

March 28, 1961

G. DIRKS

2,976,801

PRINTING AND OTHER REPRESENTATION OF CHARACTERS

Original Filed May 25, 1954

2 Sheets-Sheet 1

FIG. 1

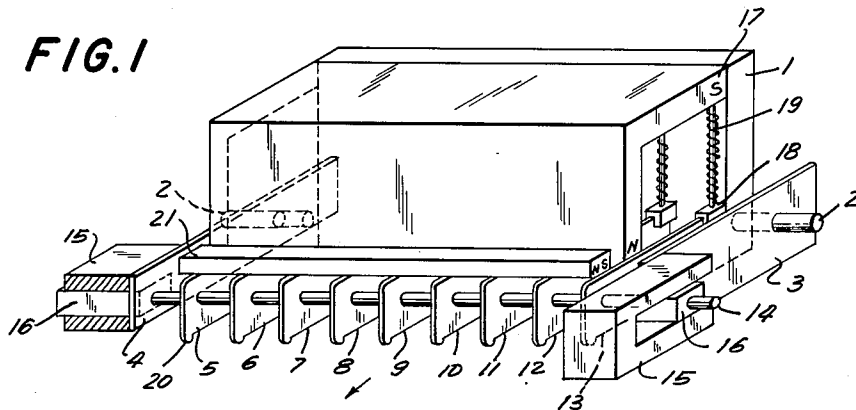
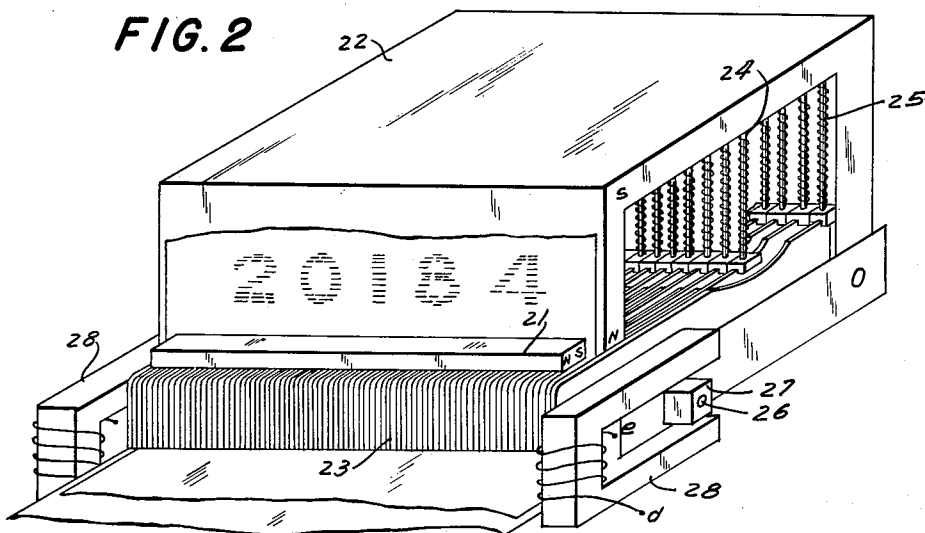


FIG. 2



INVENTOR.
Gerhard Dirks
BY
Michael S. Striker
Attorney

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FIG. 3

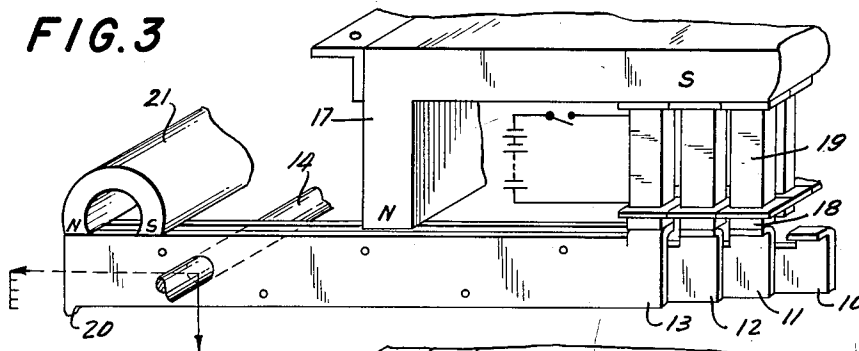


FIG. 4

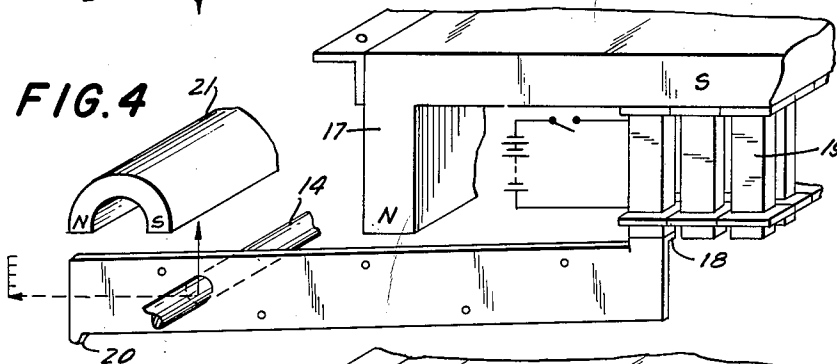


FIG. 5

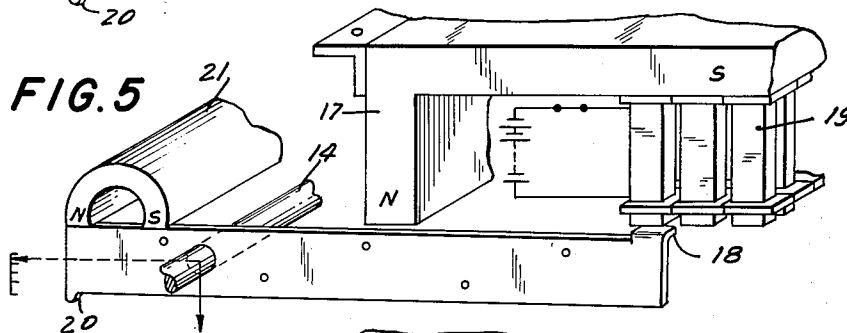
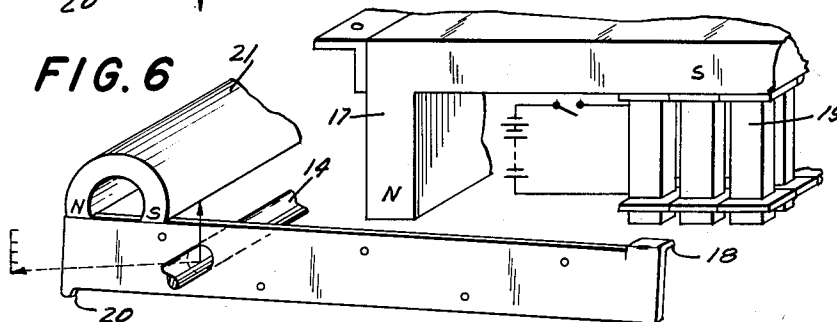


FIG. 6



INVENTOR.

BY *Gerhard Dirks*
Michael S. Striker
Attorney

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PRINTING AND OTHER REPRESENTATION OF CHARACTERS

Gerhard Dirks, Moerfelder Landstrasse 44,
Frankfurt am Main, Germany

Continuation of application Ser. No. 432,297, May 25, 1954, which is a continuation-in-part of application Ser. No. 101,032, June 24, 1949. This application May 21, 1959, Ser. No. 814,874

Claims priority, application Germany Oct. 1, 1948

11 Claims. (Cl. 101—93)

This invention relates to an apparatus for the printing and other representation of characters for example numerals or the letters of an alphabet or mathematical signs or other characters and is useful, among other purposes, in connection with the printing of the results obtained by a calculating machine, or in a bookkeeping machine or the like.

This application is a continuation of my application Serial No. 432,297, filed May 25, 1954, entitled "Printing and Other Representation of Characters," now abandoned, which, in turn, is a continuation-in-part of application Serial No. 101,032, filed June 24, 1949, now abandoned.

The invention comprises, for each denomination in which printing is to be effected a series of parallel levers each having a printing surface, means imparting relative feeding movement between said levers and the paper or other material to be printed, means imparting a constant movement of an intermediate portion of said levers towards and away from the paper and selective means operating in dependence on the shape of the character to be printed determining which end of the lever shall be moved towards the paper. The arrangement is such that if one end of a lever is held against movement towards the paper, the printing surface is held out of contact and no printing takes place, whereas if the other end of the lever is held, the printing surface is moved into contact with the paper and a printing operation takes place.

The selective means is preferably of a magnetic character and is such as to require only very short pulse-like energizing, at a rather high intensity, thus allowing of very high speeds of the printing device.

In order that the present invention may be readily carried into effect, it will now be described with reference to the accompanying drawings, wherein:

Fig. 1 is a diagrammatic perspective view of an embodiment of a printing device for the printing of characters in a single denomination, column or the like, the view being taken from the front;

Fig. 2 is a diagrammatic perspective view of a similar device, also taken from the front, as adapted for the printing of characters in a number of side-by-side denominations or columns or the like;

Fig. 3 is a diagrammatic fragmentary sectional view of the apparatus, seen from a rear corner, illustrating the operation of the various parts in one particular position;

Fig. 4 is a view corresponding to Fig. 3 but with the parts in another particular position, as explained below; and

Figs. 5 and 6 are two further views similar to Fig. 3 showing still further positions of the various parts, according to the operation of the apparatus at different times.

In the drawings, referring first to Figs. 1 and 3-6, there is schematically shown an apparatus having a non-

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magnetic base plate or frame (Fig. 1) and having on either end of such plate a fixed stud 2 on which levers 3 and 4, respectively, are located. The studs 2 are fixed to and project from the magnet frame 1 and turnably support levers 3 and 4 to which a reciprocating movement is imparted by the reversing magnets 15. Stud 2 and levers 3, 4 constitute a movable support for the printing levers 12-20. These levers are arranged on the respective outer sides of a set of parallel levers 5 to 13. A shaft 14 extends through a hole in each of the levers 5 to 13, and also between the arms of the C-shaped members 15, and through holes in the adjacent ends of the levers 3 and 4.

The levers are actuated by means of magnet systems in the members 15 (or by curved wheels) causing the levers 5 to 13 to move correspondingly in unison with each other and with the levers 3 and 4 in an up and down manner. The shaft 14 will be moved up and down by the magnet system 15 which is energized by an alternating current, said system actuating the shaft by the magnets 16 fixed on the respective ends of the shaft 14. The up and down movement will be initiated by the energy of the magnetic fields of coils, with windings around the magnet-systems 15, said energy being generated by an alternating current of a certain frequency, therefore moving the levers 5 to 13 up and down in that frequency. The levers 5 to 13 are shown somewhat exaggerated as spaced apart from each other. Actually, they are arranged close enough to print mosaic-like characters as shown in Fig. 2.

In the case shown in Fig. 2, for a multi-column printing unit, the nine levers 5 to 13 for each denomination are together equal to the normal width of a character. By means of a non-magnetic layer upon their surfaces the levers 5 to 13 are insulated against mutual magnetic contact. Alternatively, they may be made of a non-magnetic material.

The distance between adjacent sets of the levers 5 to 13 for adjacent denominations is determined by distance sleeves or washers on shaft 14 or by additional levers not having printing elements, whereas the distance between the levers 5 to 13 themselves is determined by small humps or the like pressed out of the levers, or by thin washers between the levers. By this arrangement, a frictionless operation of all reciprocating printing levers 5 to 13 will be guaranteed.

A multi-column printing unit (Fig. 2) consists of a corresponding number of sets of levers 5 to 13, spacing sleeves, distance-elements and the like, kept at the desired spaces from each other, according to the denominational spacing of the various printing columns. Above the printing levers 5 to 13 (see also Fig. 1), between the shaft 14 and the rearward ends of the levers, the permanent magnet 17 is mounted, this covering all the printing levers within the one printing column (Fig. 1) and all the printing levers in all the columns (Fig. 2).

The magnetic flux of the field of the permanent magnet 17 will flow from the north-pole N via the rear end of the printing levers 5 to 13 to the permanent magnetic plates 18 at the rear of the levers and via the iron-core of the magnetic coils 19 back to the south-pole S of the magnet 17. There are only minor air gaps throughout the whole magnetic flow, because, when the shaft 14 is in the higher position, the levers 5 to 13 anchor to the magnet 17 at its north-pole, and the magnetic plates 18 directly touch the cores of the magnet-coils 19.

Such a coil 19 and plate 18 is provided for each of the printing levers 5 to 13. To secure such an arrangement in a practical design, in which the printing levers are closely spaced together over the maximum of the width of a character, each of the nine magnet-coils 19

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will be set-off against the neighboring one with regard to their widthwise and lengthwise location, thereby overlapping each other. That is to say, the coils 19 will vary progressively in their distance from shaft 14 so as to overlap each other and allow their axes to lie in closer planes than would be the case if they were all in line parallel with shaft 14.

The magnetic plates 18 are made of thin pieces fixed to the printing levers, or are lugs or flanges of the printing-levers themselves and extended laterally therefrom.

In a practical case, these plates 18 are located under their respective magnet coils 19 without hindering each other in their correct action, the levers 5 to 13 being of varying lengths to accommodate the staggered arrangement of the coils 19. The printing levers 5 to 13 follow the up and down movement of the shaft 14, initiated by the magnet-system 15, and, with the plates 18 held below the magnet coils 19 as pivots, this causes the tilting of the levers about those pivots. The up and down movement of the printing levers 5 to 13 results from the frequency of said alternating current, acting in such a way that the printing levers will oscillate at their extreme rear ends with an amplitude of about 0.25 mm. As each of the printing levers has on the front edge of its lower surface a small printing nipple or dot 20, the nipple will act as the printing medium when set in operation. If between the nipples 20 of all the printing levers, an inked ribbon be inserted, a thin-punctuated black line will be produced in every printing column on the paper if the paper is moved in the direction of the arrow (Fig. 1) and if one of the magnet coils 19 has been excited.

Above the front end of the printing levers 5 to 13 a permanent magnet 21 is arranged (Figs. 3 to 6) stretching across all of the levers 5 to 13 and acting as an alternative pivot for the printing levers in cases when the magnet coils 19 are excited as explained below.

Each of the printing levers 5 to 13 rests normally with its upper front edge against the lower part of permanent magnet 21, which operates as a spring. The distance from the middle of shaft 14 to the actuating point of each magnetic plate 18 represents the longer arm of the respective double-armed printing levers 5 to 13, while the distance from the middle of the shaft 14 to the magnet 21 is relatively short representing the shorter arm of said double-armed lever.

If the magnet coils 19 are not excited at the instant when the upper limit of the up-and-down movement of the levers is reached, the magnetic force of the relatively-weak magnet 21 will not hold the levers as shaft 14 descends again, and will not prevent the printing levers 5 to 13 from pivoting around the bearing surface of the plates 18 on the cores of their corresponding coils 19. On the other hand, when the coils 19 are excited in such a way that the permanent flux of magnetism in the magnet 17 is directed in the cores of the coils 19 in the opposite sense from the flux excited by the coils in that instant, when the up-and-down movement of the levers reaches the upper limit the magnetic force between the core of coil 19 and the plate 18 will be eliminated, by reason of the opposite polarity, and in that case the magnet 21 will hold levers 5 to 13 as the shaft 14 descends. The exciting of the coils 19 can be pulse-like, effected with a rather high intensity, in spite of the small dimensions of the coils, as this control-pulse is only necessary for the very short instant from shortly before the upper limit of the upward movement of the levers until shortly after it.

Furthermore, the exact moment of excitation can be chosen in such a way that the time of inertia from the self-induction of the coils 19 is just passed when the limit of the upward movement is reached, so that this "relay" is practically free of any additional inertia which relays usually require for self-induction and armature-movement, since the "armature-lever" is, at the moment of excitation of the coil, lying directly against the core of the

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coils 19. As soon as the plate 18 of a lever has been separated from the coordinated core of the coil 19 only by a narrow air-gap, so that the direct magnetic circuit is broken, a further excitation of the coil 19 is no longer necessary, as the downwardly moving end of this lever cannot be held again. Consequently, those printing levers, of which the coils 19 have been excited, will pivot around their lugs resting upon magnet 21 when the shaft 14 is moving downward, as soon as the rear end of each of the actuated levers 5 to 13 has been released from the corresponding core of the coil 19 and the magnetic flux interrupted by the consequent air-gap. The printing levers are thus able to pivot about either of two axes, one at the rear end and one at the front end, one of such pivoting movements allowing the lever to effect a printing operation and the other preventing a printing operation.

The printing nipples or dots 20 remain inactive on those levers which are held by the magnet 21, so that no printing takes place on to the paper at these points, the nipples being held up off the paper by the magnet 21. If the exciting of all the coils 19 will be controlled by pulses in dependence on the shape of the different numbers or other characters to be printed, the printing will be effected correspondingly in connection with the control pulses, blackening the paper at the respective points, leaving the paper free at other points and thereby eventually forming the image of the respective characters. With eight printing levers as shown, characters can be printed each composed of dots or lines in one or more of eight vertical rows. The printing pressure can be adjusted by an auxiliary coil-winding (not shown), coordinated to the permanent magnetism, resulting in an increase or decrease of the magnetic flux of the magnet 17, when energized accordingly. High printing speeds may be obtained by the use of higher frequencies, if the exciting of the coils 19 is to be controlled in accordance with the oscillation of the shaft 14 during the period of upward movement in such a way that the inductance within the coils 19 has declined when the shaft has gained its upper position.

By the use of this principle, relatively high printing frequencies with high printing pressures will be obtained, for the pressures operating in this printing mechanism originate exclusively from the central driving system of the shaft 14 itself, and the coils 19 have only to provide a controlling magnetic flux in the form of short pulses.

As the previously explained arrangement of the actuation of said printing levers requires a surge, exciting the corresponding coil 19 only at the moment when the shaft 14 is just short of the uppermost position, the dimensions of the coils 19 can be kept relatively small, as the coils can be highly charged for the short intervals in which they operate, so that a minimum of space is required for the printing levers and their control coils.

If, shortly after the reaching of the uppermost position of shaft 14, the magnetic flux of the permanent magnet 17, by means of the magnetic pole-changing devices should be inactive or reversed, the non-existence of control pulses in the following time of actuation of the printing levers will be insignificant as the magnetic flux between plates 18 and the cores of coils 19 will meanwhile have practically ceased altogether, preventing the movement of the front end of the levers 3 and 4 and consequently preventing the printing nipples 20 from marking the paper. The control pulses will preferably be fed from a glow-discharge relay device or the like, which can be controlled by stored signals or by the direct signals, e.g. pulses of a coding device. It is also possible, in a modified arrangement to operate the printing mechanism in the opposite way, causing the printing levers 5 to 13 to pivot on the end surface of the cores of coils 19 only, if the coils are excited, while in case of non-exciting, the frontal pivoting on magnet 21 will come into action.

A multitude of printing levers operating on the same principle as described above may be used for a high-efficiency single line multi-column printing unit. A per-

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manent magnet 22 (Fig. 2) has its magnetic arms bridged by the several printing levers 23, and the cores of the coils 24, 25 are arranged one behind the other. The main shaft 26 is moved up and down by means of the polarized magnetized pieces 27 moving between the poles of magnets 28, excited by an alternating current flowing through the coils of the magnets 28 with the ends *d* and *e*. By an exciting of the magnet coils 24 and 25 in a rhythm depending on the shape of the type characters which are to be printed, the printing of the different lines or dots forming the parts of the character can be effected at rather high speeds.

The speed of operation is limited only by the maximum frequency of movement which can be reached by oscillating levers controlled by magnet coils. As, under the more difficult conditions obtaining in relays with the times of inertia by self-induction in the coils and the like, an armature frequency of two hundred and fifty cycles per second can be reached, an output under the better conditions obtaining with the present invention allows 250 dot-lines to be printed per second, equalling 25 type character lines per second as a maximum speed. This output corresponds to 10,000 type character lines per hour or, in a multi-column printing unit of 100 columns, to a maximum speed of 250 type characters per second.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A printing apparatus comprising, in combination, a series of printing levers arranged side by side and having printing surfaces at one end; operating means acting on an intermediate part of each of said levers for imparting a reciprocating movement to said printing levers intermediate the ends thereof; first and second magnetic restraining means for selectively restraining the ends of said levers against said reciprocating movement so that the restrained ends of said printing levers respectively constitute fulcrums for pivotal reciprocating movement of said levers under the action of said operating means; and control means adapted to be controlled by signals representing the characters to be printed for counteracting said first restraining means when said second restraining means is to be effective.

2. A printing apparatus comprising, in combination, a series of printing levers arranged side by side and having printing surfaces at one end; operating means acting on an intermediate part of each of said levers for imparting a reciprocating movement to said printing levers intermediate the ends thereof; first and second restraining means for selectively restraining the ends of said levers against said reciprocating movement so that the restrained ends of said printing levers respectively constitute fulcrums for pivotal reciprocating movement of said levers under the action of said operating means; and control means adapted to be controlled by signals

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representing the characters to be printed for counteracting said first restraining means when said second restraining means is to be effective.

3. The combination of claim 1, wherein said reciprocating movement is imparted by electro-magnetic operating means at the frequency of an alternating current.

4. The combination of claim 1, wherein said reciprocating movement is imparted by electro-magnetic operating means at the frequency of a controlled electronic tube.

5. The combination of claim 1 including a shaft, said levers being mounted on said shaft, the ends of the shaft extending into electro-magnetic means whereby they are raised and lowered at a frequency in dependence on an alternating current or the controlled plate current of an electronic tube.

6. The combination of claim 1, wherein the several levers are each provided with a flange constituting an armature, and including a permanent magnet having a common pole attracting all the levers and having individual poles for the respective levers, said poles attracting said armatures, coils on said individual poles and means operating in dependence on the shape of the character to be printed to energize said coils selectively to release said armatures and allow said second restraining means to be effective.

7. In combination a plurality of printing levers each having a printing dot at one end and a lateral flange as a permanent magnet at the other end, a first permanent magnet having a pole common to all the levers and individual poles for the respective levers, said flanges comprising armatures for said individual poles, means imparting to all the levers a to-and-fro movement towards and away from said magnet, a second permanent magnet common to all said levers at the ends having said printing dots, coils around said individual poles and means energizing said coils selectively just before the levers reach the topmost position for counteracting said first permanent magnet and allowing said second permanent magnet to be effective.

8. An assembly according to claim 7, wherein the magnet poles are of greater width than the thickness of the levers and are grouped together in rows, the flange of each lever being extended to lie opposite the pole of the respective magnet.

9. The combination of claim 1, wherein the reciprocating movement of the printing levers towards and away from the paper is in step with the feeding movement of the paper past the levers so that on each movement of a lever towards the paper a new printing surface is presented to the lever and the successively printed marks are in rows common to all characters to be printed.

10. The combination of claim 1, wherein the printing levers are provided with a non-magnetic coating and have means spacing them from each other so as to reduce friction between them.

11. The combination of claim 1, having the side-by-side levers in groups and spacing means between the various groups whereby movement of levers in one group does not affect levers in other groups.

No references cited.