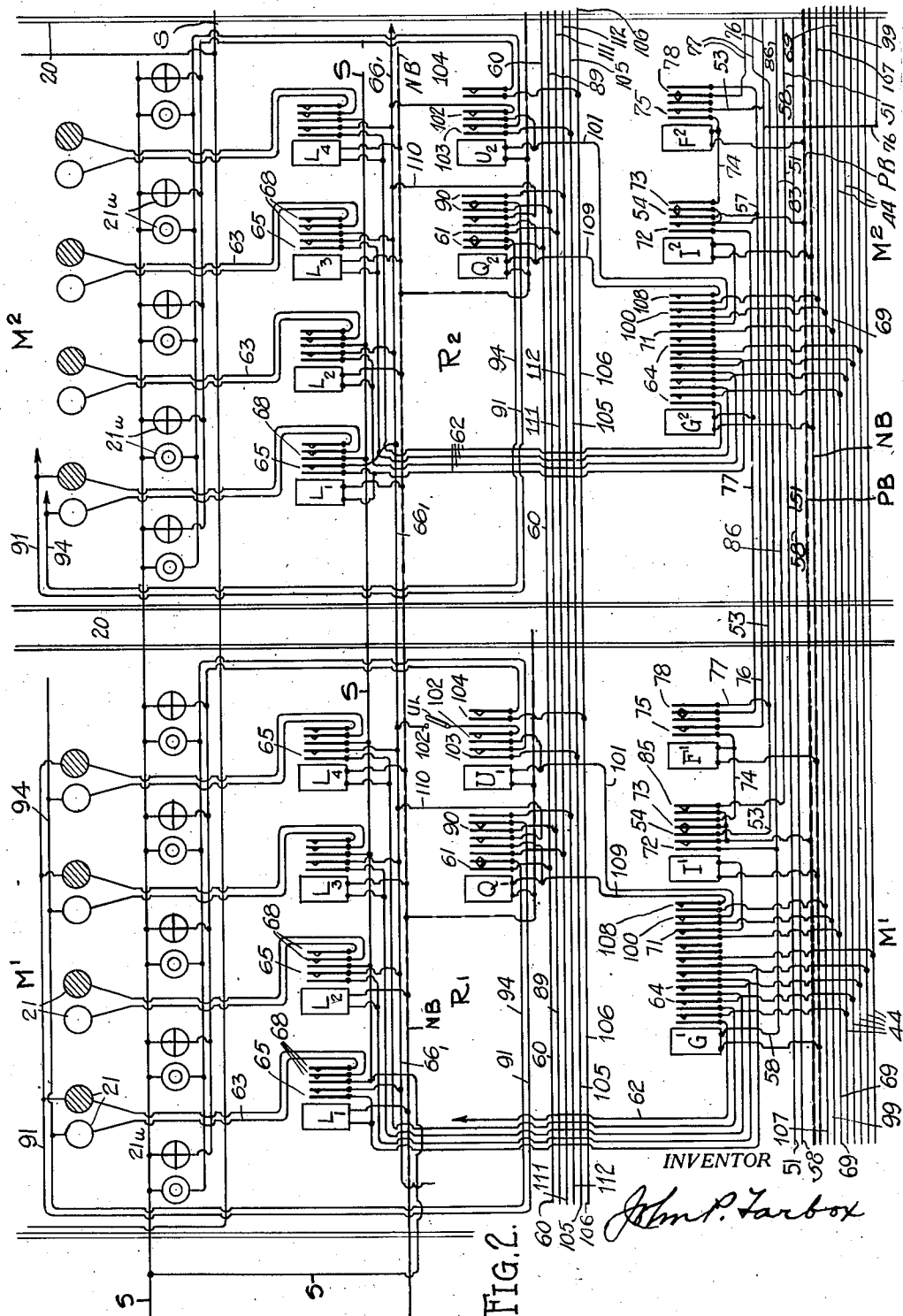
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4 Sheets-Sheet 2



July 1, 1930.

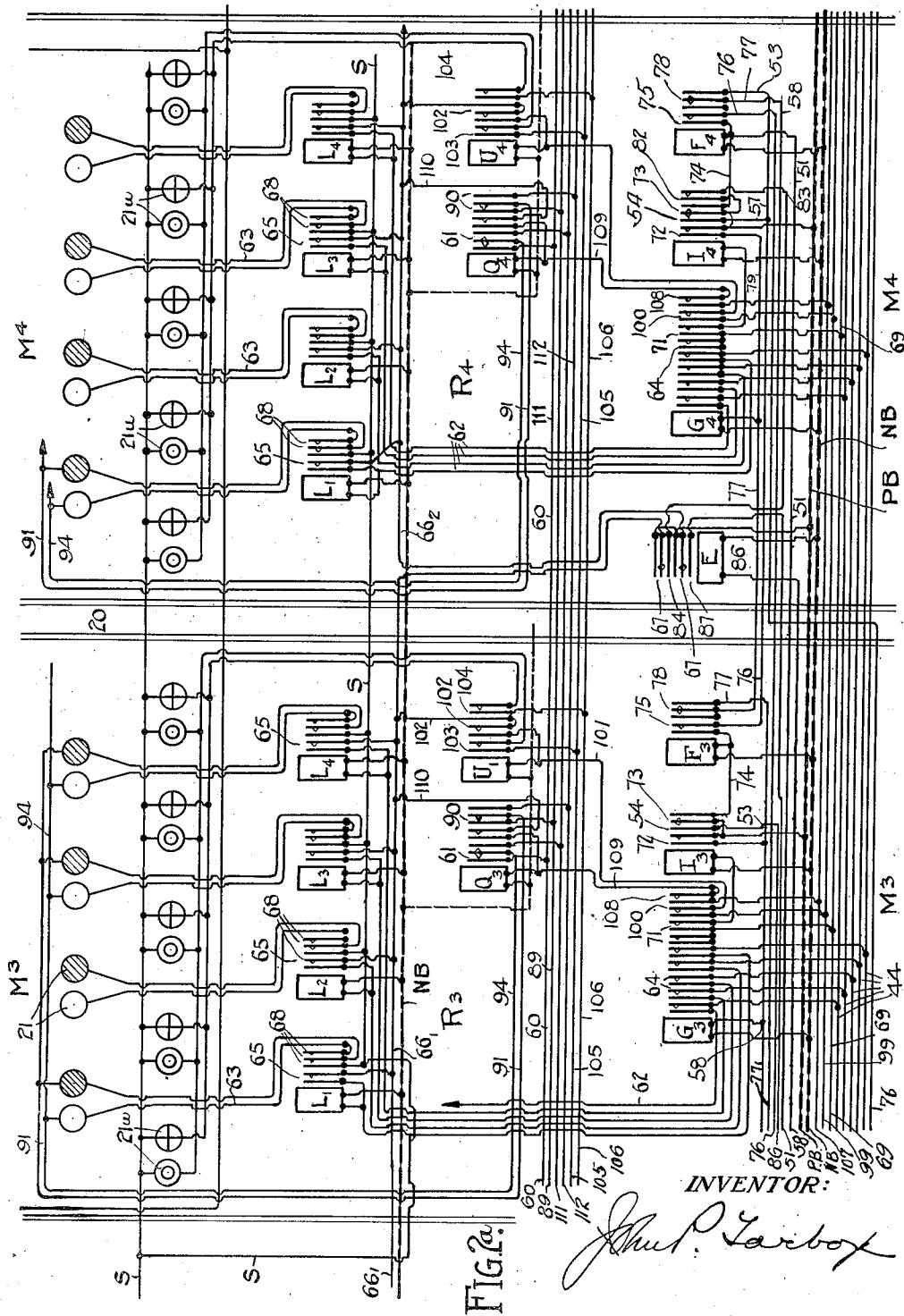
J. P. TARBOX

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ELECTRIC DISPLAY SYSTEM

Filed Feb. 9, 1924

4 Sheets-Sheet 3



INVENTOR:

John P. Tarbox

July 1, 1930.

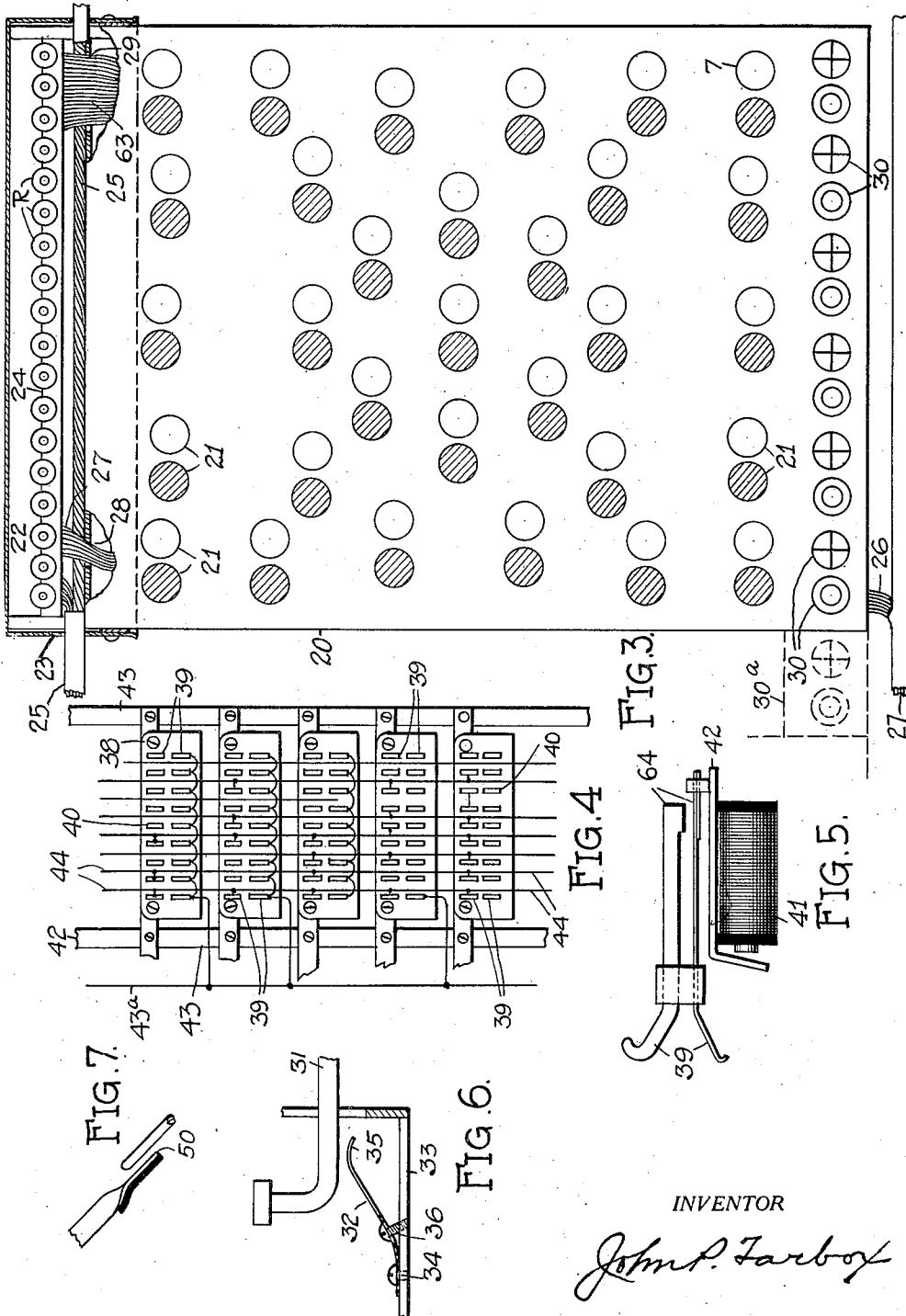
J. P. TARBOX

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ELECTRIC DISPLAY SYSTEM

Filed Feb. 9, 1924

4 Sheets-Sheet 4



INVENTOR

John P. Tarbox

UNITED STATES PATENT OFFICE

JOHN P. TARBOX, OF GARDEN CITY, NEW YORK

ELECTRIC DISPLAY SYSTEM

Application filed February 9, 1924. Serial No. 691,731.

My invention relates to those electric display systems especially adapted for outdoor display work of the kind carried on a large scale in Times Square, New York city. In these systems are used immense display boards to advertise manufacturing and trade names of various products, but few facts about the products can be set forth at a time by reason of the utter inflexibility of the display devices. Commutator operated monogram systems and scroll operated controlling systems have been used in an attempt to overcome this general inflexibility but their scope is limited. The prime object of my invention is to practically obtain unlimited flexibility of and versatility in subject matter, to draw and hold the interest of the public, and to drive the subject matter home thru strong emphasis.

These ends were also the object of my earlier inventions in this art, Patent Nos. 1,218,015, March 6, 1917, and 1,218,916, March 6, 1927, and from this point of view the present invention constitutes an improvement over my prior inventions.

The improvement is directed especially to the ends of simplicity of organization, reduction of first cost and maintenance, and reliability of operation. These ends are attained by an organization of standard commercial telephone relays and their operation according to a new method. The organization applies especially to the character forming machine and the monogram spacing and control relays, whereas the new method is applied particularly to the operation of spacing, which is to say, the stepping of the display from one monogram to another.

Substantially the entire system is novel and the novelty will be self-apparent from the following description. The outstanding feature, however, is the development of the spacing and allied control circuits. These circuits are started in the character determining means. Thru a process of timing each character determination they are developed from one display position to another with absolute reliability and extremely great rapidity. Thus is over-lapping of display and all other interferent action utterly

removed and perfect display assured irrespective of the speed of operation.

Of the drawings,

Fig. 1 is a diagram of that portion of the apparatus located at the control or operating station (usually in a roof structure called a "penthouse"), and comprising a typewriter or typewriter keyboard, a character forming machine, the motor generator or other source of power, and the control switches and circuit breakers;

Figs. 2 and 2^a represent a similar diagram of that portion of the apparatus mounted upon the out-door display board or steel structure and comprising the monograms themselves, their control relays and the power busses;

Fig. 3 is a diagram of the bi-color monogram used;

Fig. 4 is a diagrammatical illustration in the plan form of a character forming machine;

Fig. 5 is a side elevation illustrating in general the type of relay of which this character forming machine is composed;

Fig. 6 is a detail of the operating keyboard; and

Fig. 7 is a detail of a contact connected with a starting switch.

The relays of the system are in general illustrated by rectangles and as de-energized. The contact points point in the direction of the circuit to be closed. When the relays are energized, contacts shown open are closed and contacts shown closed are opened.

Referring now first to Fig. 3, the body of casing of the monogram is represented by the rectangle 20 and the lamps arranged in pairs are represented by the circles 21. Those circles which are cross-hatched represent red or other colored lamps, whereas those open and not cross-hatched represent white lamps or their equivalent or they may represent lamps of some color different from their mates. The lamps may be mounted in the monogram casing according to any of the well known methods in practice, in sockets of one form or another and associated with reflectors or shields of any chosen pattern. One feature of my invention resides in the

arrangements of these lamps. All of the lamps of any given color constitute in themselves a complete monogram on which any letter of the alphabet or any numeral or any chosen number of punctuation marks or other characters may be formed thru energization of the appropriate lamps. Thus, as shown, there are two complete monograms of lamps in the one body 20. The lamps of the pairs are located closely adjacent each other and substantially in horizontal alignment, with the result that by energizing one set or the other the color of the formed letter may be changed without substantial change in its position with respect to those letters formed on adjacent monograms, and without any change in its alignment. Moreover, by energizing both sets of lamps one color may be utilized as a shadow or shading for the other without destroying the alignment.

On the top of the casing 20 is a compartment 22 formed by a cover member 23 which laps the top of casing 20 in a manner to make the chamber 22 weather-proof. Within chamber 22 is a frame structure 24 which supports the control and character forming relays "R" governing the monogram. Control connections are made laterally thru weather-proof conduits 25 from one chamber to the next adjacent. Power connections, however, are made thru branches 26 from busses 27 multiplied from one monogram to another and extending below the monograms. These connections 26 run all the way thru the body of the monogram up to the control relays thru an appropriate aperture or apertures 28, in the closed top of casing 20, while the individual lamp connections 63 pass from the relays down into the monogram thru similar apertures 29. This keeps the main power circuits separated from the control circuits running thru conduits 25. At the same time, because the relays are mounted on top of the monogram body, a thoroughly weather-proof cover can be provided and the heat from the interior of the casing 20 utilized to keep the chamber 22 thoroughly dry, while by merely removing the cover the relays are readily accessible both front and back.

At the bottom of the monogram body is a row of lamps 30 comprised of a number of equidistant pairs 21 which together constitute a bi-color underscore. These pairs are not only in horizontal alignment but also have the endmost pairs projecting beyond the lateral borders of the monogram figures formed by the other lights, whereby when the underscore lamps of a number of adjacent monograms are energized a continuous straight line underscore in either color may be formed. The casing itself may have offsets 30^a to accommodate the project-

ing row 30 and the offsets of adjacent rows may abut each other.

In Figs. 2 and 2^a are shown in diagram, four such monograms 20 with their control relays. They are denominated M¹, M², M³ and M⁴ and R¹, R², R³ and R⁴ respectively.

Each group of control relays R¹, R², etc., comprises a group relay G thru which the control of the other relays is extended, a timing relay I, a transfer relay F, a quality or color control relay Q, an underscore relay U, and a plurality of lamp or character forming relays L.

In Fig. 1, K designates a group of control keys or push button switches by the operation of which various combinations of colors, of letters and underscores, and various flashings of the same may be derived. CB, of Fig. 1, designates the associated group of circuit breakers controlled by these keys.

S, Fig. 1, designates the principal source of power and M, G a motor generator thru which control current is derived from this source of power. T, Fig. 1, designates the typewriter keyboard or typewriter proper and D designates the character determining machine operated or controlled from keyboard T and thru which the characters formed on the monograms M¹, M², etc., are determined.

The keyboard K, I shall hereafter term the emphasis control keyboard, in that change of color, flashing, etc., is but a change of quality to derive emphasis or expression. The keys of this board may be of any suitable form of electric switch but are preferably in the form of telephone number or switch board keys, typewriter keys or push button control switches. Toggle switches are another good form to use. The essential requirement is quick, light, easy operation.

The circuit breakers CB are preferably of the type known as industrial circuit breakers, the contacts of which are arranged to make and break large currents an enormous number of times without renewal. They may or may not have magnetic blow-outs and other features insuring more or less quick break. Their capacities are adjusted to the amount of current required in the busses which they control.

The motor generator set MG is preferably of the voltage and type usually employed in connection with automatic telephone circuits, inasmuch as the type of relays employed in connection with the monograms is intended to be telephone or other low voltage type. Deriving the control current in this manner renders the control relay equipment independent of the character of the principal source of power, which varies very considerably in different localities. It is much more economical to change motors of the relatively small motor generator set than

to change the entire relay and circuit breaker equipment.

The typewriter keyboard T may be the keyboard of any of the well known typewriters. Such a keyboard is adapted, as shown in Fig. 6, by merely placing beneath the key bars 31, spring contacts 32 fixed to an insulating base 33 at one end 34 and curved at the other end 35 to make a wiping contact with the underside of the bar 31 when the same is depressed. The adjusting screw 36 passing thru the contact strip 32 freely at a point between its ends (and preferably close to the end 34) and threaded into the base 33, constitutes an effectual adjustment of the gap between end 35 and bar 31. Any other form of contact, one for each bar of the typewriter and one for the spacing bar 37 (Fig. 1), may be provided. Thus, for example, instead of making contact thru the bar 31 itself, there may be used an insulating mating contact connected with that bar. For simplicity I am using the bars themselves and connecting them commonly to the source of power.

The character forming machine D is constituted by a number of identical multi-contact relays 38 having their pairs of contacts 39 arranged in banks 40. A general form of this relay is shown in Fig. 5. A single magnet 41 thru its armature 42 carries the entire bank into wiping contact simultaneously and thus closes 20 or 30 contacts at one time. This relay is of a well known form. I arrange a number of these relays in serial order on parallel supports 43 with their contact banks 40 extending transversely of the supports and numerically corresponding pairs 39 of their contacts in alignment from bank to bank. One set of contacts of each bank 40 I connect commonly together and to a source of power as indicated by conductor 43^a. The other set of contacts of each bank 40 I connect variously to character multiple conductors 44 which extend longitudinally of the series of relays 38 parallel to longitudinally corresponding contacts. Thus the contacts of the banks themselves support the multiples which extend between them in a parallel and orderly arrangement in which they may be readily connected and numerically identified. By using one such relay for each character to be determined and mounting these relays either all in serial order or in a number of parallel rows as indicated at the left of Fig. 4, a complete character determining machine is organized. The supports 43 may be arranged vertically on a suitable base or horizontally, as may be preferred.

These apparatuses are interconnected by a system of electrical conductors in which inheres the principal part of my invention. An understanding of the operation of the invention will result also in a further com-

prehension of the means and method by which that operation is attained.

An operator coming to the keyboard K opposite the keyboard T (keyboard K may indeed be part and parcel of the keyboard T), will close first main switch 45 and motor generator switch 46. This latter results in the starting of the motor generator set. Thereupon he presses starting key ST of the system at large which closes circuit from control main PC thru conductor 48 to circuit breaker 49. This results in the placement of power upon the control busses PB and NB. Pressing of key ST also closes a one way contact 50 (see Fig. 7) which means contacting only on the down stroke and extends a circuit from conductor NB which we will call hereafter positive battery, by way of conductor 51 to transfer relay F⁴ and to conductor NB which we will hereinafter call negative battery. This is representative of the last monogram of a series.

The positive battery bus is designated by a heavy dot and dash line and the negative battery by a heavy dash line throughout the drawings, and with these significant delineations, it will be unnecessary to specifically mention positive and negative battery connections. However, all other portions of the circuits will be traced. Also through the drawings the front contacts are delineated as those closed by movement toward magnet of the relay and the back contacts closed by movement away from the magnet.

Transfer relay F⁴ pulling up locks itself up thru contacts 75 by way of conductor 76 thru back contact 54 in timing relay I¹ of the display position M¹. Transfer relay F⁴ at the same time by front contact 78 closes the circuit of group relay G¹ from battery at back contact 54 of relay I¹ thru conductor 53 and by way of conductor 77, extending from contacts 78 to relay G¹. The starting circuits described are illustrated in connection with the fourth display position M⁴, but in actual practice these starting circuits (which later become reconditioning circuits as will be seen) start from the last monogram of an entire series. Relay G¹ of the first display position pulling up closes all of its large number of normally open pairs of contacts and renders the remaining control relays of the group R¹ ready for their control and character forming functioning. Thereafter, the operator has simply to proceed to write on the typewriter keyboard T just as he would on the typewriter and at any speed he chooses, pausing only to intermittently operate the emphasis keys of the group K.

Suppose he desires the letters to be displayed in fixed white, he operates push button switch SW (meaning "sign white"). This closes the circuit breaker 59 of group CB and connects one of the mains S to

bus 60. This bus connects thru back contacts 61 of the relays Q with the white lamps of all the monograms. Unless other switches than SW have been operated all of the other lamps are for the time being disconnected on one side from the source of power.

Now, assuming the operator is to begin to display with the letter "A", he operates key A of the typewriter T. This energizes relay A of the character determining machine D and this relay is maintained energized as long as the key A is held down or remains down sufficiently to keep its bar 31 in contact with spring 32 (Fig. 6). Period of its closure may be governed in relation to the position of bar 31 by merely adjusting screw 36 and so the relation of the period of closure by one key in point of time to the period of closure by another key of the typewriter keyboard may be regulated and the relays of the character determining machine closed only for separated periods, never for over-lapping periods. Relay A of the machine D pulling up closes all of its contacts and connects battery by way of common conductor 43^a, not to all of the character multiples 44 but to those of them which are connected with the contacts of the relay. Thus multiples 44 which are so connected are those which extend thru the contacts of relay G¹ by way of conductors 62 to those lamp relays L associated thru conductors 63 with those lamps which when illumined will form the letter "A" in the monogram. Thus certain of the relays L are pulled up over the circuit 43^a, 44 their contacts 64, conductors 62 and battery, while certain others whose multiples 44 are not connected to battery thru relay A of machine D are not pulled up. Those which do pull up are locked to battery thru their contacts 65 by way of locking circuit 66₁, which extends thru back contacts 67 of a repeat relay E, Fig. 2^a (whose principal function will be described later). Locking up, these lamp relays thru the three contacts of the group 68 connect the associated lamps to the source of power S. Thus the lamps of the pairs 21 forming the letter "A" are illumined the instant the key A is pressed and the letter "A" is displayed in white.

Simultaneously, with the determination of the character as just described there is commenced the process of timing the period of that determination. At the same moment that the character determining relay A puts battery on character multiples 44 it puts also battery on space multiple 69 thru its contacts 70. Space multiple 69 is multipled to contacts 70 in each relay of the character determining machine D and also (see Figs. 2 and 2^a) to contacts 71 in each group relay G. Relay G¹ being energized, battery placed on multiple 69 thru contacts 70 of relay A, is placed thru contacts 71 of

relay G¹ on timing relay I¹. This timing relay is pulled up at the same moment as are the lamp relays L and is held up for the same period of time, to wit, that period of time during which key A of the typewriter keyboard T is in such position as to retain closed the circuit of relay A of the character determining machine D. Timing relay I¹ (and all such relays I) is held down for this period and additionally for such period as relay A of the character determining machine D requires for such deenergization as to open all its contacts.

Relay I¹ pulling up opens at back contact 54 the circuit of the preceding transfer relay, in this case the locking circuit 76 of relay F⁴. Thru front contact 72 relay I¹ at the same time independently closes the circuit 58 of relay G¹, which was until this time retained closed by front contact 78 of relay F⁴. So, when transfer F⁴ falls back relay G¹ remains up.

Timing relay I¹ also closes by front contact 73, the circuit 74 of transfer relay F¹. This relay pulling up locks itself up thru contacts 75 controlling locking circuit 76 extending thru back contact 54 of relay I² of the succeeding display position to battery. Thus transfer relay F¹ is retained energized until the institution of the timing process in connection with the display in the second position of the series.

The moment the process of character determination ceases, relay A of character determining machine D being deenergized removes battery from spacing multiple 69 and the timing process until now carried on by timing relay I¹ is terminated thru the resulting deenergization of that relay. Falling back, relay I¹ opens at front contact 72, the circuit of group relay G¹, and at the same time or immediately following such opening, closes thru back contacts 54, and conductors 53 the heretofore partially completed circuit 77 of relay G², the partial completion having been effected at front contact 78 of transfer relay F¹ when the latter was pulled up by relay I¹ upon the institution of the timing process. Thus the transfer of character determination from one position to a succeeding position effected thru the initiation of the timing process, is completely effected only thru termination of the timing process, guaranteeing a perfect and non-interfering transfer from one display position to another, and absolutely preventing over-lapping of one display upon another or any other interference. Display at each position is unquestionably upon its own footing.

At this juncture, display at one position having been effected and display at the succeeding position not yet having been commenced, the control of the succeeding po-

sition continues in the preceding position thru the timing and transfer relays of which it was effected, that is to say, if the timing relays I^1 or F^1 , or either of them, are changed in energization, the control of group relay G^2 is affected.

When the second key of the typewriter keyboard T is pressed, however, and the same or another relay of the character determining machine D is energized, battery is again placed upon spacing multiple 69 with the result that timing relay I^2 is energized thru the now closed contacts 71 of relay G^2 .

Relay G^1 being deenergized has opened all its contacts. So too lie open the contacts of all other relays G of the series of display position except G^2 . The energization of relay I^2 now institutes the timing procedure of character determination of position M^2 . With this institution the control of position M^2 is assumed by the apparatus of position M^2 ; timing relay I^2 opening the locking circuit 76 of transfer relay F^1 (heretofore controlling relay G^2) at its back contact 54, and at the same time closing at its front contact 72 the local circuit 58 of relay G^2 . Also at front contact 73 there is closed the local circuit 74 of transfer relay F^2 , resulting thru closure of its front contacts 78 in partially effecting the transfer of character determination from position over its conductor 77 M^2 to the next succeeding position M^3 .

Simultaneously with the institution of the timing process thru energization of relay I^2 , relays L^1 , L^2 , etc., pertaining to the lamps of monogram M^2 which are to form the new character, are energized over appropriate multiples 44, contacts 64 of relay G^2 and conductors 62 of monogram M^2 . Being energized these lamp relays lock up and remain locked up like the corresponding relays of the monogram M^1 , also through conductor 66.

Upon termination of the character determination thru release or rising of the second key so pressed, battery is removed from multiples 44 and also from spacing multiple 69. Timing relay I^2 now falls back and in falling back not only opens the circuit 58 of the local group relay G^2 , relinquishing control of the local position, but also thru closure of the back contact 54 completely effects the transfer of character determination by conductor 77 and relay G^3 to the next succeeding position M^3 of the series thru the already closed contacts 78 of transfer relay F^2 .

In an entirely similar manner the control is stepped from position M^3 to position M^4 , and from the position M^4 back to position M^1 . The description of the starting key ST , conductor 51, etc., indicates the manner in which the stepping from position M^4 to M^1 is carried out. The conductor 76 extend-

ing from contacts 75 of relay F^4 back past positions M^3 and M^2 to position M^1 and to contacts 54 of relay I^1 constitutes the locking circuit for the transfer relay F^4 . Similarly, the conductor 77 likewise extending back to the head of the series of positions M^1 constitutes the energizing circuit of the relay G^1 . The relations of the other circuits are the same as in the instances of transfer between adjoining positions of the series.

So any letter of the alphabet, any numeral, any punctuation mark, and even blank spaces themselves may be embraced upon the display positions in serial order. Blank spaces are made by pressing the spacing bar 37 of the typewriter keyboard " T " which results in placing battery upon spacing multiple 69 independently of the relays of the character determining machine, the connection being made over conductor 81. By this method display may be made serially on any number of positions whatsoever, the only requirement being that these positions shall be interrelated by the spacing circuits outlined between monograms M^1 and M^4 .

When the end of a series of display positions has been reached, however, the entire display would be obliterated by one or more manual operations, as for example by opening the main switches of the apparatus which connect it to the source of power. I have devised in connection with this system a new and novel method whereby the entire operation of obliteration or erasure is not only carried out automatically, but the display board is progressively conditioned and reconditioned as the writing proceeds. Specifically the method consists in selectively determining the characters displayed in the serial order which they occupy on the display board as usual, but at a point intermediate the beginning and the end of the series obliterating characters earlier displayed, and at a point nearer the beginning than said intermediate point obliterating those characters between the intermediate point aforesaid and the end of the series.

The method is carried into effect firstly thru the transfer of the control of character determination from the last position of a series back to the first. This is the function of the circuit 77 previously described between transfer relay F^4 of monogram M^4 and group relay G^1 of monogram M^1 . Secondly, I place on relay I^4 , or on some other relay intermediate the beginning and the end of the series, a pair of contacts 82 arranged normally to place battery on conductor 83 and thru conductor 83 on contact 84 of a relay E located at any convenient point of the series and which I shall here term a repeat relay. On a certain other relay I^1 nearer the beginning of the series than the relay I^4 or its equivalent, I place contacts 85, similar to contacts 82, which normally

place battery thru conductor 86 on a contact 87 of relay E. As aforesaid, the locking circuit 66₁ of lamp relays L of positions M¹ to M³ terminates in contacts 67 of relay E. These contacts 67 are normally closed to battery as indicated, so that all the display positions of the series may be used without obliteration and when obliteration does not take place some manual operation is carried out, such for example as release of the starting key ST in the group K. To institute the new method, repeat key RK of the group K is closed energizing relay E over circuit 58 and bringing the locking circuit contacts 67 into engagement with contacts 84 and 87, with the result battery is now supplied these locking circuits thru the normally closed contacts 82 and 85 of relays I⁴ and I¹. The locking circuit 66₂ of positions M¹ to M³ (representing all of those positions in advance of the chosen control position) is controlled from contacts 82, whereas the locking circuit 66₂ of position M⁴ (representing all those positions succeeding the chosen control position) is controlled from contacts 85 of relay I¹. Thus the forepart of any display board is eliminated upon the institution of display upon the rear part and the rear part of the display is obliterated upon institution of the display upon the forepart of the board, and when one has due regard for syllabication (as appearing on the typewritten record in the typewriting machine of which the keys A, B, C, D, etc. are a part) a display may be carried on by continuous operation of the typewriter keyboard without manual operation in connection with release of the display board.

The display has been described as being made in a fixed white color. It is not necessarily so, it may have been made in fixed red by merely pressing key SR in lieu of key SW resulting in the energization of circuit breaker 88 instead of circuit breaker 59. In this case conductor 89 connected with the red lamps on pairs 21 is energized and power is supplied to the lamps thru back contact 90 of emphasis control relays Q and the connected common conductor 91, so too, the writing could have been done in a flashing white by pressing key SWF of control group K resulting in the energizing of circuit breaker 92 which instead of connecting the source of power continuously to conductor 60 connects it intermittently thru commutator 93. Conductor 60 connects thru back contact 61 of relay Q with conductor 94, which is the common conductor of the white lamps of the pairs. So too, the display could have been made in flashing red by the pressing of key SRF which results in energizing circuit breaker 95 and the placing of power intermittently upon conductor 89 thru a second commutator 96, the conducting segment of which is 180 degrees

removed from the conducting segment of the commutator 93.

So also the display can be made in any desired combinations of favorable colors and flashings merely by closing for the same time the keys desired. Thus keys SW and SR down at the same time make the display in white with a red shading. Thus keys SWF and SRF down at the same time effect the display flashing alternately white and red, alternately because the white and the red circuit flashing breakers 92 and 95 are connected with the respective commutators 93 and 96, the conducting portions of which by reason of the 180 degree spacing alternately engage their contacts.

Nor is it necessary that the color or other emphasis of the display be predetermined. It may be determined initially after the characters have all been determined, the board remaining entirely black until one or another or several of the keys SW, SWF, SR and SRF are operated. This follows simply because while appropriate lamp relays L are energized and locked up as character determination proceeds, they but partially close the circuits of the lamps which are to constitute the characters, those circuits being only completed when the emphasis controlling the keys of the group K are closed to supply power thru the common terminals 91 and 94 of the lamps. Therefore instead of adhering to a display made letter by letter, an entire display board, for the moment entirely dark, may be suddenly completely filled just as is the regular practice with the one-announcement board of today. At the time of the complete display the color and flashing emphasis may be in any color desired, and after the display is made, either an entire display or a display letter by letter, the color and flash emphasis may be changed from one thing to another, back and forth as desired. The initial quality of the display is determined by those of the quality control switches K which are initially closed. The subsequent quality is determined by opening these switches and closing others.

But the emphasis of the display at large is not the most effective emphasis which can be given every display, in fact not the most important emphasis which can be given the majority. The emphasis more often belongs upon a single word or a single group of words. In the earlier one of my two prior patents in this art I claim broadly the method of display thru which this more important emphasis is attained. In this system I have likewise incorporated a means of obtaining it, incorporated it in such a manner that it has become part and parcel of this particular system.

When the relays A, B, C, etc. of the character determining machine are energized,

they not only put battery upon spacing multiple 69 thru contacts 70, but they also thru contacts 97 put battery upon multiple 98 which is branched to keys L and U of the emphasis control board K. The key U when depressed extends this battery connection by conductor 99 and contacts 100 of the relays G^1 , G^2 , etc., conductors 101 to the relays U^1 , U^2 , etc. Conductor 99 is multiplied to all corresponding contacts 100 with the result that the relay U associated with that display position at the moment under control thru character determination, and that relay U only, is energized. Relay U^1 pulling up locks up by contact 102 to locking circuit 66₂ of the lamp relays L^1 , L^2 , etc. It closes both front contacts 103 and 104, thereby extending busses 105 and 106 to the green and blue lamps of the pairs 21¹, which constitute the underscore display of the monogram. Depending upon which of the keys UG, UGF, UB and UBF of the control group K are pressed, either the green lamps, the green lamps flashing, the blue lamps or the blue lamps flashing, are energized and the underscore is given the corresponding character, for the closure of any one of these keys closes only the corresponding circuit breaker of the group CB. Relations of the circuit breakers to the busses 105 and 106 are identical with those described in connection with keys of the series SW, SWF, etc., and need not be repeated here. Thus the underscore may have any one of four different characters or any combinations of these.

The operation described in connection with display position M^1 is precisely what follows for position M^2 and for all other positions, but only as long as the underscore key U of the control group K is maintained closed. Because key U may be closed at any point in the display and opened at any succeeding point, the underscore display just described may be made under any letter or group of letters lying anywhere in the entire display. Nor does the use of the underscore in connection with one word preclude its use in connection with a word removed any distance therefrom, for key U can be closed and opened with the same results as many different times in the course of a single display as may be desired, and after the attainment of such individual emphasis its character may be changed even as the character of the display at large may be changed at will after its initial determination. Only when the display is obliterated is the underscoring obliterated, although it may be specially obliterated by pressing special underscore release key UL located in conductor 102, if desired.

But going farther than this I have also incorporated the method described in my prior patent for individualizing the control

of the color and flashing of the character itself, thus still further intensifying individual emphasis of characters and groups of characters. This is done thru the series of keys L, LW, LWF, LR, LRF, and LL. When key L is pressed it places battery from multiple 98 upon multiple 107 which is multiplied to the contacts 108 of all the relays G^1 , G^2 , etc. and thru them by conductors 109 to the emphasis control relays Q^1 , Q^2 , etc. As in the case of underscore relays U, whenever and as long as key L is closed, always when a character is determined the emphasis control relay Q^1 or the like associated with the particular display position upon which a character is being determined, is pulled up and locked up simultaneously with the lamp relays L^1 , L^2 , etc. Like underscore relays U character quality relay Q also locks up over the associate locking multiple 66₁, or 66₂, in this case by branch conductor 110. Whenever a quality relay Q^1 , etc., pulls up it shifts the common terminals 91 and 94 of the red and white lamps respectively from the busses 60 and 89 respectively to the busses 111 and 112 respectively, the shift being made by the closing of the front contacts of groups 61 and 90. Busses 111 and 112 extend to the circuit breakers connected with the series of keys L, LW, LWF, etc., and bear the same relation to them as that of the busses 60 and 89 to the group S, SW, SWF, etc., with the result that the same color and flashing variations which are possible on the sign at large thru the group SW, etc., are possible with the individualized letters and groups of letters thru the group LW, LWF, etc. Thus any trademark, tradename, or any important descriptive matter may be emphasized as intensely as desired.

Still further it is obviously possible with this system to combine such individualized and underscore emphasis and again redouble the intensity of the expression. In short the system provides for the attainment of any degree of emphasis of any character which may be advantageous, in any case, no matter how special.

As is almost always the case with inventions of broad scope, my invention is capable of many modifications without departing from its generic spirit. I desire to cover all of them of whatsoever nature falling within the purview of my invention in the annexed claims.

What I claim is:

1. A character display system comprising a plurality of character display devices, character keys, character forming relays governed thereby, and character spacing circuits serially interrelating said display devices and emanating initially from said character forming relays.

2. A character determining machine com-

prising a number of character multiples, a character emphasis multiple, and a plurality of groups of switching contacts including variable connections from said character multiples to a source of power according to the group used, and invariable partially completed connections from the emphasis multiple to a source of power.

3. A character determining machine comprising a number of character multiples, a spacing multiple, and an emphasis multiple and a plurality of groups of switching contacts including variable connections from said character multiples to a source of power, and invariable separate connections from said spacing and emphasis multiples to a source of power.

4. In a character display system, a series of display devices, each comprising character forming elements, a group relay, a timing relay, and a transfer relay, primary circuits for the character forming elements controlled by the local group relay, primary circuits for the timing relays controlled by the local group relays, primary circuits for the transfer relays controlled by the timing relays, primary circuits for the group relays controlled each jointly by a timing relay and associated transfer relay, secondary circuits for the group relays controlled by the local timing relays, and secondary circuits for the transfer relays controlled each through a succeeding timing relay.

5. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, primary circuits for the transfer relays controlled by the timing relays, primary circuits for the timing relays controlled each jointly by a timing relay and associated transfer relay, and secondary circuits governing the timing relays and controlled by the timing relays themselves.

6. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, initial circuits for the transfer relays controlled by the timing relays, and initial circuits for the timing relays partially closed by the transfer relays and completed by the timing relays associated therewith.

7. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, primary circuits for the transfer relays controlled by the timing relays, primary circuits for the timing relays controlled each jointly by a timing relay and associated transfer relay, and secondary circuits gov-

erning the timing relays which circuits are closed when the timing relays are energized over the primary circuit.

8. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, primary circuits for the transfer relays controlled by the timing relays, primary circuits for the timing relays controlled each jointly by a timing relay and associated transfer relay, and secondary circuits for the transfer relays controlled each through a succeeding timing relay.

9. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, primary circuits for the transfer relays controlled by the timing relays, and secondary circuits for the transfer relays controlled each through a succeeding timing relay.

10. In a character display system, character determining means, a series of display devices, each comprising character forming elements, a timing relay associated with the character determining means, and a transfer relay, primary circuits for the timing relays controlled each jointly by a timing relay and associated transfer relay, and secondary circuits governing the timing relays and controlled by the timing relays themselves.

11. In a character display system, character determining means, a series of display devices each comprising character forming elements, and a group relay associated with the character determining means, a primary circuit for each group relay generated from the preceding group relay, and a secondary circuit for each group relay generated at the group itself.

12. A bicolor monogram comprising two sets of character forming elements, one set of circuit controlling relays therefor, a single character determining means common to a plurality of monograms, and two sets of circuit controlling contacts governed by said relays, one for each set of character forming elements.

13. A monogram display device comprising a plurality of character forming elements, a group relay controlling the same, and an emphasis device also controlled by said group relay.

14. A monogram display device comprising a plurality of character forming elements, a group relay controlling the same, and an emphasis controlling relay, whose circuit is made by way of contacts closed by the group relay.

15. In a selective character display sys-

tem, a plurality of character display monograms controlled from a central point, a cut-in device in the form of a group switch for each monogram, and an emphasis device controlled from the central point thru the cut-in device.

16. In a selective character display system, a plurality of character display monograms, character determining means common to a plurality of devices, and an emphasis device on each monogram, controllable from the character determining means.

17. In a selective character display system, a plurality of character display monograms, character determining means, a cut-in device in the form of a group switch for each monogram, and an emphasis device for each monogram controlled from the character determining means thru the cut-in device.

18. In a selective character display system, a plurality of character display devices, a spacing multiple common to the devices, an emphasis multiple also common to the devices, and a cut-in device in the form of a group switch for each display device through which the said multiples are separately extended to the display device.

19. In a selective character display system, a plurality of changeable multicolor display devices, selective switching means common to a plurality of devices to determine the character display, group control segregating means, a flashing device for the display at large, and a flashing device connected to flash the colors of segregated groups oppositely to the flashing of colors of the remainder of the display.

20. In a selective character display system, a plurality of changeable display devices, control devices for the same, selective switching means to determine the character of the display and common to a plurality of display devices, a multicolor underscore display on each device, and selective switching means independent of the display control devices to determine the color of said underscore.

21. In a selective character display system, a plurality of changeable display devices comprising character forming means set to display various characters, and restoring means for the character forming devices in certain of said display devices controllable thru the operation of a certain other display device when such other is set, together with a set of spaced transfer circuits extending from device to device from the beginning to the end of the series and also from the last to the first device of the series.

22. In a selective character display system, a plurality of changeable display devices comprising character forming means set to display various characters, restoring

means for the character forming devices in certain of said display devices controllable thru the operation of a certain other display device when such other is set, and selective means to determine such control, together with a set of transfer circuits extending from device to device from the beginning to the end of the series, and also from the last to the first device of the series.

In testimony whereof I hereunto affix my signature.

JOHN P. TARBOX.

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