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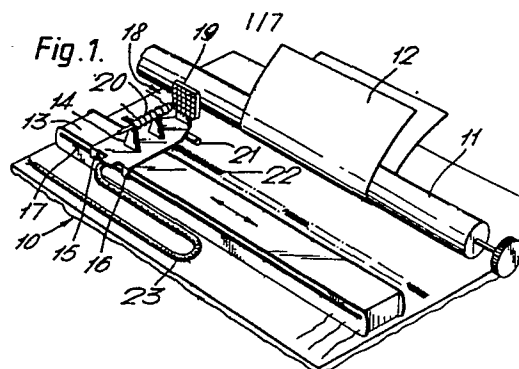
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(54) **Printing head and printing device, and word processor incorporating such a device.**

(57) A printing device comprises a platen (11) for supporting items on which text is to be printed, a printing head for printing text, the printing head comprising an array of cells (19) each containing an interchangeable type for printing a respective character, the types being slidable relative to the cells from a rest position to an impression position, the arrangement being such that return of each type towards its rest position from its impression position is effected by its resiliently rebounding from the platen (11), a trolley (14) carrying the printing head and movable longitudinally relative to the platen between a number of print positions, a print hammer-arrangement (20) for propelling the types to their impression positions, a linear motor (13) for causing said relative movement of the platen and trolley and circuitry for controlling the operation of the impelling means and the drive means. The position of the trolley may be under closed loop control. The printing head may be movably mounted on the trolley for movement in the horizontal and/or vertical directions, optionally by one or more linear motors and optionally with closed loop positional control. Various forms of the printing head, linear motors and print hammers are disclosed.



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TITLE MODIFIED

DESCRIPTION

see front page

"PRINTING HEAD AND PRINTING DEVICE"

This invention relates to printers, particularly, but not exclusively, to those used for printing on stationery and more particularly to printing devices and printing heads.

5 Large use is currently made of printing devices as peripherals of a wide variety of computer systems. A particular and rapidly growing use of such devices is in the field of computer controlled typing systems, known as Word Processing systems and the present
10 invention is particularly but not exclusively concerned with printing devices for use in such systems. These systems usually comprise, in addition to their printers, an electronic keyboard (to take the place of the customary typewriter keyboard), a visual display unit
15 (for displaying on an electroluminescent screen the text typed), a central processor unit (for running the software programs necessary for the manipulation and retrieval of text to be displayed) and a disc storage unit (for storing standard texts and documents to be printed).
20 The printer is usually of high quality and precision, and is capable of at least matching the quality of print of good typewriters.

A form of printer widely associated at present with word processing systems is that known as a 'daisy
25 wheel' printer. This name derives from the appearance of its print element which comprises a multiplicity of flexible radial arms, or petals, emanating from a central spindle with dies at their free ends.

Users of Word Processing systems often have
30 differing requirements as to the various character

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repertoires that they may wish to be able to print. For example, the provision of a character font incorporating a large proportion of the Greek alphabet might be desirable for a scientific establishment, whereas
5 a quite different font might be required by a commercial concern. A limitation of the daisy wheel type of printer is that such individual requirements of various users cannot be easily met. Non-standard wheels have to be especially manufactured or individual petals
10 modified to provide the desired characters. It is not usually possible for the user to select a special repertoire, or modify the print element, to exactly meet particular requirements.

According to a first aspect of the invention,
15 there is provided a printing head comprising an array of cells each containing an interchangeable type for printing a respective character, the types each being slidable relative to the cells from a rest position to an impression position, the arrangement being such
20 that return of each type towards its rest position from its impression position is effected by its resiliently rebounding from a platen.

A second aspect of the present invention provides a printing device comprising a platen for
25 supporting items on which text is to be printed, a printing head for printing text, the printing head comprising an array of cells each containing an interchangeable type for printing a respective character, the types being slidable relative to the cells from a
30 rest position to an impression position, the arrangement being such that return of each type towards its rest position from its impression position is effected by its resiliently rebounding from the platen, a support

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carrying the printing head and movable longitudinally relative to the platen between a number of print positions, means for propelling the types to their impression positions, drive means for causing said
5 relative movement of the platen and support and circuitry for controlling the operation of the impelling means and the drive means.

The array of cells will be termed herein a 'honeycomb' for short as in one form it may comprise
10 a block having the cells extending between and open to opposite faces thereof. In another form the cells may be defined by pairs of aligned apertures in two spaced apart lattices or grids.

The cavities ('cells') of the honeycomb are
15 not necessarily hexagonal in cross-section, indeed in a preferred embodiment of the invention the cavities and types are of rectangular cross-section. However, their cross-section may also take other forms which advantageously ensure the types are positioned the
20 correct way up, in addition to preventing rotation. The types may protrude from both sides of the honeycomb and may be biased towards a home position away from the stationery. It will be appreciated that the cavities of the honeycomb may each be filled by individual types
25 bearing the desired characters so fulfilling the requirements of the user of the printer. An ink or carbon ribbon may be located in between the honeycomb and the stationery for providing an impression of the print die.

30 Printers of the daisy-wheel kind make use of a trolley to carry the print mechanism and element. The trolley is free to slide along bars positioned parallel to and in front of the platen of the printer.

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Stationery is fed around the platen using pinch rollers as in a typewriter. In some examples, motion is imparted to the trolley by means of a direct current servo motor, cable and pulley arrangement. Information
5 on the position of the trolley at any moment is obtained from an optical encoder disc mounted on the shaft of the motor. When movement of the trolley is required, a signal is sent to the motor, the force and polarity of which is determined by the extent and direction
10 of the required displacement. Comprehensive compensation circuits allow for variations in performance of the motor servo loop system. The support in embodiments of the present invention may comprise such a trolley mounted for sliding movement longitudinally of the
15 platen by a guide rail arrangement.

Relative motion of the platen and the printing head of the printer of the present invention is achieved by use of a linear motor so controlled as to enable the platen and printing head to be arrested, relative
20 to one another, in any desired print position. The linear motor may be a stepping motor or an alternating current linear motor.

To obtain linear motor action from an alternating current, two or more such currents, each
25 out of phase with the other, are applied to coils lain along the direction in which motion is to be imparted. To increase their effect, the coils are normally placed in slots in a ferrous stator. A conducting material, such as aluminium, when placed
30 adjacent to the coils, experiences induced currents. These in turn create magnetic fields which react with those created initially by the applied currents, so producing thrust. When lateral constraints are

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applied, the thrust, in general, is in the direction of the magnetic river created by the coils.

In an optional feature of the invention in which propulsion is imparted to the printing mechanism trolley by means of such an alternating current linear motor, both the amplitude and phasing of alternating currents applied to accelerate the trolley may be determined on the basis of the required extent and direction of the displacement thereof to be effected, and braking of the trolley is achieved by reversing the direction of magnetic flux created by the motor and similarly regulating the amplitude and phasing of the now decelerating currents according to the speed and position of the trolley relative to its destination.

In one version, a two phase supply may be utilized to feed a two-phase A.C. linear motor, with the direction and amplitude of thrust imparted to the trolley being determined solely by the relative displacement of one supply relative to the other.

A transducer arrangement may be provided for detecting the relative position of the trolley and platen for positional feedback. For example, an optical encoder grill may be located along the length of the linear motor and provide, by means of transducers mounted on the trolley, information on the position thereof to circuits controlling the alternating currents supplied to the motor. The grill could of course be located on the trolley and the transducers adjacent the path of the trolley.

There may be defined a plurality of detents in the relative positioning of the trolley and platen, the spacing of the detents corresponding to the spacing between adjacent character positions of the printed

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text or an integral sub multiple thereof. Where a transducer arrangement is provided for detecting the relative position of the trolley and platen, the detents may be defined electronically by the control circuitry
5 associated with the drive means.

In a particular form of the invention, stationery is fed around a fixed-type platen and is guided by friction pinch rollers. The stationery thus remains substantially stationary relative to the
10 sides of the body of the printer. Feed action is effected by means of a split phase stepper motor.

In a feature of this particular form of the invention, the propelling means of the print mechanism is mounted in a fixed position on the
15 slideable trolley while the honeycomb housing the type is supported on the trolley by a bracket which is movable relative thereto the extent and direction of movement being effected by electromagnetic forces created by surrounding field coils, and the arrangement being
20 such that, in use, the displacement of the honeycomb relative to the propelling means and the trolley relative to the stationery determine respectively the characters to be printed and their sequence.

In one version the bracket supporting the
25 honeycomb is in the form of a pyramid like frame with the honeycomb forming its base, and lies, in its rest position, substantially perpendicular to the platen along the breadth of the trolley. The type propelling means is located within the space within the frame. Two
30 pairs of field coils act on magnets mounted on each of the four sides of the frame and control of the deflection of the bracket by the currents flowing in the coils is governed by servo-loop signals. These are

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provided by optical-encoder grills mounted on the bracket moving relative to transducers mounted on the trolley, or vice-versa. In one form, the honeycomb has substantially the same number of type-receiving
5 cavities width-wise as it does in depth. It will be appreciated, by way of example, for ten pitch type (ten printed characters to an inch), the maximum deflection from its rest position to an extreme print position only requires a three-quarter inch horizontal and
10 vertical movement of a one and one half inch square honeycomb housing one hundred characters.

In another version of this embodiment of the invention, the bracket supporting the honeycomb moves within a further bracket affixed to the trolley and
15 is guided therein by gimbals or grooves giving freedom in the horizontal and vertical senses relative to the platen of the printer. Deflection of the first bracket and therefore the honeycomb to a desired print position is effected by means of solenoids, or small
20 linear motors, acting on the gimbal and bracket assembly. The honeycomb itself may be constructed from, or is clad by, an electrically conductive material, and the linear motors themselves act directly upon the honeycomb and/or its cladding to move the honeycomb to the
25 desired position. In a preferred form the sides of the honeycomb itself are fashioned from an aluminium alloy.

In printers of the daisy wheel kind, sophisticated servo-mechanisms are required to arrest
30 accurately a daisy wheel in a given print position, there being usually nearly one hundred petals - and therefore stop positions - on most daisy wheels.

In a further feature, also relating to the use of linear induction motors to move the honeycomb, a

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servo-mechanism utilized for controlling the position of the honeycomb relative to the print hammer is able so to do by means of impulses received from a combination of toothed notches on the honeycomb and/or its cladding moving relative to fixed electromagnetic sensors, or vice-versa. The notches may correspond directly to the position of rows and columns of types, thus the counting of impulses created by movement of the notches relative to the sensors in the vertical and or horizontal directions establishes the precise position of a given type, relative to the hammer. It will be appreciated that for a ten square honeycomb accommodating one hundred types, only ten stop positions are required respectively in the horizontal and vertical senses.

In a further feature, the honeycomb is moved relative to the print hammer by stepping motors. Energisation of the coils of the stepping motors in a given sequence attracts pole pieces embedded within the honeycomb, and thus the honeycomb itself, to stable detent positions, these positions corresponding to individual rows and columns within the honeycomb. No servo-mechanism is required in this arrangement. Furthermore, in a further scheme in which no servo-mechanism is required, rotary stepper motors take the place of the linear stepping motors, and position the honeycomb in the vertical/horizontal senses by means of pinions engaging racks affixed to the honeycomb. Imparting an appropriate number of stepping pulses to each motor locates the selected type opposite the print hammer.

Referring now to the honeycomb itself, in use a type returns towards its original, rest position

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in its cell - after having been impelled towards the platen of the printer by the propelling means - as a result of bouncing off the resilient platen. In order to assist this return the honeycomb as a
5 whole may be inclined away from the vertical and away from the upper portion of the platen, but in such a way that the face of the honeycomb remains substantially perpendicular to a radius of the platen, the arrangement being such that gravitational
10 forces aid the said bouncing effect restoring type to its original position within its cavity.

An important aspect of the invention is the interchangeability of types within the honeycomb. Any character font desired by a particular
15 user can thereby be provided up to the capacity of the honeycomb. In practice, easy interchangeability is desirable, but not at the expense of types slipping from their respective positions during printing operation and during removal of the honeycomb
20 from the printer. A removable retaining member may be provided to retain the types in their cells while permitting movement between their rest and impression positions. Thus grooves on the honeycomb slideably accommodate, on one of its open surfaces, a
25 slotted base plate, the slots of the base plate engaging corresponding slots along the body of each type, there being sufficient freedom to permit each type to impinge against the platen when impelled theretowards by the print hammer. Thus, in this arrangement, the
30 slotted base plate prevents types from inadvertently falling from the honeycomb, but, on removal from its supporting grooves, allows the types to be withdrawn

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and exchanged.

The invention further provides a word processor incorporating a printing device embodying the second aspect of the present invention.

5 The invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

 Figure 1 is a somewhat schematic perspective view of part of a printing device embodying the present
10 invention;

 Figure 2 is an illustration showing to an enlarged scale the print head of the printer of Figure 1;

 Figure 3 is a block circuit diagram showing
15 the derivation of control signals used within the printer of Figure 1;

 Figure 4 is an illustration showing yet another embodiment of printing device according to the present invention;

20 Figure 5 shows part of a printing device embodying the invention and including linear motors acting on a honeycomb printing head;

 Figure 6 is an illustration showing a honeycomb printing head and position sensor embodying
25 the present invention;

 Figure 7 shows linear stepping motors acting on a honeycomb printing head embodying the present invention;

 Figure 8 shows part of a printing device
30 embodying the invention including a honeycomb printing head;

 Figure 9 shows detached, constituent parts together comprising a honeycomb printing head embodying the present invention;

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Figure 10 shows waveforms applied to a linear motor used within a printer according to Figure 1;

Figure 11 shows a phase control network for regulating supplies to the linear motor; and

5 Figure 12 is a cross-sectional view of a print hammer of an embodiment of the present invention.

Referring to Figure 1, a printing device according to the invention is generally designated 10 and includes a platen 11 embraced circumferentially along part of its length by stationery 12. The coil of an alternating current linear induction motor 13 is mounted on the base of the printer, and is used to propel a trolley 14 in a horizontal sense from left to right and vice-versa, as indicated by the
15 arrow. The trolley is held above and guided along the motor by means of tongues, two of which are shown at 15 and 16, engaging grooves 17 running along the motor's length. A print mechanism 18 is supported on the trolley 14 and includes a suspended honeycomb print
20 head 19 and means (not shown) for moving the head relative to an electromagnetic hammer 20, also mounted on the trolley. Information on the position of the trolley and its movement is obtained from a transducer 21 mounted thereon and arranged to scan an optical
25 encoder grill 22 affixed to the linear motor. A 'snake' 23 attached at one end to the trolley and at the other to the base of the printer is used to convey and protect signal cables connected to the transducer and other components of the print mechanism.

30 The print head 19 of the printer is now described with reference to Figure 2 which shows from the rear such a head but to an enlarged scale. The head consists of a symmetrical open-sided honeycomb-

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like array of a multiplicity of cavities. Each of the cavities is, in this example, of square cross-section and is occupied by a slideable type, two of which are shown protruding, for clarity, from the rear face of the honeycomb at 24. There is no physical bond
5 between each type and the surrounding honeycomb frame, with the exception of a type-retaining bracket to be hereinafter described in more detail. Thus each type may be directly extracted from the honeycomb on removal
10 of the said bracket. Each type ends in a print die, as shown for example at 25. In practice, lips on each type 26, not shown, prevent protrusion of the types from the plane of the rear face of the element. In one example, the honeycomb is constructed from
15 lightweight plastics, but has attached to its rear face a ferromagnetic lattice. The types may be magnetised to aid their retention in the honeycomb. The lattice may be magnetised instead.

The mode of operation of the printing device
20 of Figures 1 and 2 is as follows:-

The linear motor first causes the trolley to move to the first desired print position. Whilst this is happening, the honeycomb is deflected by electromagnetic forces acting on its suspension unit to a position which
25 brings the desired type opposite the electromagnetic hammer 20 (see Figure 1). As soon as the trolley stops, and the honeycomb is positioned, the hammer is fired and the selected type slides along its cavity sufficiently to impinge, through an ink ribbon, (not
30 shown) onto the stationery 12 mounted within the printer, thereby leaving an inked impression. The type returns to its cavity as a result of bouncing off the resilient platen, and may also be aided in this respect by the

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ink ribbon which may be kept appropriately tensioned.

As shown in Figure 12, in a further version each type may contain in its rear end a ferromagnetic core. The hammer itself is magnetized, and as the hammer and type
5 return from the platen as a result of bouncing there off, the attraction exerted by the hammer on the core within the type ensures the type returns to its cavity. The hammer by virtue of its return momentum, breaks away from the type, once the protruding lips
10 26 prevent further movement thereof, so becoming ready for the next impact. (The hammer also returns, in part, as a result of the type bouncing off the platen, the 'bounce' being transmitted to the body of the hammer from the body of the type. A return spring may
15 aid the return of the hammer). The trolley is then moved by the linear motor to the next desired position, the honeycomb is repositioned, and the process repeated. Thus the desired sequence of characters is printed. The honeycomb may be detached from the
20 suspension unit by the operator using the printer. The cavities of the honeycomb may then be filled by types corresponding exactly to the operator's particular requirements, so providing a very flexible character repertoire. Furthermore, with regard to wear, only
25 those types in most frequent use need be replaced, rather than changing the entire element. (It will be appreciated from the die illustrated at 25 in Figure 2 that the effective print portion may have considerable body, so reducing necessity for frequent replacement.)
30 The method of imparting motion to the trolley, and its control, will now be described with reference to Figures 10 and 11.

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In one embodiment, a two-phase linear induction motor is employed to move the said trolley. A phase control network, responsive to trolley positioning commands received by the printer, regulates whether
5 phase a leads b, or b leads a, (see Figures 10 i and ii); this thus determines the direction of thrust. In addition to this, the amplitude of thrust exerted by the linear motor on the trolley is similarly determined, being dependent on the extent to which one phase is
10 made to lead the other. Thus, for a corresponding pole pitch, a maximum thrust is experienced with a $\frac{\pi}{2}$ radians out of phase with b, whereas no thrust is experienced with the two phases superimposed (see Figure 10 iii). The phase control network need
15 therefore only regulate the relative phasing of the two supplies a and b, to both control the direction of thrust imparted to the trolley and its amplitude, so providing means conveniently responsive to a servo-loop control system for controlling the position of the
20 trolley.

A convenient form of phase control network may take that shown in Figure 11. In this, regulation of the gating currents to four thyristors 126, 127, 128 and 129, controls the degree of direct and phase-
25 displaced alternating current supplied to each coil of the motor. Thus, with 126 and 129 switched on, full thrust will be experienced in one direction and, conversely, switching on 127 and 128 causes full thrust to be experienced in the opposite direction. Intermediate
30 degrees of thrust in each direction are obtained by appropriately controlling the firing periods of the various thyristors.

To obtain, however, carefully regulated

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acceleration and deceleration of the trolley, a modified embodiment of the invention makes use of control of both the amplitude of the applied currents and also their phase displacements. An example of
5 such control is now described with reference to Figure 3.

Suppose a displacement D is to be effected, D being represented by a multiple bit binary word indicating the number of gradations to be traversed by
10 the transducer 21 over the optical encoder grill 22 (see Figure 1). The start position of the trolley P_s is first added in a binary adder to D , to arrive at the finishing position, P_f ; (P_s is derived from an internal binary counter, P_a , which permanently follows
15 the output of the transducer). Once P_f is obtained, the absolute mid-point position P_m is also calculated; see equation 1 in Figure 3. A digital to analogue converter, 28, then interprets these signals to regulate the amplitude, A , of the supplies a and b ,
20 according to the extent of the displacement to be effected. Thus the accelerating thrust, A_a is made proportional to a combination of the initial difference between P_s and P_m , and thereafter to the difference between the absolute position of the trolley,
25 P_a , and, say, the mid-point position P_m . (Note, for very small displacements, a minimum value of A_a is applied to overcome static friction.) As the mid-point is reached, the accelerating thrust is substantially reduced. However, as soon as the mid-point is crossed,
30 the decelerating thrust A_d is made sufficient to counter the velocity imparted to the trolley, and is therefore determined partly by the difference between P_m and P_f (reflecting the velocity imparted by A_a),

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and also, towards the end of the trolley's travel, by the difference between P_a and P_f . Suitably regulating the degree to which these two quantities act on the deceleration ensures the trolley actually arrives at its destination. Simultaneous to the regulation of the amplitude of thrust A , P_m and P_a are fed to a comparator, 29, to determine the phase relationship between $\underline{a}$ and $\underline{b}$ and thus the direction of thrust, so giving rise, effectively, to the two components A_a and A_d . A component of the signal A is also fed to the comparator to further influence the phase relationship according to the thrust required, as described earlier. The use of absolute reference positions, such as P_s and P_a , enables comparison to be made with predetermined reference positions, so safeguarding against such eventualities as displacements being effected which would otherwise result in the trolley crashing into end-stops mounted on the printer.

It will be appreciated that the foregoing is given by way of example for one particular embodiment of the invention only. Many methods of servo-control of the movement of the trolley are possible.

In a feature of the invention, once the honeycomb is positioned and the print hammer is fired, energisation of the hammer solenoid causes attraction onto it of the ferromagnetic rear face of the honeycomb, so preventing relative movement therebetween while the firing pin of the hammer propels the chosen type forward. The natural resilience of the support frame detaches the honeycomb from the hammer solenoid once it is de-energised. It will be appreciated that the most commonly used letters within a given character repertoire may be grouped centrally. Thus, for example,

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all but one of the lower case letters of the English alphabet will occupy a five square matrix, so requiring - in the main - only a small deflection of the honeycomb from its rest position while printing.

5 Referring to Figure 5, two-phase linear induction motors depicted at 110 and 111 are shown acting on a honeycomb printing head 19, and a thrust plate 113 respectively. The print head is free to move in a vertical sense relative to the motor 110.

10 The linear motor 110 acts directly on the print element 19, which itself is constructed from an aluminium alloy, to establish vertical movement thereof. The thrust plate 113 is affixed to the base of the motor 110, and is acted upon by the motor 111 to cause

15 horizontal displacements of the honeycomb and motor 110 combination. In use, appropriate phasing of currents to the two motors thereby establishes both horizontal and vertical movement of the honeycomb to any desired position. Third and fourth motors may be provided

20 opposite those shown at 10 and 11 to increase the thrust exerted upon the honeycomb and thus the speed at which a desired position is reached. The honeycomb may be supported by tongues emerging therefrom and slideably engaging grooves 14 in the linear motor 110.

25 Referring to Figure 6 in an alternative arrangement, teeth 115 are shown protruding from a lateral face of the print element 19. A fixed electromagnetic sensor 116 is positioned adjacent to the teeth for their detection. A similar arrangement

30 (not shown) exists on the horizontal face of the honeycomb, or the thrust plate 113. The position of the honeycomb relative to the linear motor (shown in Figure 5) is established by detection of the number of teeth passing

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either sensor. The teeth may each correspond to each row and or column of types housed within the honeycomb, the arrangement being such that a servo-mechanism circuit controlling the action of the

5 linear motors ensures the required displacement of the honeycomb to a desired position by counting the number of teeth passing each sensor. Alternating currents are passed through the coils of the sensors, and the horizontal/vertical teeth of the honeycomb are

10 detected by virtue of the change they effect in the inductance of the sensor/tooth combination, and thus the current passing through the respective sensor coil(s).

An alternative method of effecting movement

15 of the honeycomb is now described with reference to Figure 7. Instead of using linear induction motors, linear stepping motors are employed. These are shown, schematically, at 117 and 118. Magnetised cores 119 and 120 are embedded in the sides of the honeycomb.

20 The sequence of North/South pole magnetisation of the cores is such that suitable energisation sequences of the coils of the stepping motors causes horizontal and vertical movement of the honeycomb to a desired position. One or other of the motors 117,

25 118, of course moves with the honeycomb during actuation of the other motor 118 or 117. In this arrangement, stable detent positions of the cores opposite the poles of the stepping motors correspond to individual rows and columns of types within the

30 honeycomb, thus no servo-mechanism is required.

As described above, the types, having first been impelled forwards, return to their cavities within the honeycomb as a result of bouncing off a resilient

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In yet a further embodiment of the invention, for applications where high speed print is required, movement of the honeycomb and its print types is effected in the vertical sense only, see Figure 4.

5 In this example, a small stepper motor 51 is used by means of a crank arrangement 52, to raise and lower the honeycomb on guide rods 53 and 54 affixed to the base of the trolley 30. A circular optical encoder grill 55 is mounted on the axis of the motor and
10 serves, in conjunction with a transducer 56, to provide information on the position of the honeycomb. Mounted above the motor and directly in front of the honeycomb is a battery of electromagnetic hammers (shown offset for clarity at 57), one for each column
15 of cavities in the honeycomb. (In an alternative arrangement, the honeycomb is raised and lowered by a servo-controlled linear motor, or by a stepper motor.) In this arrangement, when a sequence of characters is to be printed, control circuitry
20 regulates the movement of the trolley such as to bring the column containing the desired type to the desired print position. At the same time, the stepper motor raises or lowers the honeycomb to the correct height and the appropriate hammer is then fired. It will be
25 appreciated that for a honeycomb twelve cavities wide, the motor need only oscillate between two adjacent positions to present nearly all the lower case characters of this alphabet to the battery. Furthermore, by comparing the character string to be printed with
30 the corresponding lateral position of the honeycomb, it will frequently be possible to fire more than one hammer at a time, so improving the rate of print. When this occurs, to avoid 'back-stepping', the characters

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may be printed not necessarily one after the other.
For example, the honeycomb may be so positioned that
a letter or letters of a second word may be printed
while a first word is being formed, and so on. The
5 extent to which this occurs is of course determined
by any given character sequence, and may be optimised
by comparison registers within the printer controlling
the motion of the trolley and honeycomb relative
to the stationery. The positioning of the hammers
10 and honeycomb relative to the trolley may be adapted
to be at right angles to the arrangement shown in
Figure 4 for oriental printing requirements.

It will be appreciated that the various
modifications described above to the basic form of
15 the printing device of Figure 1 may be used alone or in
various appropriate combinations with one another.

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C L A I M S

1. A printing head comprising a plurality of types, characterised in that they are interchangeably mounted in respective ones of an array (19) of cells, the types (24) each being slideable relative to the cells from a rest position to an impression position, the arrangement being such that return of each type towards its rest position from its impression position is effected by its resiliently rebounding from a platen.

2. A head according to claim 1 characterised in that the array comprises rows and columns of cells.

3. A head according to claim 1 or 2 characterised in that the cells and types are of corresponding rectangular cross-section.

4. A head according to claim 1, 2 or 3 characterised in that means (N,S, Figure 12) are provided to magnetically bias each type towards its rest position.

5. A head according to claim 1, 2 or 3 characterised in that a removable retaining member (124) is provided to retain the types within their cells while allowing movement thereof between their rest and impression positions.

6. A printing device comprising a platen (11) for supporting items on which text is to be printed, a printing head (19, 24) for printing text and having a plurality of types each for printing a respective character and each being movable from a rest position to an impression position, a support (14) carrying the printing head and movable longitudinally relative to the platen between a number of print positions, means (20, 57, 122) for propelling the types to their impression positions, drive means (13) for causing said relative

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movement of the platen and support and circuitry for controlling the operation of the impelling means and the drive means characterised in that the printing head comprises an array (19) of cells each containing an interchangeable type (24) for printing a respective character, the types being slidable relative to the cells from their rest positions to their impression positions, the arrangement being such that return of each type towards its rest position from an impression position is effected by its resiliently rebounding from the platen.

7. A printing device according to claim 6 characterised in that said support is a trolley (14) movable along a guide rail arrangement (13).

8. A printing device according to claim 6 or 7 characterised in that the drive means (13) comprises a linear motor or a stepping motor.

9. A printing device according to claim 8 characterised in that the support (14) comprises an armature of said motor.

10. A printing device according to any one of claims 6 to 9 characterised in that a plurality of detent positions are defined on the support relative to the platen.

11. A printing device according to claim 10 characterised in that the detent positions are defined electronically by said control circuitry.

12. A printing device according to any one of claims 6 to 11 characterised by a transducer arrangement for effecting closed loop control of the drive means.

13. A printing device according to any one of claims 6 to 12 characterised in that the printing head is movable relative to the support in at least one direction.

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14. A printing device according to claim 13 characterised in that the propelling means (20, 57, 122) comprises a print hammer (20, 122) and the printing head (19, 24) is movable relative to said support in the horizontal and vertical directions to present a selected type to the print hammer.

15. A printing device according to claim 13 characterised in that the printing head (19, 24) is movable in the one direction only relative to the support and the propelling means comprises a plurality of print hammers (57) each associated with a group of said cells which are aligned in said one direction.

16. A printing device according to claim 14 or 15 characterised in that the cells are each open to their rears and the print hammer (20) or hammers (20, 57, 122) move in the longitudinal directions of the cells when propelling a selected type towards the platen.

17. A printing device according to any one of claims 13 to 16 characterised in that the printing head is movable in the at least one direction by means of at least one linear motor or stepping motor (110, 111).

18. A printing device according to claim 17 characterised in that said motor is an A.C. linear motor.

19. A printing device according to any one of claims 13 to 16 characterised by a transducer arrangement (115, 116) for effecting closed loop control of the position of the printing head relative to the support.

20. A printing device according to any one of claims 6 to 19 characterised in that the array comprises rows and columns of cells.

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21. A printing device according to any one of claims 6 to 20 characterised in that the cells and types are of corresponding rectangular cross-section.

22. A printing device according to any one of claims 6 to 21 characterised in that means are provided to magnetically bias each type towards its rest position.

23. A printing device according to any one of claims 6 to 22 characterised in that a removable retaining member is provided to retain the types within their cells while allowing movement thereof between their rest and impression positions.

24. A printing device according to any one of claims 6 to 23 characterised in that the printing head is mounted so that the axis of the cells are inclined to the horizontal such that gravity tends to bias the types towards their rest positions.

25. A word processor characterised in that it incorporates a printing device according to any one of claims 6 to 24.

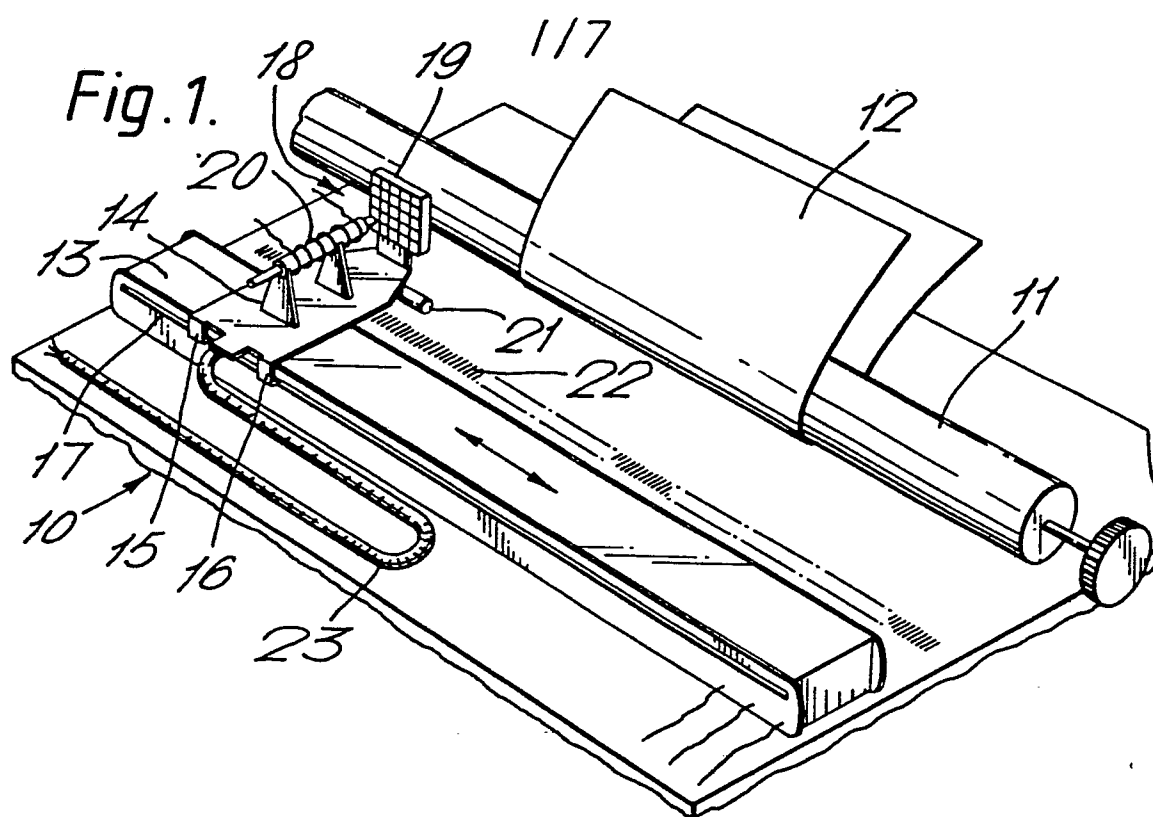
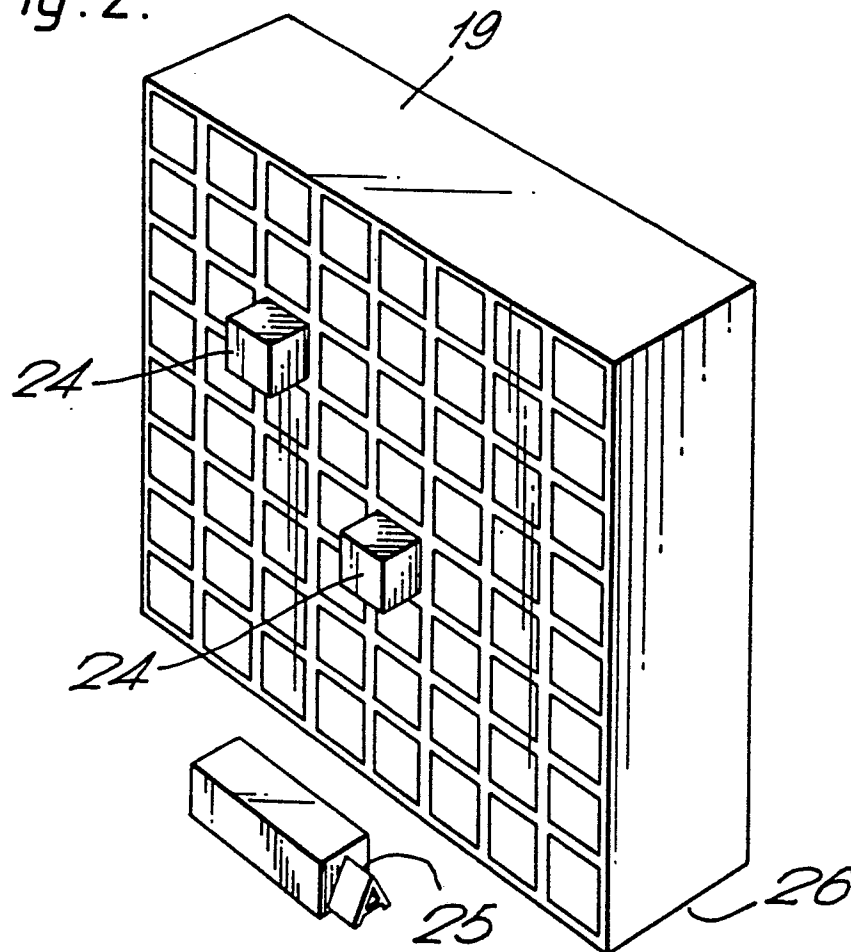
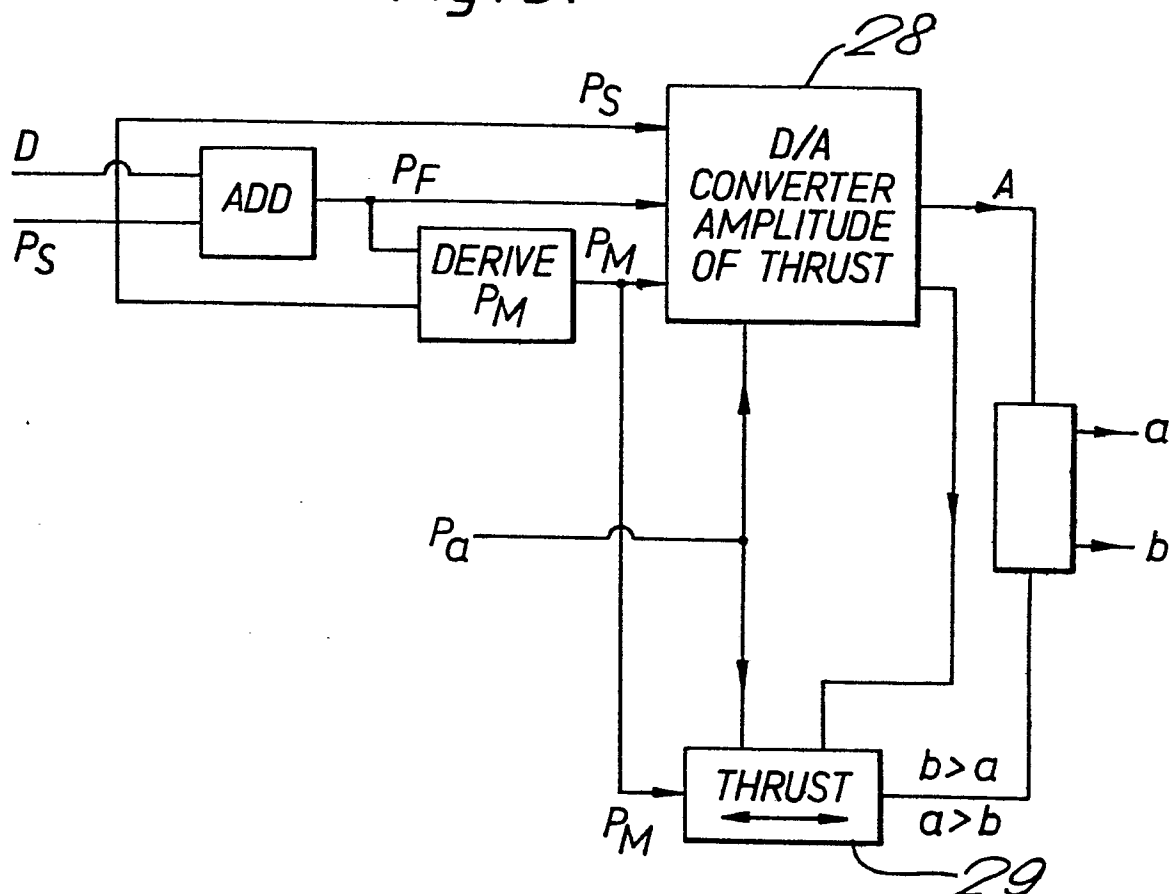


Fig. 2.



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Fig. 3.

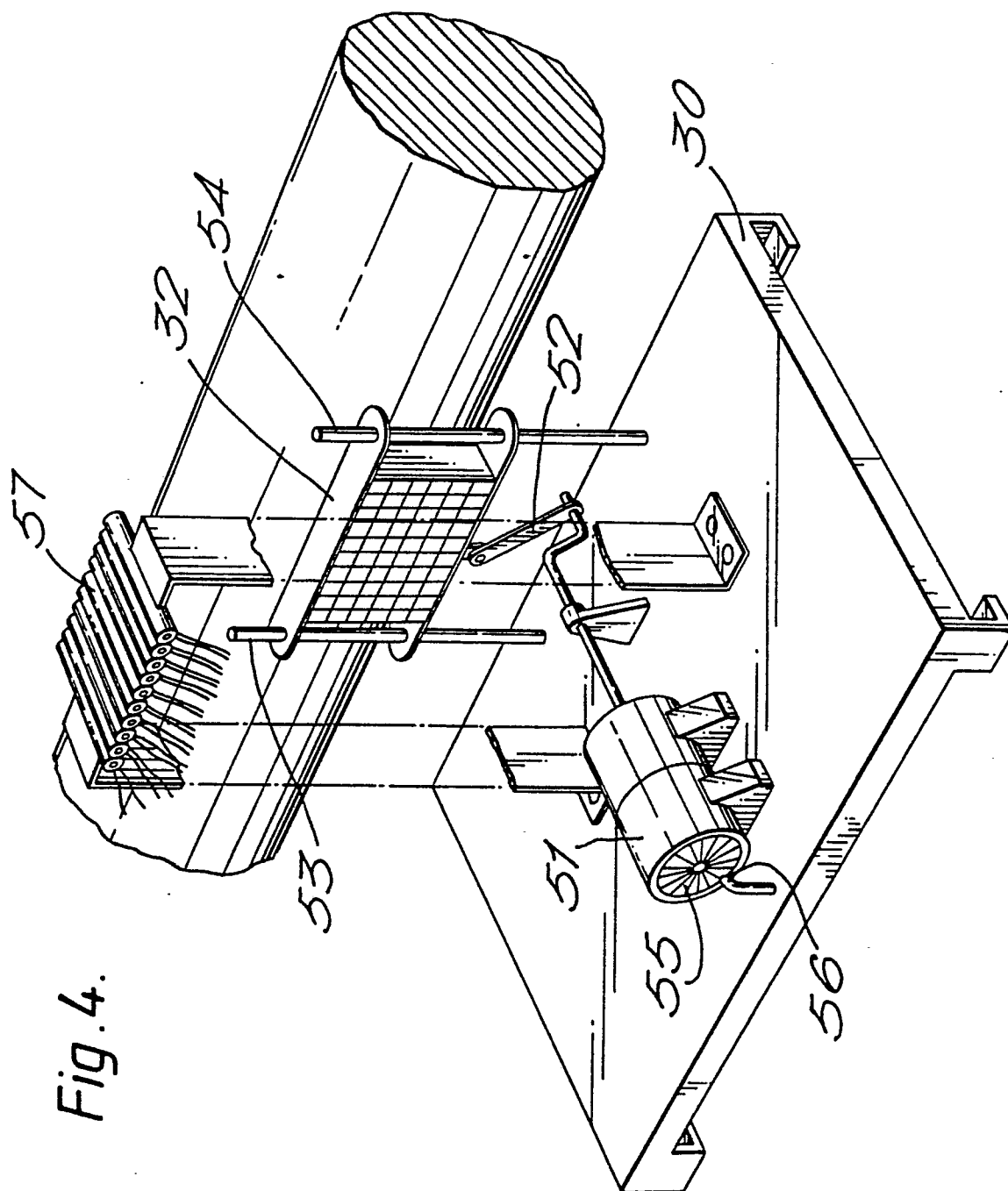


$$1) \quad P_M = P_S + \frac{P_F - P_S}{2}$$

$$2) \quad P_F = P_S + D$$

$$3) \quad A_a \propto |P_S - P_M| \quad \& \quad P_a - P_M$$

$$4) \quad A_d \propto |P_F - P_M| \quad \& \quad P_a - P_F$$



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Fig. 5.

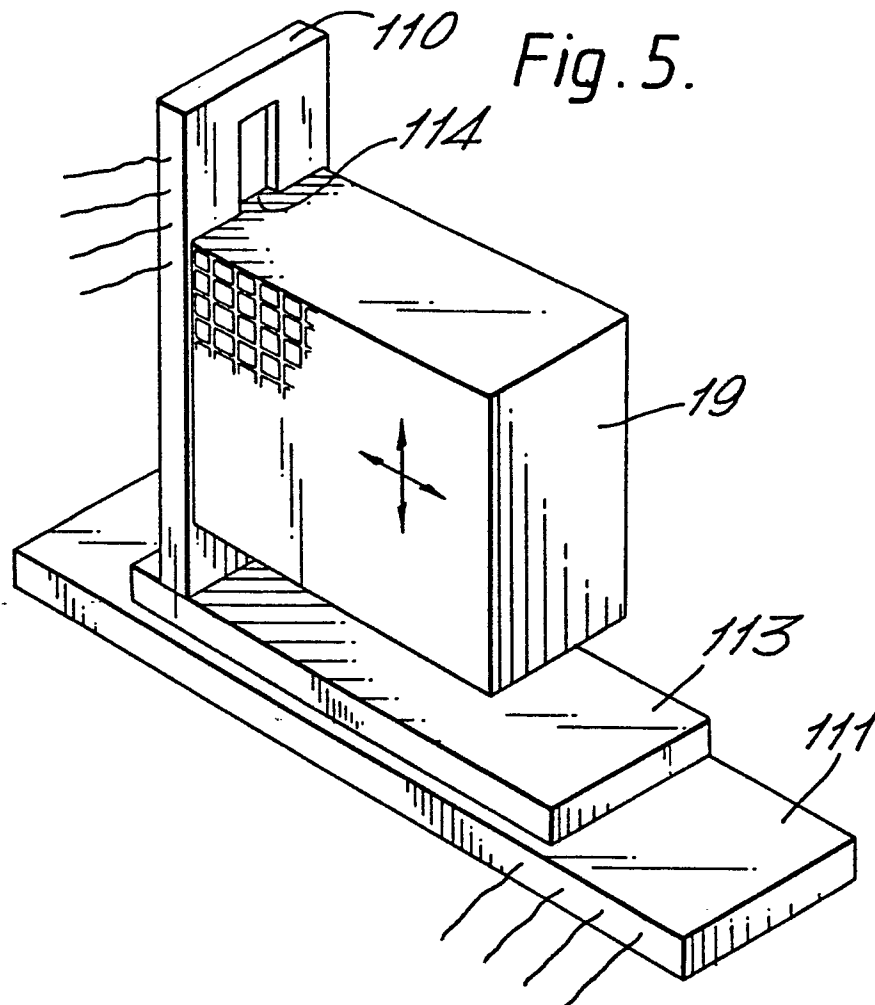
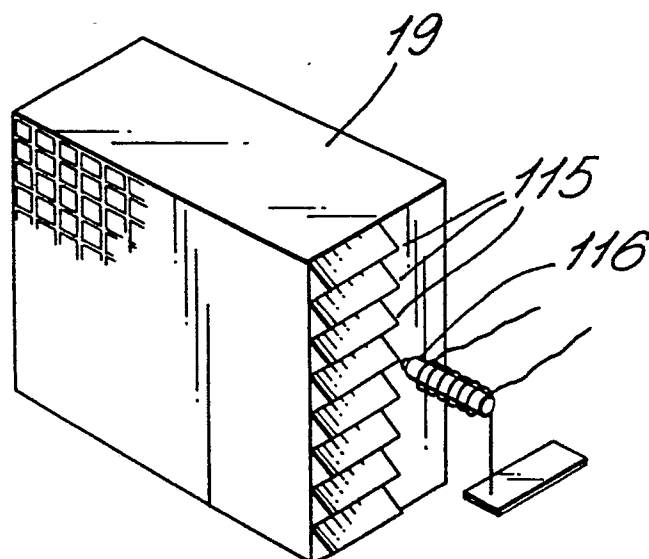
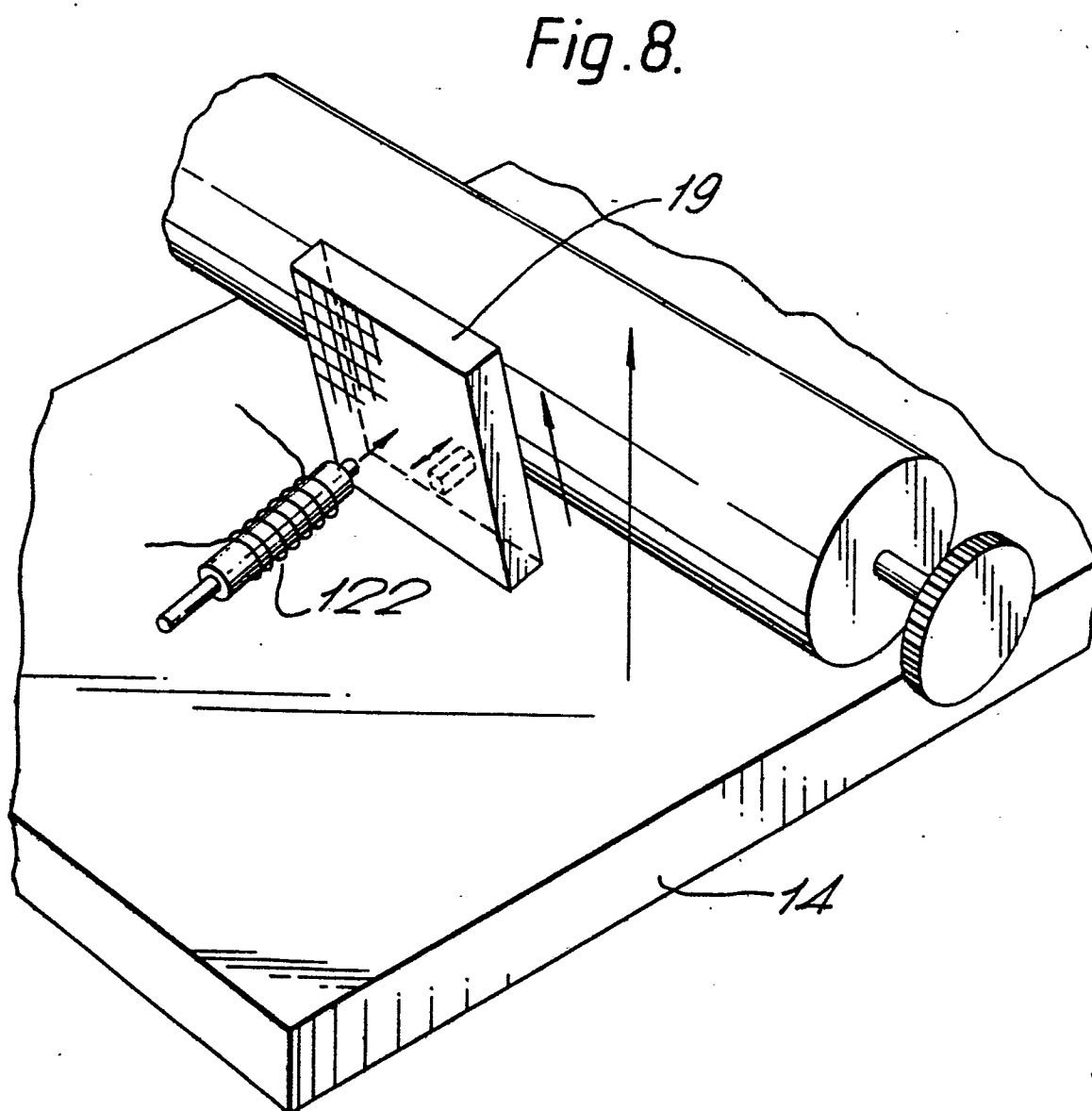
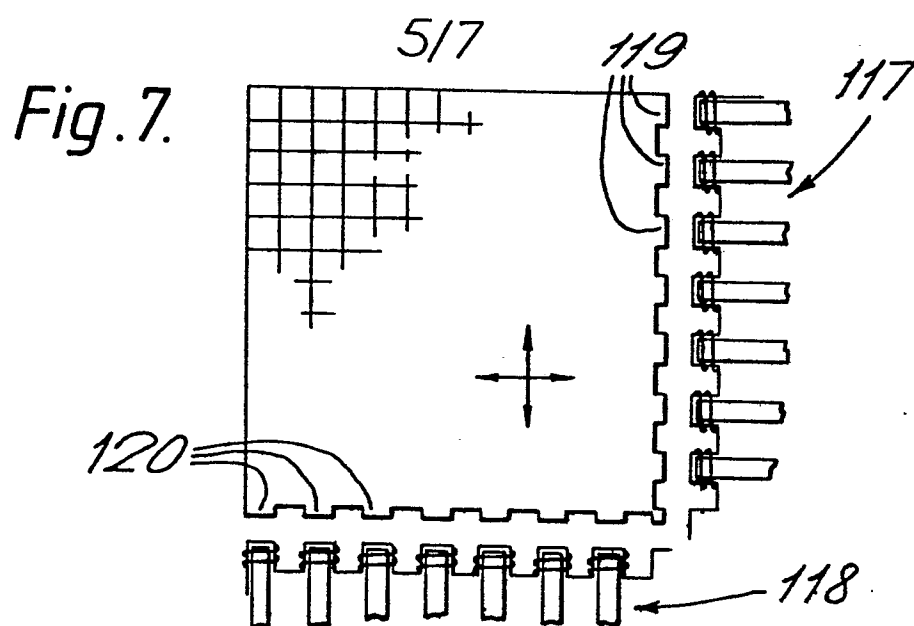


Fig. 6.





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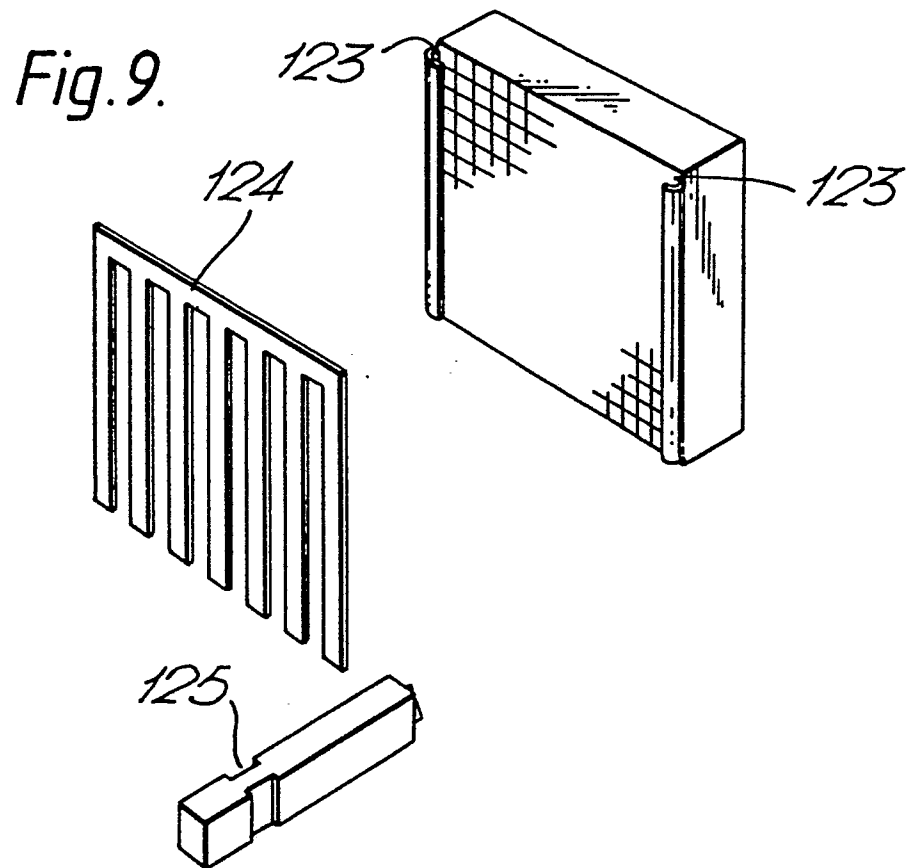
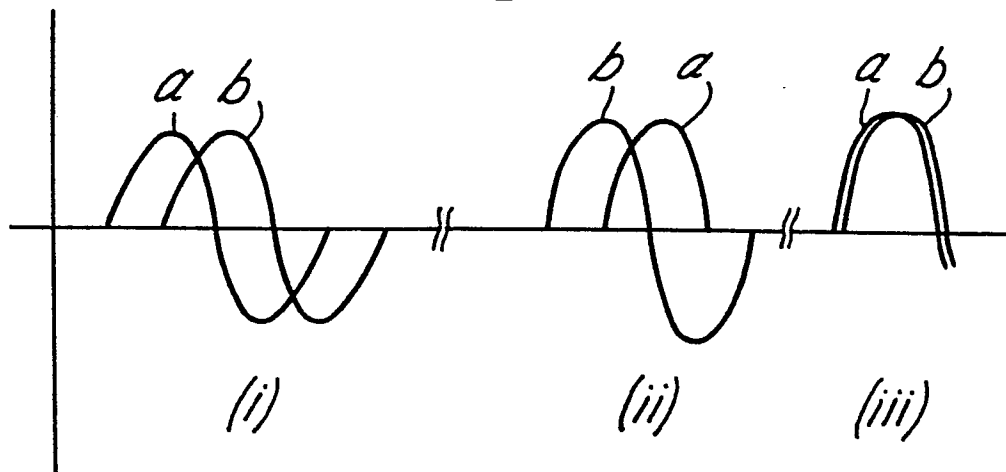
*Fig. 10.*

Fig. 11.

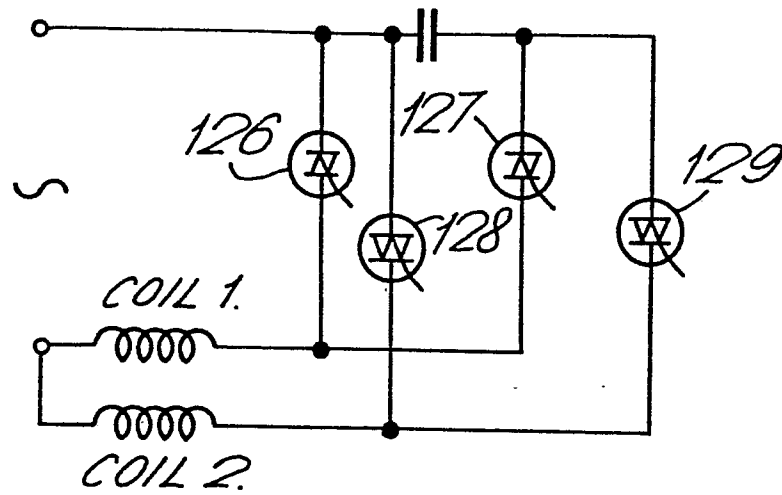
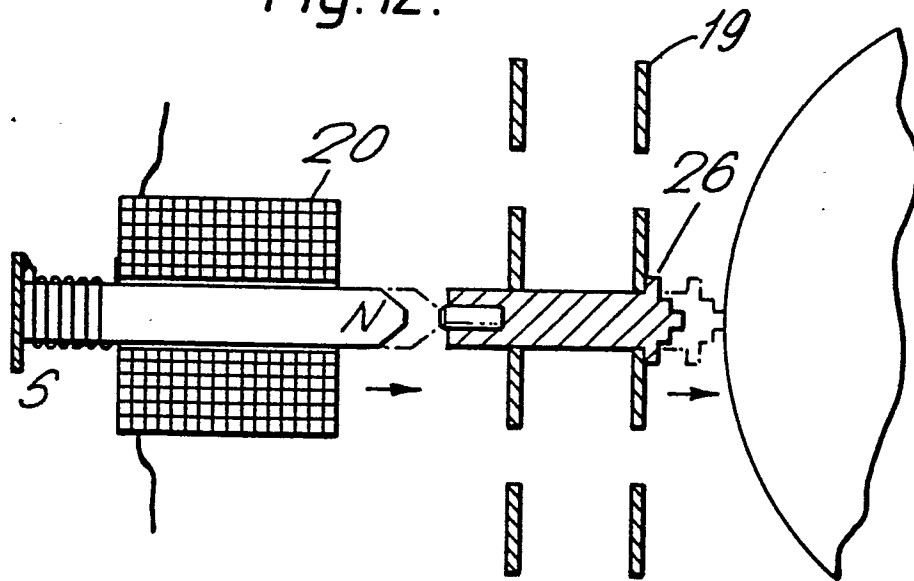


Fig. 12.





European Patent
Office

EUROPEAN SEARCH REPORT

0019453
Application number

EP 80 30 1569

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>FR - A - 2 093 848</u> (TELETYPE) * Page 3, line 15 to page 6, line 26; figures 1-4 * -- <u>US - A - 4 015 699</u> (N. KONDUR) * Column 2, line 63 to column 4, line 2; figures 1,2,6,8 * --	1,2,6, 7,8,9, 13,14, 16-18, 20 1,2,6, 13,14, 16,20	B 41 J 1/16 3/00
X	<u>DE - B - 1 197 474</u> (H.E. KRUTSCHAU) * The whole document * -- <u>US - A - 3 007 400</u> (J.H. LEGO) * Column 3, lines 10-25; figures 2,5 * -- <u>US - A - 4 064 983</u> (FUMIYOKI INOSE) * Column 4, line 4 to column 5, line 65; column 6, line 39 to column 9, line 19; figures 1,2 * ----	1,2,3, 6,13, 14,16, 20,21, 24 5 6,12, 25	TECHNICAL FIELDS SEARCHED (Int.Cl. 3) B 41 J
			CATEGORY OF CITED DOCUMENTS
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			&: member of the same patent family, corresponding document
☒ The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20.08.1980	Examiner VAN DEN MEERSCHAUT