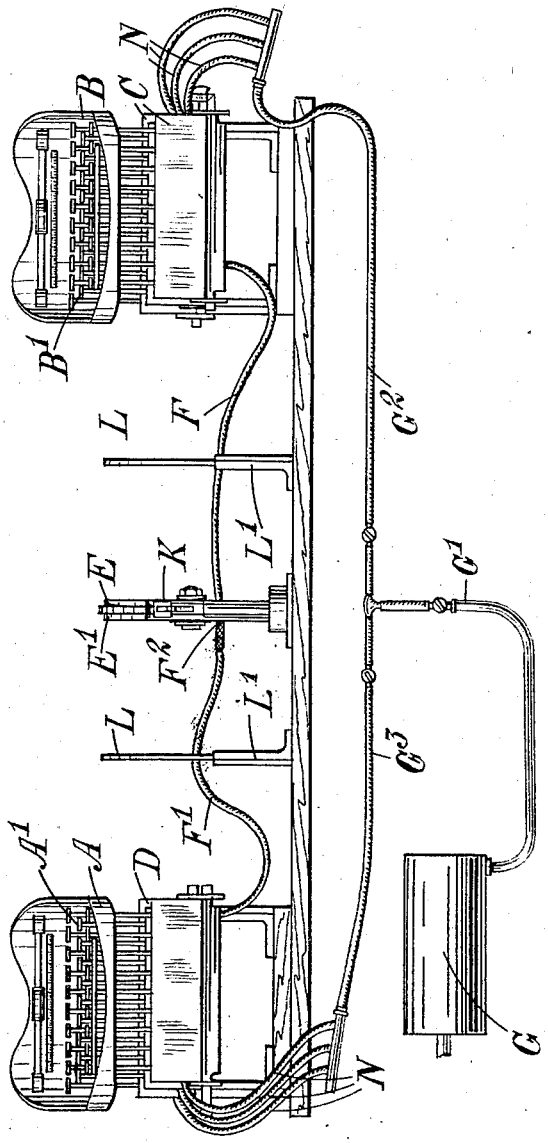
Jan. 20, 1925. 1,523,689

S. HOLE

CODING AND DECODING MACHINE

Filed Aug. 18, 1923 3 Sheets-Sheet 1

Fig. 1.

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Filed Aug. 18, 1923 3 Sheets-Sheet 2

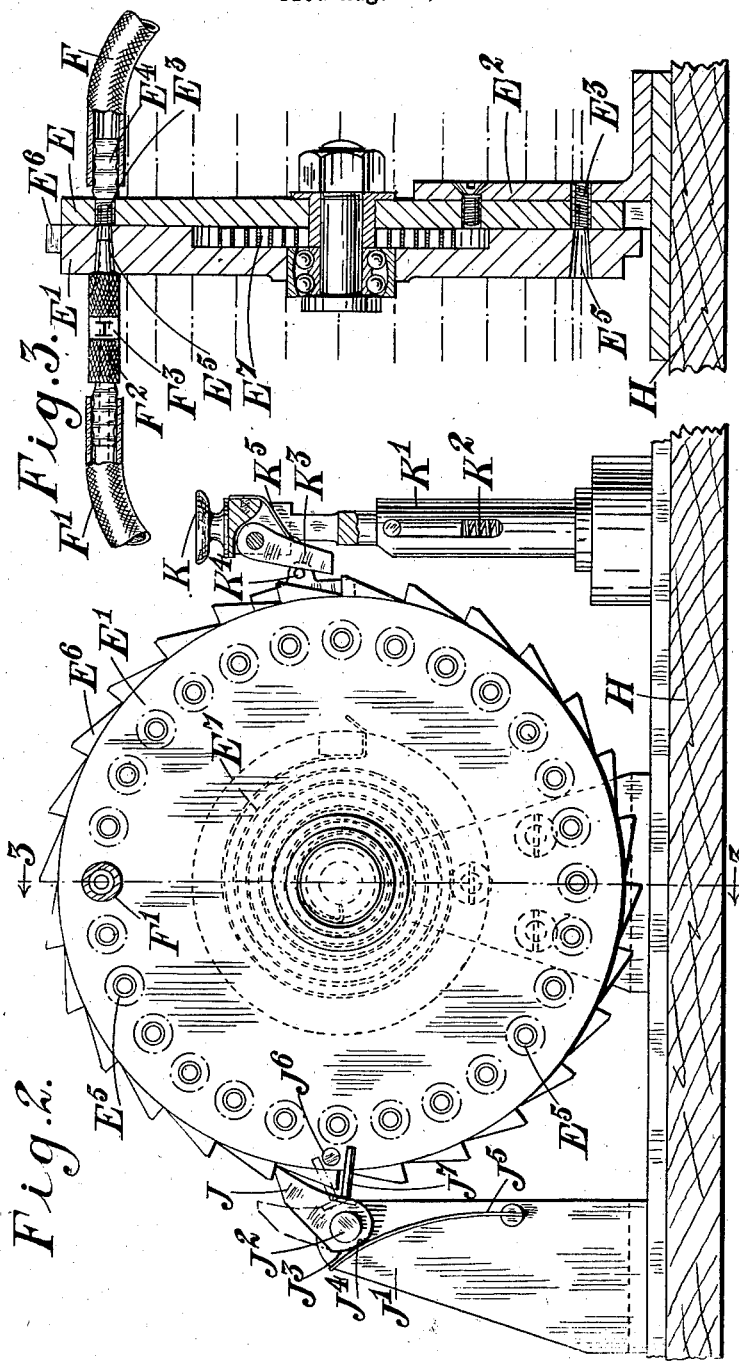


Fig. 3.

Fig. 2.

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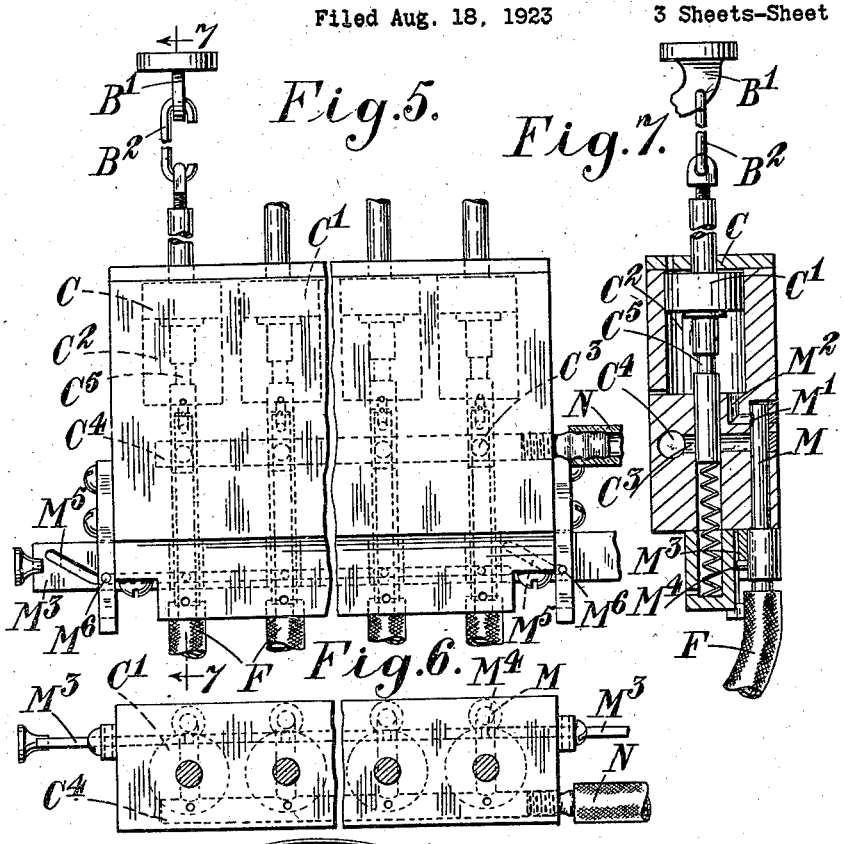
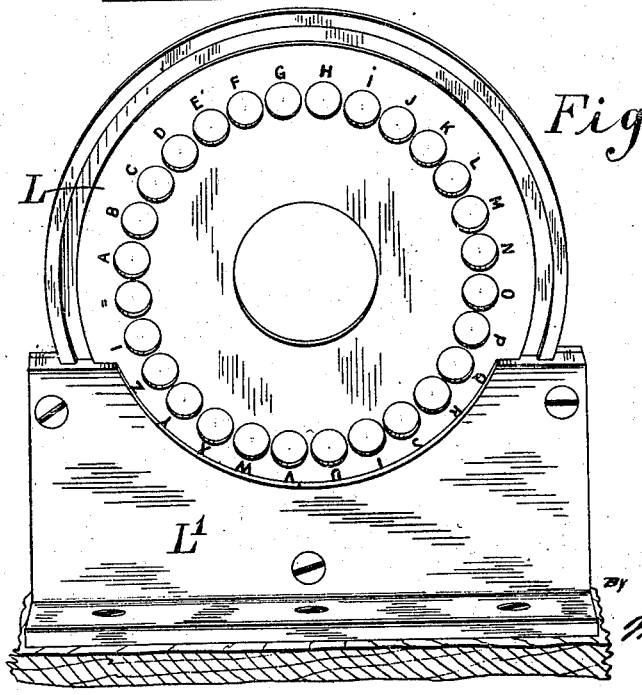
Filed Aug. 18, 1923 3 Sheets-Sheet 3

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Patented Jan. 20, 1925. 1,523,689

# UNITED STATES PATENT OFFICE.

SIDNEY HOLE, OF ALBOURNE, ENGLAND.

## CODING AND DECODING MACHINE.

Application filed August 18, 1923. Serial No. 658,158.

*To all whom it may concern:*

Be it known that I, SIDNEY HOLE, a subject of the King of England, residing at Albourne, Hassocks, Sussex, England, have invented certain new and useful Improvements in Coding and Decoding Machines, of which the following is a specification.

This invention relates to coding and de-coding machines of the type wherein one set of sign-keys is operatively connected to a second set of sign-keys constituting writing keys through a code-changing device comprising two members whereof one is moveable in relation to the other and which has transmission points, one for each key, and operative means is provided passing through the said members by way of said transmission points and connecting the keys in pairs, one of one set to one of the other set, and the said transmission points of one member are arranged all to register simultaneously with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission-point of the one member will be advanced to the preceding one of the other member, with the result that the pairs of keys will be changed, i. e. individual keys in one set will now co-operate with different keys in the other set.

Heretofore the code-changing device has provided two opposite series of transmission-points between which a member moved having two other opposed series of transmission-points, the transmission-points of this second member being irregularly cross-connected so that that point directly opposite another was not connected to the one it was opposite but to some other point. This central member therefore constituted the means for giving an initial "setting-up" of a code in that a key of one set would thereby be made to operate a key which was not apparently the corresponding key in the other set, and further code changing was effected by stepping the one member relatively to the other. To change this initial "setting-up" of the code required the substitution of another member provided with the necessary cross-connections; or where the apparatus is worked electrically the same member could be re-wired, either of which operations however would absorb an undesirable amount of time.

The object of the present invention is to provide a form of code changing device whereby the amount of time necessary for "setting-up" where a change is required may be greatly reduced.

According to the present invention coding or de-coding apparatus of the type described is characterised by the operative connections between one set of keys and one member providing the transmission-points being of a flexible character, such as rubber tubes, and provided with engaging means, such as plugs, adapted to be instantly engaged each with, or disengaged from, any one of the transmission-points in that member for rapidly "setting-up" an initial code according to any desired plan.

The code-changing device may take the form of two plates (for example discs) placed face to face and arranged so that at least one can be moved over the other, for example rotated thereon, the transmission-points on the plates being such that they communicate with each other on the inner faces of the plates and afford a hold for the engaging-means of the connections with the keys on the outer faces. One of the plates or discs is conveniently made stationary and the other arranged to move or rotate upon it.

Preferably, pneumatic means is employed for operating that set of keys which is not manually operated; such means comprising valves controlled by the manually-operated keys, tubes extending from these valves to one series of transmission-points on one of the members of the code-changing device, fluid-operated pistons connected one to each of the keys of the other set, and tubes extending from the cylinders of these pistons to the other set of transmission-points, the aforesaid valves being arranged to control the action of the working-fluid in such manner that when any one valve is opened by the manual depression of one key a key of the other set will be operated by the fluid.

Both sets of keys may be arranged to impress signs upon a paper sheet or other receiver, in which case each set of keys is provided with self-operating means, one connection only extends from each key to the

code-changing device, and changing-over means is provided so that either set of keys can at will become the manually-operated set and the other set the responsively-operated set.

Two standard typewriters may be employed having the keys of one operatively connected to the keys of the other through the code-changing device; such an arrangement avoids unnecessary expense in providing special means for recording the operations of the keys and thus considerably reduces the cost of producing a machine in which either of the two sets of keys can be used at will for coding or decoding.

In the accompanying drawings which illustrate one method of carrying out this invention—

Figure 1 shows diagrammatically the general arrangement of the machine;

Figure 2 is a side elevation of the code-changing device on a larger scale than that of Figure 1;

Figure 3 is a central vertical section through the code-changing device on the line 3—3 of Figure 2;

Figure 4 is a side elevation of one of the designation plates used in the machine;

Figure 5 is a front elevation showing the arrangement of the valve-boxes whereby one set of keys is operated from another;

Figure 6 is a plan of the parts shown in Figure 5, and

Figure 7 is a vertical section through the parts shown in Figure 5 on the line 7—7 of that figure.

Like reference letters indicate like parts throughout the drawings.

The machine shown in the drawings comprises two standard typewriters A and B respectively, which are provided with the usual keys $A^1$, $B^1$ whereby typewritten matter can be executed.

Beneath the typewriters are three or more valve-boxes C, D respectively, the valves in which are operatively connected with the keys as hereinafter described.

Between the two typewriters is a code-changing device comprising a fixed disc E and a movable disc $E^1$, which parts will hereinafter be described in greater detail.

Extending from the valve-boxes C are a number of tubes F, whereof only one is shown in Figure 1, one tube being allotted to the valve of each type-key, and having connection at the end remote from the typewriter with the plate E of the code-changing device. Similarly, the valve-boxes D have a series of tubes $F^1$ connecting the valves therein with the disc $E^1$ of the code-changing device, and these tubes are brought opposite one another by the code-changing device so that when one of the keys $B^1$ is manually-operated a key $A^1$ will be operated by pneumatic means or vice versa.

Exhaust apparatus is connected to the chamber G and thence by a conduit $G^1$ and branch-conduits $G^2$, $G^3$ to the valve-boxes C and D respectively, so that when a key in one set is manually-operated a key in the other set will be moved down by atmospheric pressure.

The disc E is carried from the base-board H by a bracket $E^2$ and is provided with a series of holes $E^3$ arranged in a circle, each carrying a nipple $E^4$ to receive one of the tubes F. Similarly, the plate $E^1$ is provided with a series of tapered holes $E^5$ which are arranged to register with the holes $E^3$, all the holes being equally spaced. The plate $E^1$ has on its periphery a series of teeth $E^6$, one allotted to each hole, and these teeth are engaged by a retaining pawl J carried on a standard $J^1$ by a pivot-pin $J^2$. The pawl has on it two flats $J^3$, $J^4$ respectively and a spring $J^5$ bears against one or other of these flats according to the position in which the pawl lies. A spiral spring $E^7$ is mounted in a recess of the disc $E^1$ and tends always to rotate the disc in a direction to engage the pawl J. It thus follows that if the disc is advanced one or more teeth it will be retained in the position to which it is advanced by the pawl J, and the spacing of the teeth is such that whatever tooth is engaged by the pawl J the holes $E^3$, $E^5$ will be in register with each other.

A series of hollow tapered plugs $F^2$ are secured to the ends of the tubes $F^1$ and serve as engaging-means between these tubes and the holes $E^5$ in the plate $E^1$. Each plug $F^2$ has a flat $F^3$ thereon, and on this is marked the sign corresponding to the sign of the key to which that tube $F^1$ is allotted.

The holes $E^3$, $E^5$ thus constitute transmission-points which communicate with each other on the inner faces of the plates. Also the holes afford a hold for the engaging means, viz: the plugs $F^2$ and nipples $E^4$ of the connections with the keys on the outer faces of the plates E, $E^1$.

To step the disc $E^1$ round, a code-changing key K is provided. This is mounted to slide vertically in a support $K^1$ and is normally retained in the raised position by a spring $K^2$, which carries a pawl $K^3$. When the key is in the raised position the pawl lies against a pin $K^4$ on a fixed member, and is held back thereby against the action of its spring $K^5$ so that it lies clear of the teeth $E^6$ of the disc, but as the key is depressed the pawl moves towards the disc and engages the tooth which lies immediately beneath it. Continued depression of the key will then move the disc around the space equal to one tooth allowing the retaining-

pawl J to drop behind its next tooth, whereupon the key K can be released and will again resume the position shown in Figure 2.

The disc $E^1$ carries a stop $J^6$ which cooperates with a pin $J^7$ on the pawl J. When the disc is in the zero position the stop is slightly in advance of the pin $J^7$, as shown in Figure 2, and it will travel further therefrom as the disc is advanced until the latter has completed one revolution, when the stop $J^6$ will be brought against the underside of the pin $J^7$. This will lift the pawl so that it will spring back to the position shown in chain-line in Figure 2 with the flat $J^3$ engaged by the spring $J^5$, and then as the key K rises after the last operation the disc will fly back to the zero position under the action of its spring $E^7$, and on reaching the zero position the stop $J^6$ will strike the pin $J^7$ and bring the pawl again into engagement so that the parts resume the position shown in Figure 2.

In order that the tubes F, $F^1$ may be easily designated irrespectively of the plugs $F^3$, (which moreover are only shown as employed with the tubes $F^1$ though they may be also used with the tubes F if desired) the tubes are passed through designation-plates L. These plates are supported in carriers $L^1$ so that they can be turned therein if desired, and they are provided with a series of holes through which the tubes are threaded, each hole having set against it the sign of the key to which that tube is allotted.

All the valve-boxes C and D are in every respect alike and therefore a part of one valve-box C need only be described in detail. In Figures 5 and 7 part of a type-key $B^1$ is shown, which key is connected by a link $B^2$ to the rod of a piston $C^1$. The piston is conveniently of graphite and slides in a cylinder or barrel $C^2$ formed for it in the valve-box. The piston-rod extends beyond the cylinder so that it crosses a transverse passage $C^3$ which communicates with a longitudinal passage $C^4$. This lower extension of the piston-rod has in it an annular port $C^5$ which registers with the passage $C^3$ when the key $B^1$ is in the depressed position. A tubular hand-operated valve M is arranged to slide vertically in the valve-box and extends below the same to receive one of the tubes F. This valve M is plugged at the upper end and has a lateral port $M^1$ which communicates by a passage $M^2$ with the cylinder $C^2$ when the valve is in the raised position shown in Figure 5. The valve can be raised and lowered by a sliding-bar $M^3$ which is slotted to receive a pin $M^4$ on the lower end of the valve, and when the valve is in the lowered position its port $M^1$ registers with the transverse passage $C^3$.

Each valve-box is made of the same length as a row of keys and contains as many cylinders as there are keys, each key being connected with a piston operating in a cylinder located beneath it. The passage $C^4$ runs from one end of the valve-box to the other and communicates with transverse passages $C^3$, one for each piston-rod. The passage $C^4$ is closed at one end but at the other end has a nipple to which a tube N is connected whose other end connects with the conduit $G^2$. There are three of these valve-boxes to each typewriter and the three tubes therefrom thus all connect to the conduit $G^2$. The other set of valve-boxes D also have three tubes N connected in the same manner to the conduit $G^3$.

The bars $M^3$ are provided with cam-slots $M^5$ which engage pins $M^6$ on a fixed part of the machine and, consequently, when the bars are slid in one direction, the valves M are all raised, as shown in Figures 5 and 7, but when the bars are moved in the other direction, that is from left to right of Figure 5, they will draw all the valves M down to their second position.

The operation of this machine is as follows:

The working-fluid employed is the external air at atmospheric pressure, this being rendered operative by maintaining a partial vacuum on the container G through any convenient exhausting-means, such as an electrically-driven exhaust-pump. From this it will be seen that the conduits $G^1$, $G^2$, $G^3$, $M^2$ and N, and the longitudinal passages $C^4$ and their companion passages in the valve-boxes D will always be maintained under partial vacuum.

Supposing, therefore, it is desired to manually operate the keys $B^1$ of the typewriter B and produce responsive operations of the keys $A^1$ of the typewriter A, the bars $M^3$ of the valve-boxes C will be moved in such direction as to bring all the manually-operated valves M to their lower operative position, that is with the ports $M^1$ in register with the lateral passages $C^3$, but the bars $M^3$ of the valve-boxes D will be left in the position shown in Figures 5 and 7 so that the ports $M^1$ of the hand-operated valves M will register with the passages $M^2$ of the cylinders in the valve-boxes D. It therefore follows that when a key $B^1$ is depressed the annular port $C^5$ of the corresponding piston-rod will be brought to register with the passage $C^3$, and, consequently, the tube F corresponding to that key will be put under partial vacuum through the port $M^1$ of its valve M being thrown into communication with the longitudinal passage $C^4$ through the transverse passage $C^3$. This tube F is, however, operatively connected with one of the tubes $F^1$ through the code-changing device E, $E^1$ and therefore the cylinder in the valve-box D corresponding to that tube $F^1$

will be put under vacuum with the result that its piston will be forced down by atmospheric pressure, and the type-key $A^1$ connected thereto will thus be responsively-operated through the manual operation of the type-key $B^1$.

Preferably, the code-changing device E, $E^1$ has an initial code "set-up" therein, that is to say the tube F corresponding to the key "A" in the B typewriter does not register with the tube $F^1$ corresponding to the key "A" in the A typewriter, and so forth, but the tubes are arranged according to some initial code relatively to one another. The tubes F could be arranged, for example, in alphabetical order and the tubes $F^1$ plugged into the holes of the plate $E^1$ in a mixed order so that when the key "A" was struck on the B machine a key, for example "N", might be struck on the A machine, and so forth.

It is desirable to vary this initial code at times and for this purpose the plugs $F^2$ are of great advantage as they afford an engaging-means between the tubes and the code-changing device which can be instantly engaged with or disengaged from any one of the transmission-points represented by the holes $E^5$ in the code-changing device.

After a given number of operations of the keys, decided upon by arrangement, the code-changing key K is operated. This may be operated once or twice, or a varying number of times according to arrangement, so that the initial code is changed either at the end of each line or after the completion of each word, or after so many letters have been written.

From the above description it will be seen that a message can be written on the typewriter B and will appear in the ordinary form on paper put in that typewriter, but simultaneously the same message will be coded by the machine A so that an apparently meaningless arrangement of signs appears on the paper-sheet in that typewriter. To de-code this message the bars $M^3$ of the two sets of manually-operated valves M are reversed so that the typewriter A is now the manually-operated one and the typewriter B becomes the responsively-operated one, when by starting with the initial code as originally arranged and the coding disc E, $E^1$ in the same position as it was when the coding was started (presumably at zero) and operating the code-changing device at the same intervals as it was operated when coding the message, a de-coded message will be written on the typewriter B which in every respect corresponds to the message previously written thereon when coding it.

It will be seen that by reason of being able to change the code continuously by merely operating the key K, and also to change the initial code by re-arranging the plugs $F^2$, an endless number of changes can be produced which renders de-coding by ordinary rules impossible because there need never be a sufficient number of letters written in any one code to afford a key to the code. It has been found in practice that the plugs $F^2$ can all be removed and replaced according to any new code in five minutes or less.

Obviously, both plates E, $E^1$ may rotate if desired, for example they could rotate in opposite directions being operated by the same or separate keys, or they could rotate in the same direction and be arranged to be operated by separate keys; also plugs similar to the plugs $F^2$ could be provided in the plate E so that these could be changed as well as those in the plate $E^1$ for "setting-up" any initial code.

Obviously, the plates need not rotate relatively to one another, as so long as one plate moves over the other the desired changing of code can be effected, for instance, one plate could be made to slide horizontally relatively to the other and stepped by a suitably arranged key and pawl.

By providing the spring return to zero the operator does not have to consider whether he has carried the plate round one cycle or not as it will automatically return to zero at the end of the cycle and he continues to operate the key K according to the prearranged programme.

I claim:—

1. In a machine of the character described, the combination with a set of character-producing sign-keys, a second set of sign-keys which is a duplicate of the first set, a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a said set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member, means interconnecting the sign-keys of one of said sets each with one of the transmission points of one of said code-changing members, and a plurality of flexible connecting members operatively connecting the sign-keys of the other set each at will with any one of the transmission points of the other of said code-changing members so as to be readily attachable to and detachable from the latter, substantially as described.

2. In a machine of the character described, the combination with a set of character-producing sign-keys, a second set of sign-keys which is a duplicate of the first set, a code-changing device comprising two

code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a said set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member, tubes operatively connecting the sign-keys of one of said sets each with one of the transmission points of one of said code-changing members, and a plurality of rubber tubes operatively connecting the sign-keys of the other set each at will with any one of the transmission points of the other of said code-changing members so as to be readily attachable to and detachable from the latter, substantially as described.

3. In a machine of the character described, the combination with a set of character-producing sign-keys, a second set of sign-keys which is a duplicate of the first set, a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member, means interconnecting the sign-keys of one of said sets each with one of the transmission points of one of said code-changing members, a plurality of engaging means, one for each transmission point of the other of said code-changing members, adapted to be engaged each with, and disengaged from any one of the transmission points in that member, and a plurality of flexible connecting members operatively connecting the sign-keys of the other set each with one said engaging means, substantially as described.

4. In a machine of the character described, the combination with a set of character-producing sign-keys, a second set of sign-keys which is a duplicate of the first set, a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members have each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member, means interconnecting the sign-keys of one of said sets each with one of the transmission points of one of said code-changing members, a plurality of plugs, one for each transmission point in the form of a hole, in the other of said code-changing members, which plugs are readily placeable into and removable from any one of the transmission holes in that member, and a plurality of flexible connecting members operatively connecting the sign-keys of the other set each with one of said plugs, substantially as described.

5. In a machine of the character described, the combination with a set of character-producing sign-keys, a second set of character producing sign-keys which is a duplicate of the first set, of only one code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each transmission point of one member is advanced to the preceding one of the other member, two sets of automatic key-operating devices, one device for each key in each set of keys, for actuating the sign-keys for producing characters, controlling means for controlling the self-operation of the devices of one set from the devices of the second set and those of the second set from those of the first set, which controlling means comprise only one set of connecting members arranged in two groups associated each with a set of sign-keys, one member allotted to each key-operating device, one of which groups of connecting members connects the key-operating devices of one set thereof each with one of the transmission points of one of said code-changing members, and the second of said groups of connecting members connects the key-operating devices of the second set thereof each with one of the transmission points of the second code-changing member, and two sets of change-over mechanisms, one set associated with each set of key-operating devices, and each set so arranged as in one position to render its associated key-operating devices inoperative, and to make the key-operating devices of the other set of keys controllable by a manual operation of the keys associated with the first set of change-over mechanism, and in another position to render its associated key-operating devices controllable by manual operation of the keys associated with the second set of change-over mechanism, substantially as described.

6. In a machine of the character described, the combination of a set of character-producing sign-keys, a second set of character-producing sign-keys which is a duplicate of the first set, only one code-

changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when one member is stepped one spaced relatively to the other each transmission point of one member is advanced to the preceding one of the other member; two sets of automatic key-operating devices, one device for each key in each set of keys, for actuating the sign-keys for producing characters, a plurality of power-supply means, at least one allotted to each set of key-operating devices; controlling means comprising only one set of connecting members arranged in two groups associated each with a set of sign-keys, one member allotted to each key-operating device, one of which groups of connecting members connects the key-operating devices of one set thereof each with one of the transmission points of one of said code-changing members, and the second of said groups of connecting members connects the key-operating devices of the second set thereof each with one of the transmission points of the second code-changing member, and two sets of key-operated switch mechanisms, each mechanism being associated with one of said sets of key-operating devices, and each mechanism being adapted, when its allotted key is depressed, to operatively connect one of said power supply means to one of said connecting members; and two change-over switch mechanisms, associated each with one of said sets of key-operating devices, and each operated independently of the sign-keys for rendering the said key-operated switch mechanisms inoperative, which change-over switch mechanisms are arranged each operatively to connect a connecting member with a respective key-operating device, substantially as described.

7. In a machine of the character described, the combination with a set of character-producing sign-keys, and a second set of character-producing sign-keys which is a duplicate of the first set, of only one code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each transmission point of one member is advanced to the preceding one of the other member, two sets of automatic pneumatic key-operating devices, one device for each key, for actuating the sign-keys for producing characters; pneumatic controlling means for controlling the self-operation of the devices of one set from the devices of the second set, and those of the second set from those of the first set, which controlling means comprise only one set of connecting members in the form of tubes arranged in two groups associated each with a set of sign-keys, one tube allotted to each key-operating device, one of which groups of tubes connects the key-operating devices of one set thereof readily detachably each with one of the transmission points of one of said code-changing members, and the other of said groups of tubes connects the key-operating devices of the second set thereof readily detachably each with one of the transmission points of the second code-changing member; and two sets of change-over mechanisms, one set associated with each set of key-operating devices, and each set so arranged as, in one position to render its associated key-operating devices inoperative, and to make the key-operating devices of the other set of keys controllable by a manual operation of the keys associated with the first set of change-over mechanism, and in another position to render its associated key-operating devices controllable by manual operation of the keys associated with the second set of change-over mechanism, substantially as described.

8. In a machine of the character described, the combination of a set of character-producing sign-keys, a second set of character-producing sign-keys which is a duplicate of the first set, only one code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points in the form of ports, each having a hollow plug, one plug for each key of a set of sign-keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member is advanced to the preceding one of the other member; two sets of automatic pneumatic key-operating devices; one device for each key, for actuating the sign-keys for producing characters, a plurality of power ducts, at least one allotted to each set of key-operating devices; controlling means comprising only one set of tubes arranged in two groups associated each with a set of sign-keys, one tube alloted to each key-operating device, one of which groups of tubes readily detachably connects the key-operating devices of one set thereof each with one of the said plugs of one of said code-changing members, and the second group connects the key-operating devices of the second set thereof each with one of the plugs of the second code-changing member,

and two sets of key-operating switch mechanisms, each mechanism being associated with one of said sets of key-operating devices, each mechanism being adapted, when its allotted key is depressed, to operatively connect one of said power ducts to one of said tubes; and two change-over switch mechanisms, associated each with one of said sets of key-operating devices, and each operated independently of the sign-keys, for rendering the said key-operated switch mechanisms inoperative, which change-over switch mechanisms are arranged each operatively to connect a connecting member with a respective key-operating device, substantially as described.

9. In a machine of the character described, the combination with a set of character-producing sign-keys, and a second set of character-producing sign-keys which is a duplicate of the first set, of only one code-changing device comprising two code-changing members in the form of plates arranged face to face, whereof one is movable in relation to the other, said plates having each a plurality of transmission points in the form of ports, one for each key of a set of sign-keys, which ports of one plate are arranged to register with those of the other and are so spaced that when one plate is stepped one space relatively to the other each port of one plate is advanced to the preceding one of the other plate; two sets of automatic pneumatic key-operating devices, one device for each key, for actuating the sign-keys for producing characters; pneumatic controlling means for controlling the self-operation of the devices of either set from the devices of the other set, which controlling means comprise only one set of connecting members in the form of tubes arranged in two groups associated each with a set of sign-keys, one tube allotted to each key-operating device, one of which groups of tubes connects the key-operating devices of one set thereof each with one of the ports of one of said plates, and the second of said groups of tubes connects the key-operating devices of the second set thereof each with one of the ports of the second plate; and two sets of change-over mechanisms, one set associated with each set of key-operating devices, and each set so arranged as, in one position to render its associated key-operating devices inoperative, and to make the key-operating devices of the other set of keys controllable by a manual operation of the keys associated with the first set of change-over mechanism, and in another position to render its associated key-operating devices controllable by manual operation of the keys associated with the second set of change-over mechanism, substantially as described.

10. In a machine of the character described, the combination with a set of character-producing sign-keys, and a second set of character-producing sign-keys which is a duplicate of the first set, of only one code-changing device comprising two code-changing members in the form of plates arranged face to face, whereof one is rotatable over the other, said members having each a plurality of transmission points in the form of ports, one for each key of a set of sign-keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member is advanced to the preceding one of the other member; two sets of automatic pneumatic key-operating devices, one device for each key, for actuating the sign-keys for producing characters; pneumatic controlling means for controlling the self-operation of the said devices of either set from the devices of the other set, which controlling means comprise only one set of connecting members in the form of tubes arranged in only two groups associated each with a set of sign keys, one tube allotted to each key-operating device, one of which groups of tubes connects the key-operating devices of one set thereof each with one of the ports of one of said code-changing members, and the second of said groups of tubes connects the key-operating devices of the second set thereof each with one of the ports of the second code-changing member; and two sets of change-over mechanisms, one set associated with each set of key-operating devices, and each set so arranged as, in one position to render its associated key-operating device inoperative, and to make the key-operating devices of the other set of keys controllable by a manual operation of the keys associated with the first set of change-over mechanism, and in another position to render its associated key-operating devices controllable by manual operation of the keys associated with the second set of change-over mechanism, substantially as described.

11. In a machine of the character described, the combination of a set of manually-operable sign-keys, and a set of character-producing sign-keys which is a duplicate of the first set; a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member; pneumatic means connecting the two sets

of keys together by way of the said code-changing device, said pneumatic means comprising; valves controlled by the manually-operable keys, one valve for each key; a set of tubes extending one from each valve to the transmission points of one of said code changing members; cylinders allotted one to each character-producing key; pistons, one in each cylinder, connected each to a character-producing key; a second set of tubes extending one from each cylinder to the transmission points of the other of said code-changing members; and means for establishing a difference of pressure at the two sides of said pistons, connected to said first set of tubes by way of said valves, whereby when any one valve is opened by the depression of one manually-operable key, a character-producing key will be operated by the fluid pressure acting on its allotted piston, substantially as described.

12. In a machine of the character described, the combination with a set of manually-operable sign-keys, and a set of character-producing sign-keys which is a duplicate of the first set, of a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points in the form of holes, one for each key of a set of sign-keys, which holes of one member are arranged to register with those of the other and are so spaced that when the one member is stepped one space relatively to the other each hole of one member will be advanced to the preceding one of the other member; pneumatic means connecting the two sets of keys together by way of the said code-changing device, said pneumatic means comprising valves controlled by the manually-operable keys, one valve for each key, a set of tubes extending one from each valve to the holes of one of said code-changing members, cylinders allotted one to each character-producing key, pistons, one in each cylinder, connected each to a character-producing key, a second set of tubes extending one from each cylinder to the holes of the other of said code-changing members, and tubular plugging means, detachably inserted one in each code-changing member, connected each to one of said tubes; and means for establishing a difference of pressure at the two sides of said pistons, connected to said first set of tubes by way of said valves, whereby when any one valve is opened by the depression of one manually-operable key, a character-producing key will be operated by the fluid pressure acting on its allotted piston, substantially as described.

13. In a machine of the character described, the combination of a set of manually-operable sign-keys, and a set of character-producing sign-keys which is a duplicate of the first set; a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member; pneumatic means connecting the two sets of keys together by way of the said code-changing device, said pneumatic means comprising valves controlled by the manually-operable keys, one valve for each key, a set of tubes extending one for each valve to the transmission points of one of said code-changing members, cylinders allotted one to each character-producing key, pistons, one in each cylinder, connected each to a character-producing key, and a second set of tubes extending one from each cylinder to the transmission points of the other of said code-changing members; a support, a plate mounted to rotate on said support about an axis extending transversely through the plate, which plate has a plurality of perforations, one for each tube of one of said sets of tubes, through which the same are threaded, which perforations are marked each with a sign corresponding to the key to which the tube extending through it is allotted; and means for establishing a difference of pressure at the two sides of said pistons, connected to said first set of tubes by way of said valves, whereby when any one valve is opened by the depression of one manually-operable key, a character-producing key will be operated by the fluid pressure acting on its allotted piston, substantially as described.

14. In a machine of the character described, the combination of a set of character-producing sign-keys, and a second set of sign keys which is a duplicate of the first set; a code-changing device comprising two plates placed face to face whereof one is movable over the other, said plates having each a plurality of transmission points, one for each key of a set of sign keys, which points of one plate are arranged to communicate each with a point at the inner face of the other plate and are so spaced that when the one plate is stepped one space relatively to the other each transmission point of one plate will be advanced to the preceding one of the other plate; the movable plate having on its periphery teeth spaced apart to correspond to the stepping required for single-step changes of the transmission points, a key arranged to engage said teeth in succession and advance the movable plate

one space at a time, and means for arresting the movable plate in the position to which it is advanced; means detachably interconnecting the sign-keys of one of said sets each with one of the transmission points of one of said plates at the outer face thereof, and a plurality of flexible connecting members operatively connecting the sign-keys of the other set each with one of the transmission points of the other plate at the outer face thereof so as to be readily attachable to and detachable from the latter, substantially as described.

15. In a machine of the character described, the combination of a set of character-producing sign-keys, and a second set of sign-keys which is a duplicate of the first set; a code-changing device comprising two plates placed face to face whereof one is movable over the other, said plates having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one plate are arranged to communicate each with a point at the inner face of the other plate and are so spaced that when the one plate is stepped one space relatively to the other each transmission point of one plate will be advanced to the preceding one of the other plate; the movable plate having on its periphery teeth spaced apart to correspond to the stepping required for single-step changes of the transmission points, a key arranged to engage said teeth in succession and advance the movable plate one space at a time, a spring tending to move the movable plate in a direction opposite to that in which it is advanced by the key, and a locking pawl for preventing the return movement of the movable plate after each advance; means detachably interconnecting the sign-keys of one of said sets each with one of the transmission points of one of said plates at the outer face thereof, and a plurality of flexible connecting members so operatively connecting the sign-keys of the other set each with one of the transmission points of the other plate at the outer face thereof, as to be readily attachable to and detachable from the latter, substantially as described.

16. In a machine of the character described, the combination with a set of manually-operable sign-keys, character-producing mechanism arranged to be actuated by said keys, a second set of manually-operable sign-keys which is a duplicate of the first set, character-producing mechanism arranged to be actuated by said second set of keys, and transmission means operatively interconnecting the two sets of keys and arranged to automatically actuate a key of one set when a key of the other set is manually depressed, said transmission means including; a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other, each transmission point of one member will be advanced to the preceding one of the other member; two sets of key-actuating devices allotted one to each set of keys; two sets of power-transmission means included in said transmission means interconnecting each one of said sets of key-actuating devices with the transmission points of one of said code-changing members so as to be detachable from the latter, one connection only extending from each key-actuating device to its allotted member; and two change-over devices, one allotted to each set of keys, for enabling each key of a set alternatively to control the transmission of power to, and to be controlled by the transmission of power from a key of the other set by way of said code-changing device, substantially as described.

17. In a machine of the character described, the combination with a set of manually-operable sign-keys, character-producing mechanism arranged to be actuated by said keys, a second set of manually-operable sign-keys which is a duplicate of the first set, character-producing mechanism arranged to be actuated by said second set of keys, and pneumatic transmission means operatively interconnecting the two sets of keys and arranged to automatically actuate a key of one set when a key of the other set is manually depressed, said transmission means including a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other, each transmission point of one member will be advanced to the preceding one of the other member, two sets of key-actuating devices allotted one to each set of keys, each set of key-actuating devices comprising cylinders, one for each key, a piston in each cylinder operatively connected to its allotted key, each cylinder having a duct for connection to a tube, and a fluid-supply passage leading to said duct, a valve associated with each piston for controlling the fluid-supply passage of its allotted cylinder, and each cylinder having a change-over valve for connecting said duct either to its cylinder or to said fluid-supply passage; two sets of tubes connecting each one of said ducts with one of the transmission points of said code-chang-

ing members so as to be detachable from the latter, one tube only extending from each key-actuating device to its allotted member, and manually operable change-over devices, at least one allotted to each set of keys, for reversing said change-over valves, substantially as described.

18. In a machine of the character described, the combination with a set of manually operable sign-keys, character-producing mechanism arranged to be actuated by said keys, a second set of manually operable sign-keys which is a duplicate of the first set, character-producing mechanism arranged to be actuated by said second set of keys, and pneumatic transmission means operatively inter-connecting the two sets of keys and arranged to automatically actuate a key of one set when a key of the other set is manually depressed, said transmission means including a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other, each transmission point of one member will be advanced to the preceding one of the other member, two sets of key actuating devices allotted one to each set of keys, each set of key-actuating devices comprising cylinders, one for each key, a piston in each cylinder operatively connected to its allotted key, each cylinder having a duct for connection to a tube, and a transverse fluid-supply passage leading to said duct, each piston carrying a valve for controlling the fluid-supply passage of its allotted cylinder, and each cylinder having a change-over valve for connecting said duct either to its cylinder or to said fluid-supply passage; two sets of tubes connecting each one of said ducts with one of the transmission points of said code-changing members so as to be detachable from the latter, one tube only extending from each key-actuating device to its allotted member, and manually operable change-over devices, one allotted to each set of keys, for reversing said change-over valves, substantially as described.

19. In a machine of the character described, the combination with a set of manually-operable sign-keys, arranged in rows, character-producing mechanism arranged to be actuated by said keys, a second set of manually-operable sign-keys arranged in rows which is a duplicate of the first set, character-producing mechanism arranged to be actuated by said second set of keys, and pneumatic transmission means operatively interconnecting the two sets of keys and arranged to automatically actuate a key of one set when a key of the other set is manually depressed, said transmission means including a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a set of sign-keys, which points of one member are arranged to register with those of the other and are so spaced that when the one member is stepped one space relatively to the other, each transmission point of one member will be advanced to the preceding one of the other member, two sets of key-actuating devices allotted one to each set of keys, each set of key-actuating devices comprising cylinders, one for each key, a piston in each cylinder operatively connected to its allotted key, each cylinder having a duct for connection to a tube, and a transverse fluid-supply passage leading to said duct, each piston carrying a valve for controlling the fluid-supply passage of its allotted cylinder, and each cylinder having a change-over valve for connecting said duct either to its cylinder or to said fluid-supply passage, each change-over valve being of tubular form closed at one end and having a side port and movable endwise to bring it to two operative positions, which tubular valves are arranged in rows corresponding to the rows of keys; two sets of tubes connecting each one of said ducts with one of the transmission points of said code-changing member so as to be detachable from the latter, one tube only extending from each key-actuating device to its allotted member, and manually-operable sliding cam-members, one for each row of keys in each set, for actuating said change-over valves, substantially as described.

20. In a machine of the character described, the combination with a typewriting-machine having a set of character-producing sign-keys, a second typewriting-machine having a set of sign-keys which is a duplicate of the first set, a code-changing device comprising only two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each key of a said set of sign-keys, which points of one member are arranged to register with those on the other and are so spaced that when the one member is stepped one space relatively to the other each transmission point of one member will be advanced to the preceding one of the other member, means interconnecting the sign-keys of one of said machines each with one of the transmission points of one of said code-changing members, and a plurality of flexible connecting members interchangeably connecting the sign-keys of the other machine with the transmission points of the other of said

code-changing members so as to be readily attachable to and detachable from the latter, substantially as described.

21. In a machine of the character described, a code-changing device comprising only two coaxial discs placed face to face, whereof at least one is rotatable over the other, said discs having each a plurality of transmission points adapted for detachable connection each to a transmission member allotted to a sign-key, which points of one disc are arranged to communicate each with a point at the inner face of the other disc and are so spaced that when one disc is rotated relatively to the other each transmission point of one disc will be advanced to the preceding one of the other disc, substantially as described.

22. In a machine of the character described, a code-changing device comprising only two coaxial discs placed face to face, whereof one is rotatable over the other, said discs having each a plurality of transmission points adapted for detachable connection each to a transmission member allotted to a sign-key, which points of one disc are arranged to communicate each with a point at the inner face of the other disc and are so spaced that when one disc is rotated relatively to the other each transmission point of one disc will be advanced to the preceding one of the other disc, the movable disc having on its periphery teeth spaced apart to correspond to the stepping required for single step changes of the transmission points, a key arranged to engage said teeth in succession and advance the movable disc one space at a time, and means for arresting the movable disc in the position to which it is advanced, substantially as described.

23. In a machine of the character described, a code-changing device comprising two coaxial discs placed face to face, whereof one is rotatable over the other, said discs having each a plurality of transmission points for detachable connection each to a transmission member allotted to a sign-key, which points of one disc are arranged to communicate each with a point at the inner face of the other disc and are so spaced that when one disc is rotated relatively to the other, each transmission point of one disc will be advanced to the preceding one of the other disc, the movable disc having on its periphery teeth spaced apart to correspond to the stepping required for single-step changes of the transmission points, a key arranged to engage said teeth in succession and advance the movable disc one space at a time, a spring tending to move the movable disc in a direction opposite to that in which it is advanced by the key, and a locking pawl for preventing the return movement of the movable disc after each advance, substantially as described.

24. In a machine of the character described, a code-changing device comprising two coaxial discs placed face to face, whereof one is fixed and the other is rotatable over it, said discs having each a plurality of transmission points for detachable connection each to a transmission member allotted to a sign-key, which points of one disc are arranged to communicate each with a point at the inner face of the other disc and are so spaced that when one disc is rotated relatively to the other each transmission point of one disc will be advanced to the preceding one of the other disc, the movable disc having on its periphery teeth spaced apart to correspond to the stepping required for single-step changes of the transmission points, a key having a pawl arranged to engage said teeth in succession and advance the movable disc one space at a time, a spring tending to move the movable disc in a direction opposite to that in which it is advanced by the key, a spring-controlled retaining-pawl for engaging with said teeth and preventing the return movement of the movable disc after each advance, said retaining-pawl having two positions in which it can be held by its controlling spring, and a stop carried by the movable disc and arranged to coact with said retaining-pawl to move it into its disengaged position when the disc has completed a cycle of movement and to again coact with the same to return it to its teeth-engaging position when the disc has returned, under the action of its spring, to its starting position, substantially as described.

25. In a machine of the character described, a code-changing device comprising two coaxial discs placed face to face, whereof one is fixed and the other is rotatable over it, said discs having each a plurality of transmission points for detachable connection to a transmission member allotted to a sign-key, which points of one disc are arranged to communicate each with a point at the inner face of the other disc and are so spaced that when one disc is rotated relatively to the other each transmission point of one disc will be advanced to the preceding one of the other disc, the movable disc having on its periphery teeth spaced apart to correspond to the stepping required for single-step changes of the transmission points, a key having a pawl arranged to engage said teeth in succession and advance the movable disc one space at a time, a spring tending to move the movable disc in a direction opposite to that in which it is advanced by the key, a spring-controlled retaining-pawl for engaging with said teeth and preventing the return movement of the movable disc after each advance, said retaining-pawl having two positions in which it can be held by its controlling spring, a

stop on the fixed disc for coacting with the said pawl on the key and holding the same free of said teeth in the inoperative position of the key, a pin carried by said retaining-pawl, and a stop carried by the movable disc and arranged to coact with said pin to move the retaining-pawl into its disengaged position when the disc has completed one revolution and to again coact with the pin to return the retaining-pawl to its teeth engaging position when the disc is returned, under the action of its spring, to its starting position, substantially as described.

26. In a machine of the type described, the combination with a set of character-producing sign-keys, of a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission ports, one for each of said keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member will be advanced to the preceding one of the other member; a plurality of cylinders, one for each key, a plurality of pistons, one in each cylinder, operatively connected each with one of said keys, a pneumatic power-supply duct, a set of passages, one alloted to each cylinder, connected each to said duct, a group of tubes, one for each cylinder, connected each at one end to one of said ports in one code-changing member and connected each at the other end to one of said passages, and valves associated each with one of said keys and arranged each to control one of said passages, substantially as described.

27. In a machine of the type described, the combination with a set of character-producing sign-keys, of a code changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission ports, one for each of said keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member will be advanced to the preceding one of the other member; a plurality of cylinders, one for each key, a plurality of pistons, one in each cylinder, operatively connected each with one of said keys, a pneumatic power-supply duct, a set of passages, one alloted to each cylinder, connected each to said duct, a second set of passages, opening each into one of said cylinders, a group of tubes, one for each cylinder, connected each at one end to one of said ports in one code-changing member, and manually-operable means connected with the other ends of said tubes, which means are arranged to place said tubes each into communication with its alloted cylinder and to render the valves inoperative, or to interrupt the communication between the cylinders and their alloted tubes and to put the valves each into operative communication with the tube associated therewith, substantially as described.

28. In a machine of the type described, the combination with a set of character-producing sign-keys, of a code-changing device comprising two code-changing members whereof one is movable in relation to the other, said members having each a plurality of transmission points, one for each of said keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member will be advanced to the preceding one of the other member; a plurality of cylinders, one for each key, a plurality of pistons, one in each cylinder, operatively connected each with one of said keys, a pneumatic power-supply duct, a set of passages, one allotted to each cylinder, connected each to said duct, controlling valves constituting each an extension of one of said pistons and arranged each to control one of said passages, a second set of passages opening each into one of said cylinders, a group of tubes, one for each cylinder, connected each at one end to one of said ports in one code-changing member, and manually operated valves, one at the other end of each of said tubes, for placing the tubes at will into communication with either of said sets of passages and closing their connection with the other of said sets, substantially as described.

29. In a machine of the type described, the combination with a set of character-producing sign-keys, arranged in rows, of a code-changing device comprising two code-changing members, whereof one is movable in relation to the other, said members having each a plurality of transmission ports, one for each of said keys, which ports of one member are arranged to register with those of the other and are so spaced that when one member is stepped one space relatively to the other each port of one member will be advanced to the preceding one of the other member; a plurality of cylinders, one for each key, a plurality of pistons, one in each cylinder, operatively connected each with one of said keys, a pneumatic power-supply duct, a set of passages, one allotted to each cylinder, connected each to said duct, a group of tubes, one for each cylinder connected each at one end to one of said ports in one code-changing member, a plurality of manually-operated valves connected each to the other end of one of said tubes, and valves associated each with one of said keys and

arranged each to control one of said passages, each said manually-operated valve being in the form of an endwise movable tube closed at one end and having a lateral port for connection each with a passage of both said sets of passages, which manually-operated valves are arranged in rows corresponding to said rows of keys, and slidable cam members, one for each row of manually-operated valves, arranged each to operate all the valves of one row simultaneously, substantially as described.

In testimony whereof I have signed my name to this specification.

SIDNEY HOLE.