(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 052 011**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **81305329.5**

(22) Date of filing: **10.11.81**

(51) Int. Cl.³: **B 41 J 3/36**, B 41 J 3/12, B 41 J 19/36

(30) Priority: **11.11.80 JP 158724/80**
03.02.81 JP 14598/81

(43) Date of publication of application: **19.05.82**
Bulletin 82/20

(84) Designated Contracting States: **DE FR GB IT**

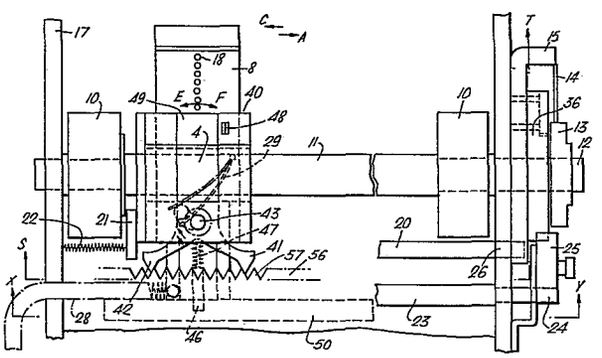
(71) Applicant: **Shinshu Seiki Kabushiki Kaisha, 3-5, 3-chome, Owa, Suwa-shi, Nagano-ken (JP)**
Applicant: **KABUSHIKI KAISHA SUWA SEIKOSHA, 4-3-4, Ginza Chuo-ku, Tokyo (JP)**

(72) Inventor: **Fujiwara, Hitoshi, 80, Oaza-hirookaharashinden, Shiojiri-shi Nagano-ken (JP)**
Inventor: **Matsuzawa, Masanao, 80, Oaza-Hirookaharashinden, Shiojiri-shi Nagano-ken (JP)**
Inventor: **Kodaira, Kozo, 80, Oaza-Hirookaharashinden, Shiojiri-shi Nagano-ken (JP)**

(74) Representative: **Miller, Joseph et al, J. MILLER & CO. Lincoln House 296-302 High Holborn, London WC1V 7JH (GB)**

(54) Dot printer and method of using the same.

(57) A dot printer having a printing head (8) arranged for reciprocal motion across a printing paper (5) which is to be printed, and feeding means (10) for feeding the printing paper (5) past the printing head (8), the printing head (8) being arranged to be moved manually in at least one direction (A, C) across the printing paper (5) during the reciprocal motion.



EP 0 052 011 A1

0052011

"DOT PRINTER AND METHOD OF USING THE SAME"

The present invention relates to dot printers, and a method of operating the same, of the type having a printing head arranged for reciprocal motion across a recording medium which is to be printed, and feeding means for feeding the recording medium past the printing head, and more particularly relates to dot printers designed for low power consumption.

Conventional printers, e.g. that shown in Japanese Utility Model Laid-Open Publication No. 53244/80, effect printing under pressure, or drive a printing wheel with energy stored in a spring due to pressure applied thereto. Such printers require two or three SUM-3 cells for generating energy to select characters on the printing wheel of the printer in addition to manually produced energy, and cannot be incorporated into pocket-size calculators. Pocket-size calculators with printers of the discharge printing type or thermal printing type consume a great amount of energy necessary for moving the printing head and feeding the printing paper, and require frequent replacement of cells, disadvantages which render the calculators unsatisfactory in practice.

According to one aspect of the present invention there is provided a dot printer of the type described above, characterised in that the printing head is arranged to be moved manually in at least one direction across the recording medium during the said reciprocal motion.

Preferably spring means are provided in which energy is stored when the printing head is manually moved in one direction across the recording medium, and return means for moving the printing head in the opposite direction back across the recording medium by means of the energy stored in the spring means.

First control means may be provided for causing the printing head to effect a printing operation as it is being moved in the said opposite direction.

The first control means may comprise means for effecting intermittent movement of the printing head as it is being moved in the said opposite direction.

Preferably second control means are provided for causing the printing head to effect a printing operation in synchronisation with the speed of travel of the printing head as it is being manually moved across the recording medium.

The first or second control means may include detector means for generating timing pulses in synchronisation with the movement of the printing head as it is being moved manually across the recording medium or being moved in the said opposite direction by energy stored in the spring means.

The detector means may be arranged to detect reciprocal motion of an escapement member, the escapement member being arranged to reciprocate as a result of rotation of gears one of which meshes with teeth on a frame member of the printer and is caused to rotate when the printing head is moved across the recording medium.

The detector means may be arranged to detect reciprocal motion of an escapement member, the escapement member having parts which are engageable with teeth on a frame member of the printer and being arranged to reciprocate when the printing head is moved across the recording medium.

Preferably means are provided for spacing the printing head from the recording medium during the said reciprocal motion of the printing head when a printing operation is not to be performed, and for moving the printing head into contact with, or closely adjacent to, the recording medium during the said reciprical motion of the printing head when a printing operation is to be performed.

The feeding means are preferably arranged to be driven by energy stored in a or the spring means when the printing head is manually moved across the recording medium.

The feeding means may comprise at least one feeding roller which is driven by a feed member, the feed member being urged towards a predetermined position by further spring means, which are weaker than the first-mentioned spring means, and being arranged to be moved against the action of the said further spring means when the printing head is manually moved in one direction across the recording medium to a further position in which it is releasably held, movement of the printing head in the said opposite direction releasing the feed member and permitting the latter to move under the action of the further spring means back to the said predetermined position, means being provided for rotating the or each feeding roller through a given angle when the feed member has returned to the said predetermined position.

Manually operable means may be provided to effect operation of the feeding means.

According to another aspect of the present invention there is provided an electronic calculator or other electronic instrument comprising a dot printer, the dot printer being arranged to print an indication displayed by a display device of the calculator or instrument.

The present invention will now be described, merely by way of example, with reference to the accompanying drawings, in which:-

Figure 1a is a cross-sectional view of a pocket calculator provided with a dot printer according to the present invention,

Figure 1b is a plan view of the pocket calculator shown in Figure 1a,

Figure 2 is a side elevational view on a larger scale of a first embodiment of a dot printer according to the present invention,

Figure 3 is a side elevational view from another side of the dot printer shown in Figure 2,

Figure 4 is a fragmentary plan view of the dot printer shown in Figures 2 and 3,

Figure 5 is a fragmentary rear view of the dot printer shown in Figures 2, 3 and 4,

Figures 6 and 8 are cross-sectional views taken along the line X-Y of Figure 4,

Figures 7 and 9 are cross-sectional views taken along the line S-T of Figure 4,

Figure 10a is a side elevational view of a second embodiment of a dot printer according to the present invention,

Figure 10b is a plan view of a dot printer shown in Figure 10a,

Figure 10c is a side elevational view of a third embodiment of a dot printer according to the present invention, and corresponds to Figure 10a,

Figure 10d is a timing chart,

Figure 10e is a block diagram of a pulse generating circuit,

Figure 11 is a side elevational view of a fourth embodiment of a dot printer according to the present invention,and corresponds to Figure 2,

Figure 12 is a side elevational view from another side of the dot printer shown in Figure 11, and corresponds to Figure 3,

Figure 13 is a fragmentary plan view of the dot printer shown in Figure 11 and corresponds to Figure 4, and

Figure 14 is a fragmentary rear view of the dot printer shown in Figure 11 and corresponds to Figure 5.

An electronic calculator 1 illustrated in Figures 1a and 1b comprises a keyboard 2, a display 3, a manually actuatable knob 4

which forms part of a dot printer incorporated in the calculator 1, a sheet 5 of printing paper on which characters are to be printed by a dot printer 7, a folded assembly or fanfold 6 of the printing paper 5, and a printing head 8 having printing elements of the discharge, thermal or ink jet type.

In operation, selected keys of the keyboard 2 are depressed for calculation of data in the calculator 1 and calculated results are indicated on the display 3. When such calculated results are to be recorded, the manual knob 4 is manually moved in the direction of the arrow A (Figure 1b). When the knob 4 is released, it is caused to return to a starting position while at the same time the same characters as those on the display 3 are printed on the printing paper 5 which is fed along by paper feed means (not shown in Figure 1). When it is required to feed the printing paper 5 to a position in which printing is to be effected, the manual knob 4 may be moved to feed the printing paper 5 in association with the movement of the printing head at a time when the latter is not carrying out printing, or a paper feed knob 9 may be turned manually. For rapid feeding of the printing paper 5, it is more convenient to actuate the paper feed knob 9.

A first embodiment of a dot printer according to the present invention, and a method of using the same to effect printing, will now be described with reference to Figures 2 to 9.

The dot printer includes paper feed rollers 10 (Figure 2) against each of which a sheet 5 of printing paper is pressed by a presser roller 19, a guide shaft 11 on which the printing head 8 is movable, and a paper feed shaft 12 (Figure 3) having a paper feed ratchet wheel 13 mounted thereon for angularly moving the paper feed rollers 10, the shafts 11 and 12 being coaxial with each other. A paper feed pawl 14 is mounted on a paper feed member 15 for angularly moving the ratchet wheel 13 one pitch at a time. Side frames 16, 17, shafts,and sub-frames jointly constitute

an overall frame of the printer. Printing elements 18 in the printing head 8 may comprise electrodes for a dot discharge method, or heater elements for a thermal method.

A control plate 21 is fixed to a control shaft 20 which controls the paper feed member 15 and is biased in the direction of the arrow G (Figure 6) by a control spring 22. A holder 26 which is secured to or integral with the control shaft 20 serves to hold the paper feed member 15 in the solid-line position shown in Figure 3. A paper feed drive shaft 23 acts to rotate a paper feed gear 25 and hence a paper feed member gear 36 to move the paper feed member 15, which is secured to the paper feed member gear 36, from the solid-line position shown in Figure 3 to a broken line position shown therein. A spring 35 prevents the paper feed ratchet wheel 13 from rotating back. The sheet 5 of printing paper is guided by paper guides 30 and 31.

A printing head body 40 (Figure 4) which includes the printing head 8 travels on and along the guide shaft 11 with the movement of the manual knob 4. An escapement member or anchor 49 is pivotably mounted by a pivot pin 43 on the printing head body 40 and has a pair of anchor pawls 41 and 42 adapted to be held in engagement with teeth 57 of a subframe 56. An anchor spring 29 normally biases the anchor pawls 41 and 42 into engagement with the teeth 57 during a required space of time. A slide guide member 44 serves to guide a slide 45 mounted on the printing head 8 for allowing sliding movement of the slide 45 which supports a leading pin 46 through a leading spring 47. The leading pin 46 allows sliding movement of the printing head body 40 along the guide shaft 11 and sliding movement of the printing head 8 towards the paper 5 as will be described below.

A detector means 48 detects reciprocating movement of the anchor 49 for producing pulses each corresponding to one dot interval for the printing elements 18, thus detecting timings for a printing operation of the printing head 8.

A leading plate 50 (Figure 5), which is fixed to the sub-frame 56, has leading grooves for guiding the leading pin 46. A leading groove 53 receives the leading pin 46 when the printing head 8 is in a standby position. The leading pin 46 moves in and along a leading groove 51 while the printing head 8 is caused to move forwardly by the manual knob 4. The leading pin 46 reaches a return starting groove 54 when the printing head 8 has been moved across the printing paper 5 and is about to start printing. A leading groove 52 allows the printing head 8 to return to the stand-by position under the force of a return spring 28 and during this time printing can be effected. The leading groove 51 has a plurality of stoppers 55 cut therein to prevent the printing head 8 from returning to the standby position unless and until the printing head 8 reaches the return starting groove 54.

The dot printer thus constructed will operate as follows: When it is desired to record the results of and/or the steps in a calculation effected by the calculator 1, the manual knob 4 is manually moved in the direction of the arrow A to start operation of the dot printer. As the manual knob 4 is thus manually moved, the printing head body 40 is caused to travel on the guide shaft 11, while at the same time the leading pin 46 travels from the groove 53 via the groove 51 to the groove 54,whereupon the printing head 8 is in a position to start printing. While the leading pin 46 moves from the groove 51 to the groove 54, the printing head 8 as it travels is kept in the solid-line position shown in Figure 2 in which it is spaced from and out of contact with the printing paper 5, thereby preventing printing operation. However, when the pin reaches the end of the groove 51 and enters the groove 54, the printing head body rotates about the shaft 40 and the printing head 8 is brought, or is

nearly brought, into contact with the printing paper as shown by the broken line position in Figure 2 under the control of the leading pin 46 and the grooves. When the manual force acting on the printing head body 40 via the knob 4 is released, the leading pin 46 is caused by the return spring 28 to move from the groove 54 via the groove 52 to the groove 53. With the stoppers 55 in the groove 51, the printing head body 40 is prevented from returning along the groove 51 for the printing operation under the force of the return spring 28 unless the leading pin 46 is manually moved to the groove 54. When the printing head body 40 is manually moved in the direction of the arrow A, the pivot pin 43 is displaced by inertia in a direction of the arrow B against the force from the anchor spring 29 so that the anchor pawls 41 and 42 are held out of engagement with the teeth 57. That is to say, when the printing head body 40 moves in the direction A, the anchor pawls 41, and 42 of the anchor 49 initially engage with the teeth 57 and the anchor 49 is thus forced in the direction B so that the pivot pin 43 is retained in the chain dotted position shown in Figure 4 while the printing head body 40 is moving in the direction A. The anchor pawls 41, 42 are thus kept out of engagement with the teeth 57 until the leading pin 46 reaches the groove 54 as the knob 4 is manually moved. Upon arrival of the leading pin 46 at the groove 54, the printing head body 40 is prevented from moving in a direction of the arrow A,whereupon the pivot pin 43 is displaced in the direction of the arrow D under the urging of the anchor spring 29, thus causing the anchor pawls 41, 42 to engage the eteeth 57. As the printing head body 40 starts moving in the direction of the arrow C under the force of the return spring 28 when the manual push on the manual knob 4 is released,

the anchor pawls 41 and 42 alternately engage the teeth 57 to thereby cause the anchor 49 to be angularly moved back and forth in the directions of the arrows E, F. The printing elements 18 of the printing head 8 are thus fed along intermittently by increments each of which corresponds to at least one dot interval. Such angular movements of the anchor 49 in the directions E and F are detected by the detector 48 which produces signals each indicative of printing for one dot interval such that printing with correct dot intervals will be effected. Intermittent movement of the printing head body 40 can be rendered smoother by attaching a resistive body, for example a fan (not shown), to the anchor 49. The angular movements of the anchor 49 in the directions E and F will be repeated until the leading pin 46 on the printing head body 40 reaches the groove 53, whereupon the intermittent movement of the printing head body 40 is stopped to finish the printing operation. During the printing operation, the printing elements are supplied with pulses for effecting printing each time that the printing head 8 is moved one increment to print a character with a plurality of printed dots (5 x 7 dots, for example). The printing elements used may be of any known low-power-consumption type such for example as discharge, thermal, laser or ink jet printing elements. Thus, the printing operation is performed while the printing head 8 travels intermittently from the groove 54 via the groove 52 to the groove 53. The printing paper 5 on which printing has been effected is fed out by the rotation through a given angle of the paper feed shaft 12 which rotates the paper feed rollers 10. Such paper feeding operation will be described in more detail with reference to Figures 6 to 9.

As illustrated in Figure 6, when the printing head body 40

is in the standby position, the paper feed drive shaft 23 is depressed by the bottom of the slide guide member 44 of the printing head body 40. At this time, the paper feed drive shaft 23 is in the solid-line position (Figures 3 and 6) as an end 24 of the shaft 23 is biased upwardly under the force of a spring 37 (Figure 3). The latter acts in the direction of the arrow m on the paper feed member 15 and thus acts on the paper feed member gear 36, the paper feed gear 25, which meshes with the gear 36, and the end 24 of the paper feed drive shaft 23 which extends into an elongated hole in the gear 25. The printing head body 40, when kept in the stand-by position, urges with a side thereof the control plate 21 in the direction of the arrow H, while the control spring 22 normally biases the control plate 21 in the direction of the arrow G. The printing head body 40 is normally biased in the direction H by the return spring 28 which is stronger than the control spring 22. As the manual knob 4 is actuated to move the printing head body 40 towards the side frame 16, the bottom of the slide frame member 44 depresses the paper feed drive shaft 23 to turn the paper feed gear 25 gradually, thereby angularly moving the paper feed member 15 in the direction of the arrow ℓ (Figure 3) against the force from the paper feed spring 37. Upon completion of the movement of the printing head body 40 towards the side frame 16 as illustrated in Figure 8, the end 24 of the paper feed drive shaft 23 becomes shifted to the broken line position shown in Figure 3, whereupon the paper feed member 15 and the paper feed pawl 14 thereon are moved to their broken line positions. As the paper feed member 15 is angularly moved in the direction ℓ, the holder 26 on one end of the control shaft 20 is shifted to the position shown in Figure 9 under the force of the spring 22 applied in the direction G until the holder 26 engages the paper feed member 15 to hold the latter against angular movement thereof in the direction m.

The manual movement of the knob 4 to move the printing head body 40 stores energy in the return spring 28 for returning the printing head body 40 to the starting position and in the spring 37 for feeding the printing paper 5. When the manual push on the manual knob 4 is released, the printing head body 40 starts moving back to the initial standby position under the force of the return spring 28. When the printing head body 40 is returned to the initial standby position, the side thereof pushes the control plate 21 in thedirection H causing the holder 26 to move back into the position illustrated in Figure 7 and out of engagement with the paper feed member 15, which is then angularly moved in the direction m under the force of the spring 37. The ratchet wheel 13 is now turned an angular interval equal to one tooth thereof, (one pitch), whereupon the shaft 12 is angularly moved in the direction of the arrow n through an angle which causes the rollers 10 to feed the printing paper through a given space. When it is desired to feed the printing paper manually irrespective of printing operation, the paper feed knob 9 is manually moved in the direction ℓ to allow printing paper 5 to be fed along under the bias of the spring 37 in the manner described above. The foregoing paper feeding operation may be repeated for continuously feeding the printing paper 5. The printing paper 5 may be fed along in a desired amount at a time by changing the number of teeth of the ratchet wheel 13, and the printing paper 5 may be fed in opposite direction by changing the contour of the teeth of the ratchet wheel 13 and the shape of the spring 35 for preventing the ratchet wheel 13 from turning back.

Further embodiments of a dot printer according to the present invention, and a method of using the same to effect printing, will now be described with reference to Figures 10 to 14. These embodiments are broadly similar to that described with reference to Figures 2 to 9 and, therefore, only the more important parts thereof are fully described.

The embodiments described with reference to Figures 10 to 14 may be incorporated into an electronic calculator or other small instrument just as is described above in relation to Figure 1.

As shown in Figures 10a and 10b the second embodiment of the dot printer comprises a manually actuable knob 104, a printing head 108, paper feed rollers 110 for feeding a sheet 105 of printing paper, a guide shaft 111 on which the printing head 108 is movable, and a presser roller 119 for pressing the sheet 105 against each paper feed roller 110. The dot printer also includes a first reed switch 134 for producing a pulse indicative of the starting of a printing operation, and a second reed switch 135 for producing a pulse indicative of termination of the printing operation. The printing head 108 is movable manually as by a finger 160 which produces manual energy. A guide rack 161 is held in meshing engagement with a gear 162 rotatably supported on the printing head 108, the gear 162 allowing the printing head 108 to move in one direction. The printing head 108 has a detector 148 (Figure 11) for generating timing pulses 480 (Figure 10d) in synchronisation with the movement of the printing head 108 while the gear 162 rotates in mesh with the guide rack 161.

When it is desired to effect a printing operation to record a result indicated by the display 3 (Figure 1), the knob 104 is moved by the finger 160 in a direction of the arrow 1a, whereupon the reed switch 134 is actuated to generate a print starting pulse 340 (Figure 10b) for permitting a subsequent printing operation. During the period of the print starting pulse 340, the detector 148 generates timing pulses 480 at intervals each equal to one printing dot (or one printing dot multiplied by an integer n) in synchronization with the movement

of the printing head 108. Even when the printing head 108 is moved at varying speeds, a pulse generating circuit 300 (Figure 10e) produces a train of printing pulses 481 or 482 on the basis of the timing pulses 480 in synchronization with the travel of the printing head 108, allowing characters and symbols to be printed at regular pitches. When the printing head 108 reaches the second reed switch 135 after the printing head 108 has completed the printing operation, the second reed switch 135 is actuated to produce a print ending pulse 350 and, at the same time, the printing head 108 is stopped. Then, the printing operation having finished, the printing head 108 starts moving back to the original standby position. The printing head 108 may be returned in the direction of the arrow 1b either by the finger 160 or by a return spring (not shown). While the printing head 108 is being moved back, the sheet 105 of printing paper is fed past the printing head 108 by the paper feed rollers 110. The knob 104 may be formed so that it can conveniently be actuated by a suitable writing instrument or other means rather than the finger 160.

In the third embodiment, shown in Figure 10c, a guide 163 is provided in place of the guide rack 161 and the gear 162 to guide the printing head 108 as the latter moves along the guide shaft 111. In operation, the printing head 108 is moved by the finger 160 in the direction of the arrow 1a (Figure 10b) while printing elements 118 are pushed by the finger 160 downwardly into contact, or nearly into contact, with the sheet 105 in the direction of the arrow 1g. The first reed switch 134 is actuated to produce a print starting pulse 340. As the printing head 108 travels across the sheet 105, a pulse generator on the guide 163 produces a train of timing

pulses 480 each corresponding to at least one printing dot in synchronisation with the movement of the printing head 108. The timing pulses 480 thus generated enable the printing device 118 to print characters and symbols on the sheet 105 of the recording paper at regular pitches irrespective of variations in the speed of movement of the printing head 108. After the printing operation has been finished, the printing head 108 arrives at the second reed switch 135 which is then actuated and the printing head 108 is stopped. Thereafter, the printing head 108 is caused either manually or by a spring (not shown) to return to the starting or standby position. The sheet 5 of printing paper is fed along in the manner described above in relation to Figures 10a and 10b. While in the embodiments described with reference to Figures 10a, 10b and 10c printing can be effected by the printing pulses 481 which are produced during the time period starting with the actuation of the first reed switch 134 and ending with the actuation of the second reed switch 135, a series of printing pulses 482 (Figure 10d) may be generated for a printing operation during the time period starting with the actuation of the reed switch 135 and ending with the de-activation of the first reed switch 134.

A pulse generating circuit 300 for producing the pulses 481, 482 will be described with reference to Figures 10d and 10e. The first reed switch 134 while being actuated produces the pulse signal 340, the second reed switch 135 while being actuated produces the pulse signal 350, and the detector 148 produces the timing pulse signal 480. The pulse generating circuit 300 comprises differentiating circuits 301, inverters 302a, 302b, 302c, and 302d, a first flip-flop 303, a first AND gate 304, a second flip-flop 305, and a second AND gate 306. The connections between these circuit components will be apparent both from Figure 10e and the following description. In operation, the signal

340 is applied through the differentiating circuit 301 and the inverter 302a to a set terminal S of the first flip-flop 303, and the signal 350 is applied through the inverter 302b to a reset terminal R of the first flip-flop 303, whereupon the flip-flop 303 produces a signal 360 as an output. The signal 360 and the timing signal 480 are applied to the inputs of the first AND gate 304, which then produces the printing pulses 481. Likewise, when it is desired to produce printing pulses during the period starting with the actuation of the second reed switch 135, the second flip-flop 305 is arranged to generate a signal 370 in a manner similar to that in which the signal 360 is generated, and the signal 370 and the timing signal 480 are supplied as inputs to the second AND gate 306, which generates the printing pulses 482 as an output. While the pulse generating circuit 300 has been shown as comprising flip-flops and AND gates, it will be apparent to those skilled in the art that other components and circuit arrangements may be employed to achieve the same circuit operation.

The printing elements 18 in the dot printer have been shown to be of the discharge printing type. The latter consumes only a small amount of electric power and hence can be powered sufficiently by a silver cell.

Figures 11 to 14 illustrate a fourth embodiment of a dot printer constructed in accordance with the present invention.

In this embodiment, the dot printer includes paper feed rollers 210 against each of which a sheet 205 of printing paper is pressed by a presser roller 219, a guide shaft 211 on which the printing head 208 is movable, and a paper feed shaft 212 having a paper feed ratchet wheel 213 mounted thereon for angularly moving the paper feed rollers 210, the shafts 211 and 212 being coaxial with each other. A paper feed pawl 214 is mounted on a paper feed member 215 for angularly moving

the ratchet wheel 213 one pitch at a time. Side frames 216, and 217, shafts and sub-frames jointly constitute an overall frame of the printer. Printing elements 218 in the printing head 208 may comprise electrodes for a dot discharge method, or heater elements for a thermal method. A paper feed drive shaft 223 serves to guide a slide 245 for moving the printing head 208. A paper feed spring 237 serves to drive the paper feed member 215 and to angularly move the paper feed shaft 212. A spring 235 prevents the paper feed ratchet wheel 213 from rotating back. The sheet 205 of printing paper is guided by paper guides 230 and 231.

A printing head body 240 which includes the printing head 208 travels on and along the guide shaft 211 with the movement of the manual knob 204. A gear 224 is rotatably mounted on a support shaft 225 in mesh with a rack 257, the gear 224 having twenty teeth in the illustrated embodiment. A gear 226 is rotatably mounted on a support shaft 229 in mesh with the gear 224, and has ten teeth in the illustrated embodiment. A gear 227, with ten gear teeth, is mounted on the support shaft 229 for rotation with the gear 226. An anchor 249 has pawls 232 engageable with the gear 227. A slide guide member 244 serves to guide a slide 245 connected to the printing head 208 for allowing sliding movement of the slide 245 and the printing head 208, the slide 245 supporting a leading pin 246 through a leading spring 247. A detector means 248 detects, with a detector bar 233, reciprocating movement of the anchor 249 for producing pulses each corresponding interval for the printing elements 218, allowing the printing operation to be performed in synchronisation with the manual movement of the printing head 208.

A leading plate 250 (Figure 14) has leading grooves for

guiding the leading pin 246. The leading groove 253 receives the leading pin 246 when the printing head 208 is in a standby position. The leading pin 246 moves from the leading groove 253 via a leading groove 251 to a return starting groove 254, while the printing head 208 is caused to move in a direction of the arrow 2a (Figure 13) by the manual knob 204 during which time printing can be effected. The leading groove 252 allows the printing head 208 to return to the standby position under the force of a return spring 228. The leading groove 251 has a plurality of stoppers 255 cut therein to prevent the printing head 208 from returning to the standby position unless and until the printing head 208 reaches the return starting groove 254.

A dot printer thus constructed will operate as follows: When it is desired to record results or procedures of calculation in the calculator 1 (Figure 1), the manual knob 204 is manually moved in the direction of the arrow 2a to start operation of the dot printer. As the manual knob 204 is thus manually moved, the first reed switch 234 disengages from the printing head body 40 and generates a print starting pulse which permits the printing head 208 to effect printing. The printing head body 240 travels along the guide shaft 211, while at the same time the pin 246 moves from the groove 253 via the groove 251 to the groove 254. While the pin 246 moves manually from the groove 251 to the groove 254, the printing head 208, as it travels, is kept in contact with or close to the printing paper 205. When the pin 246 arrives at the leading groove 254, the second reed switch 235 is engaged by the printing head body 240 and produces a print ending pulse for finishing the printing operation. When the printing head body 240 is released of a manual force, the pin 246 is caused by the return spring 228 to move from the groove 254

via the groove 252 to the groove 253, the printing head 208 being kept out of contact with the printing paper 205 under the control of the pin 246 and the grooves. With the stoppers 255 in the groove 251, the printing head body 240 is prevented from returning along the groove 251 under the force of the return spring 228 unless the pin 246 is manually moved to the groove 254. When the printing head body 240 is manually moved in the direction of the arrow 2a, the gear 224 is rotated by mesh with the rack 257. Rotation of the gear 224 causes the gears 226 and 227 to rotate, whereupon the anchor 249 moves back and forth in the directions of the arrows 2c and 2d. The movement of the anchor 249 acts as a braking force against the manual power exerted to move the printing head 208 across the paper 205 and causes the detector bar 233 to reciprocate enabling the detector means 248 to generate a signal indicative of print timing. The print timing thus detected by the detector means 248 is in synchronization with the timing at which the printing head 208 is manually moved. Printed dots are thus spaced at substantially equal intervals irrespective of variations in the speed of travel of the printing head 208, and thus characters formed by the dots are neatly printed. When the knob 204 is released, the printing head body 240 starts moving in the direction of the arrow 2c under the force of the spring 228, and the anchor pawls 232 alternately engage the teeth of the gear 227 to thereby cause the anchor 249 to be angularly moved back and forth in the directions of the arrows 2c and 2d. The printing head 208 is thus allowed to return at a constant speed of travel to the standby position. Intermittent step-wise movement of the printing head body 240 can be rendered smoother by attaching a resistive body or damping means, such as a fan (not shown), to the anchor 249. During printing operation, the printing

elements 218 are held in contact with or close to the printing paper as shown by the two-dot-and-dash lines in Figure 11 while the printing head 208 is moving, and are supplied with pulses for printing each time the printing head 208 is moved one increment to print a character with a plurality of printed dots (5 x 7 dots, for example). Upon release of a manual push on the knob 204, the printing head 208 returns intermittently as it is held in the solid-line position of Figure 11 since the pin 246 slides along the groove 252. The printing head 208 is thus moved back stepwise through increments each corresponding to one dot interval while the printing elements 218 are kept away from the printing paper 205. The printing elements 218 used may be of any known low-power-consumption type as, for example, discharge, thermal, laser or ink jet printing elements. The paper feeding operation for this embodiment will now be described with particular reference to Figure 12. It should be noted that the paper feeding operation for the embodiments shown in Figure 10 is similar to that described below.

The printing paper 205 on which printing has been effected is fed out by rotation through a given angle of a paper feed shaft 212 which rotates a paper feed roller 210. Actuation of the knob 204 to move the printing head body 240 in the direction of the arrow 2a (Figure 13) causes a wire 221 connected to the printing head body 240 and extending around a roller 222 to move the paper feed member 215 in the direction of the arrow 2ℓ, during which time a printing operation is performed. When the paper feed member 215 engages a stop 235, a spring 238 connected to the wire 221 resiliently allows the printing head body 240 to continue moving further. At this time, the paper feed member 215 is in the two-dot-and-dash line position shown in Figure 12.

When the manual knob 204 is released of a manual push after the printing has been effected, the paper feed member 215 is caused to move back in the direction of the arrow 2m under the resiliency of the spring 237, whereupon the paper feed pawl 214 angularly shifts the ratchet wheel 213 by one tooth or pitch, angularly moving the paper feed shaft 212 through an angle in the direction of the arrow 2n. Thus, the paper feed roller 210 feeds the printing paper 205 on which printing has been effected a predetermined distance past the printing head 208. When it is desired to feed the printing paper manually irrespective of printing operation, the paper feed knob 209 is manually moved in the direction 2ℓ to allow the printing paper 205 to be fed along under the bias of the spring 237 in the manner described above. The foregoing paper feeding operation may be repeated for continuously feeding the printing paper 205. The printing paper 205 may be fed out a desired amount at a time by changing the number of teeth of the ratchet wheel 213, and the printing paper 205 may be fed in the opposite direction by changing the contour of the teeth of the ratchet wheel 213 and the shape of the spring 235 for preventing the ratchet wheel 213 from turning back.

Although certain preferred embodiments have been described in detail, it should be understood that many changes and modifications may be made therein without departing from the scope of the claimed invention.

CLAIMS

1. A dot printer having a printing head (8) arranged for reciprocal motion across a recording medium (5) which is to be printed, and feeding means (10) for feeding the recording medium (5) past the printing head (8), characterised in that the printing head (8) is arranged to be moved manually in at least one direction (A,C) across the recording medium (5) during the said reciprocal motion.

2. A dot printer as claimed in claim 1 characterised by spring means (28) in which energy is stored when the printing head (8) is manually moved in one direction (A) across the recording medium (5), and return means (41,42,57) for moving the printing head (8) in the opposite direction (C) back across the recording medium (5) by means of the energy stored in the spring means (28).

3. A dot printer as claimed in claim 2 characterised by first control means (48,49) for causing the printing head (8) to effect a printing operation as it is being moved in the said opposite direction (C).

4. A dot printer as claimed in claim 3 characterised in that the first control means (48,49) comprises means for effecting intermittent movement of the printing head (8) as it is being moved in the said opposite direction (C).

5. A dot printer as claimed in any preceding claim characterised by second control means (248,233,249) for causing the printing head (208) to effect a printing operation in sychronisation with the speed of travel of the printing head (208) as it is being manually moved across the recording medium (205).

6. A dot printer as claimed in claim 3, 4 or 5 characterised in that the first or second control means (48,49; 248,233,249) includes detector means (48;248) for generating timing pulses (480) in synchronisation with the movement of the printing head (8;208) as it is being moved manually across the recording medium (5;205) or being moved in the said opposite direction (C;2b) by energy stored in the spring means (28;228).

7. A dot printer as claimed in claim 6 characterised in that the detector means (248) is arranged to detect reciprocal motion of an escapement member (249), the escapement member (249) being arranged to reciprocate as a result of rotation of gears (24,26,27) one of which meshes with teeth (257) on a frame member (256) of the printer and is caused to rotate when the printing head (208) is moved across the recording medium (205).

8. A dot printer as claimed in claim 4 and 6 characterised in that the detector means (48) is arranged to detect reciprocal motion of an escapement member (49), the escapement member (49) having parts (41,42) which are engageable with teeth (57) on a frame member (56) of the printer and being arranged to reciprocate when the printing head (8) is moved across the recording medium (5).

9. A dot printer as claimed in any preceding claim characterised by means (46,51-54) for spacing the printing head (8) from the recording medium (5) during the said reciprocal motion of the printing head (8) when a printing operation is not to be performed, and for moving the printing head (8) into contact with, or closely adjacent to, the recording medium (5) during the said reciprocal motion of the printing head (8) when a printing operation is to be performed.

10. A dot printer as claimed in any preceding claim characterised in that the feeding means (10) is arranged to be driven by energy stored in a or the spring means (28) when the printing head (8) is manually moved across the recording medium (5).

11. A dot printer as claimed in claim 10 characterised in that the feeding means comprises at least one feeding roller (10) which is driven by a feed member (15), the feed member (15) being urged towards a predetermined position by further spring means (37), which are weaker than the first-mentioned spring means (28), and being arranged to be moved against the action of the said further spring means (37) when the printing head (8) is manually moved in one direction (A) across the recording medium (5) to a further position in which it is releasably held, movement of the printing head (8) in the said opposite direction (C) releasing the feed member (15) and permitting the latter to move under the action of the further spring means (37) back to the said predetermined position, means (13) being provided for rotating the or each feeding roller (10) through a given angle when the feed member (15) has returned to the said predetermined position.

12. A dot printer as claimed in any preceding claim characterised in that manually operable means (9) are provided to effect operation of the feeding means (10).

13. An electronic calculator or other electronic instrument characterised by comprising a dot printer as claimed in any preceding claim, the dot printer being arranged to print an indication displayed by a display device of the calculator or instrument.

14. A method of using a manually-operated dot printer having a printing head (8) and spring means (28), comprising the steps of: manually moving the printing head (8) in one direction (A) to store energy in the spring means (28); and effecting a printing operation with dots produced by the printing head (8) while the latter is being moved by the stored energy in the opposite direction (C).

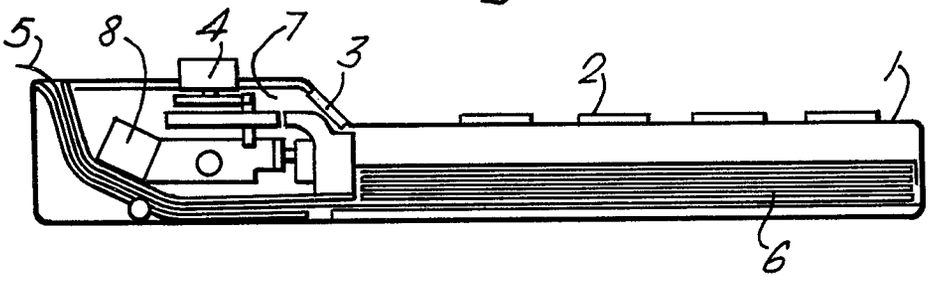
15. A manually-operated dot printer having a printing head (8) comprising: spring means (28) for storing energy when the printing head (8) is manually moved in one direction (A); means for allowing the printing head (8) to move in the opposite direction (C) with the energy stored in the said spring means (28); means (10) for feeding printing paper (5) manually or with energy stored in the said spring means (28); and means for effecting a printing operation with dots produced by the printing head (8) while the latter is being moved in the said opposite direction (C).

16. A method of using a manually-operated dot printer having a printing head (108), comprising the steps of: manually moving the printing head (108) in one direction (1a); and simultaneously effecting a printing operation with dots produced by the printing head (108).

17. A method of using a manually-operated dot printer having a printing head (108), comprising the steps of: manually moving the printing head (108) in one direction (1a); producing a signal (480) in synchronisation with the speed of travel of the printing head (108); and effecting a printing operation based on the said signal (480) with dots produced by the printing head (108).

18. A manually-operated dot printer comprising: a printing head (208); means (204) for manually moving said printing head (208) in one direction (2a); means for storing manual energy in a spring (228) while said printing head (208) is moving in said one direction (2a); means (248,233,249) for generating a timing signal (480) in synchronisation with the speed of travel of the said printing head (208) in said one direction (2a); means including said printing head (208) for effecting a printing operation with dots based on said timing signal (480) from said timing signal generating means (248,233,249); and means (210) for feeding printing paper (205) with the energy stored in said spring (228).

Fig. 1a.



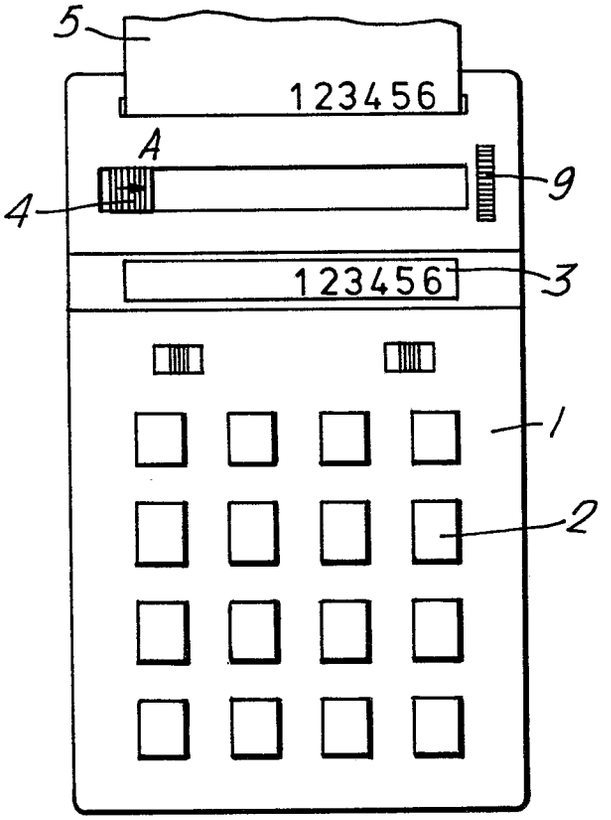


Fig. 1b.

0052011

Fig.2.

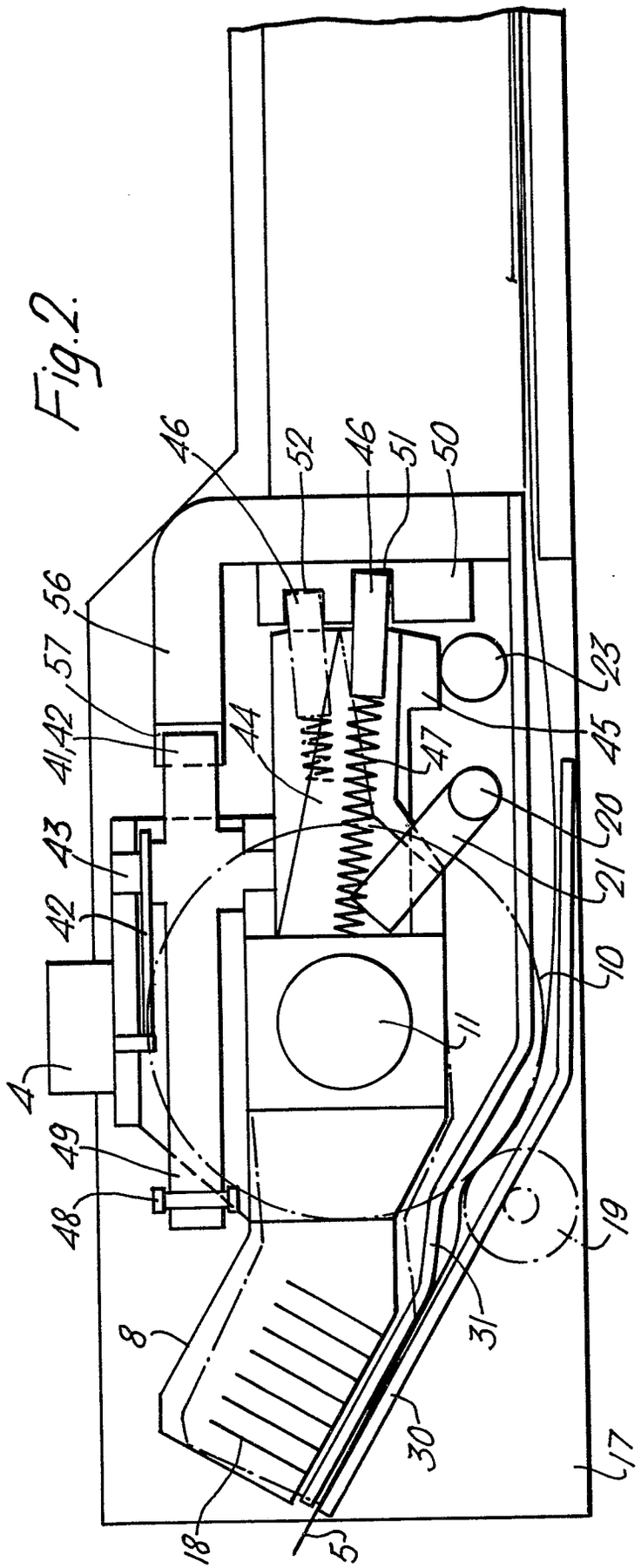
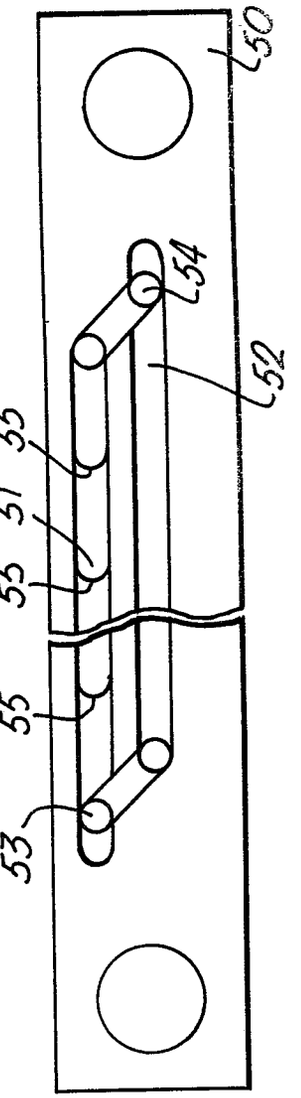


Fig.5.



0052011

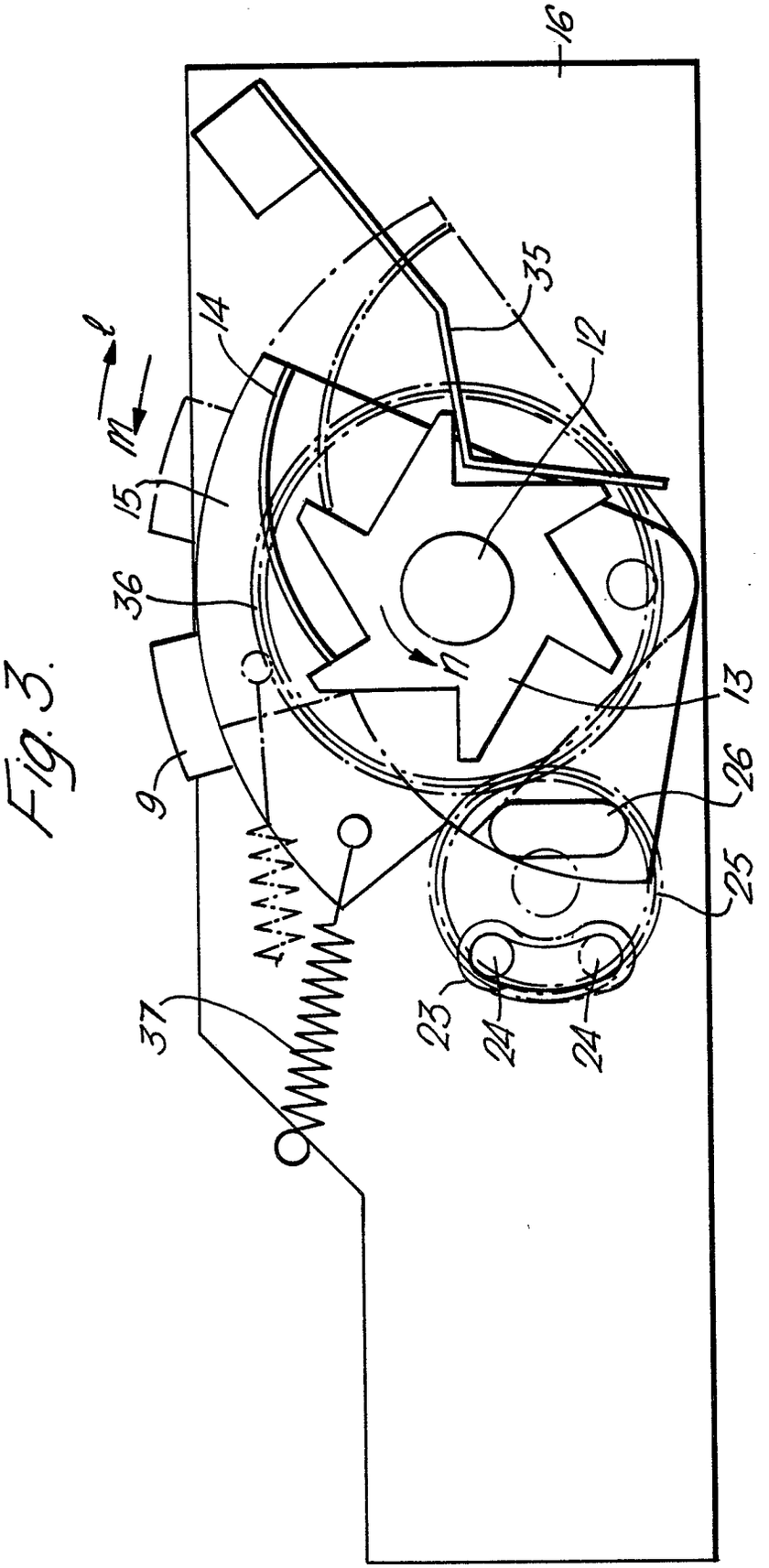
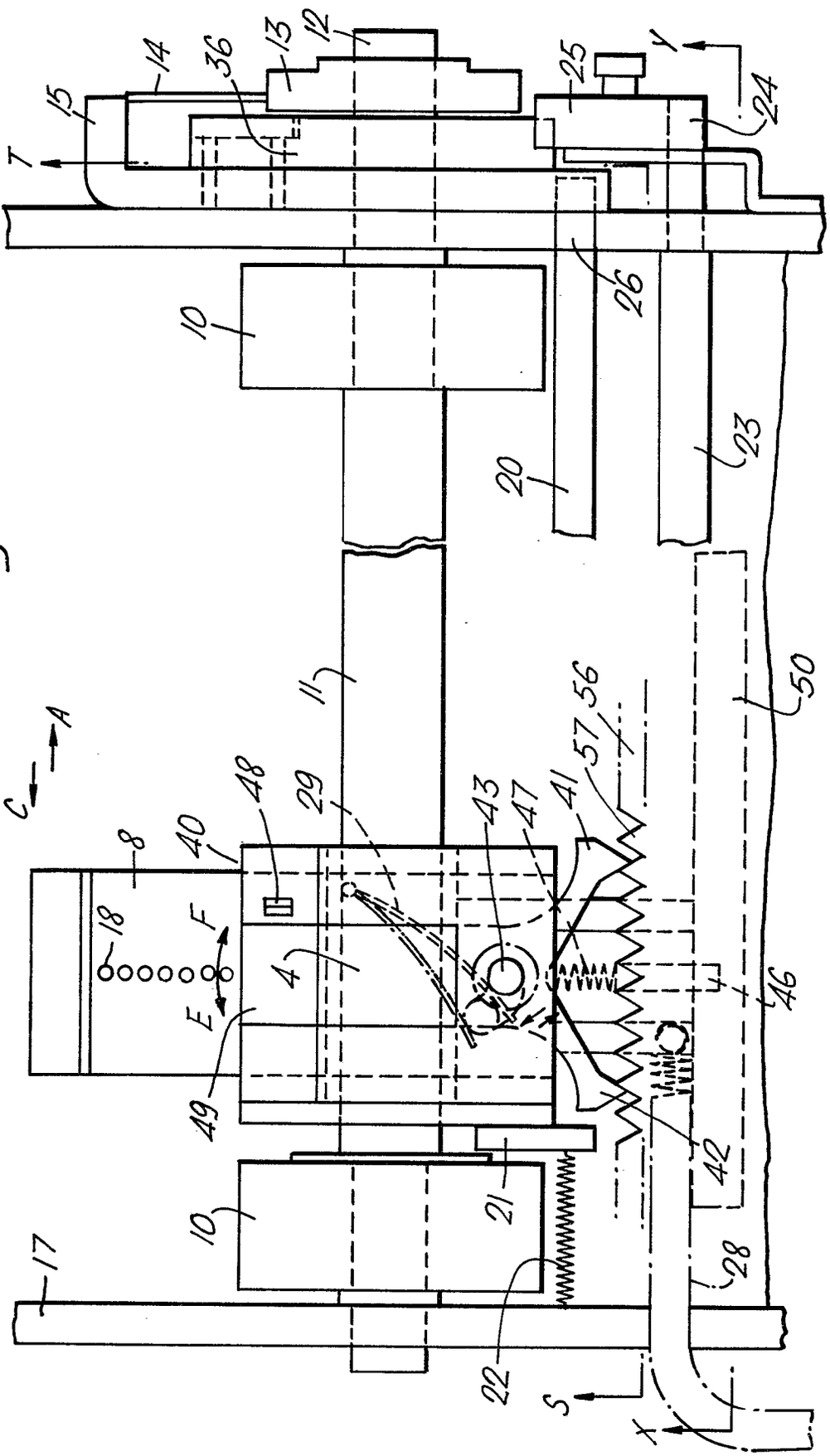


Fig. 3.

Fig. 4.


14
36
13
12
25
Y
15
24
7
26
10
20
23
11
50
A
C
48
29
43
47
41
57
56
8
40
18
F
4
E
49
46
42
21
10
17
28
22
S
X

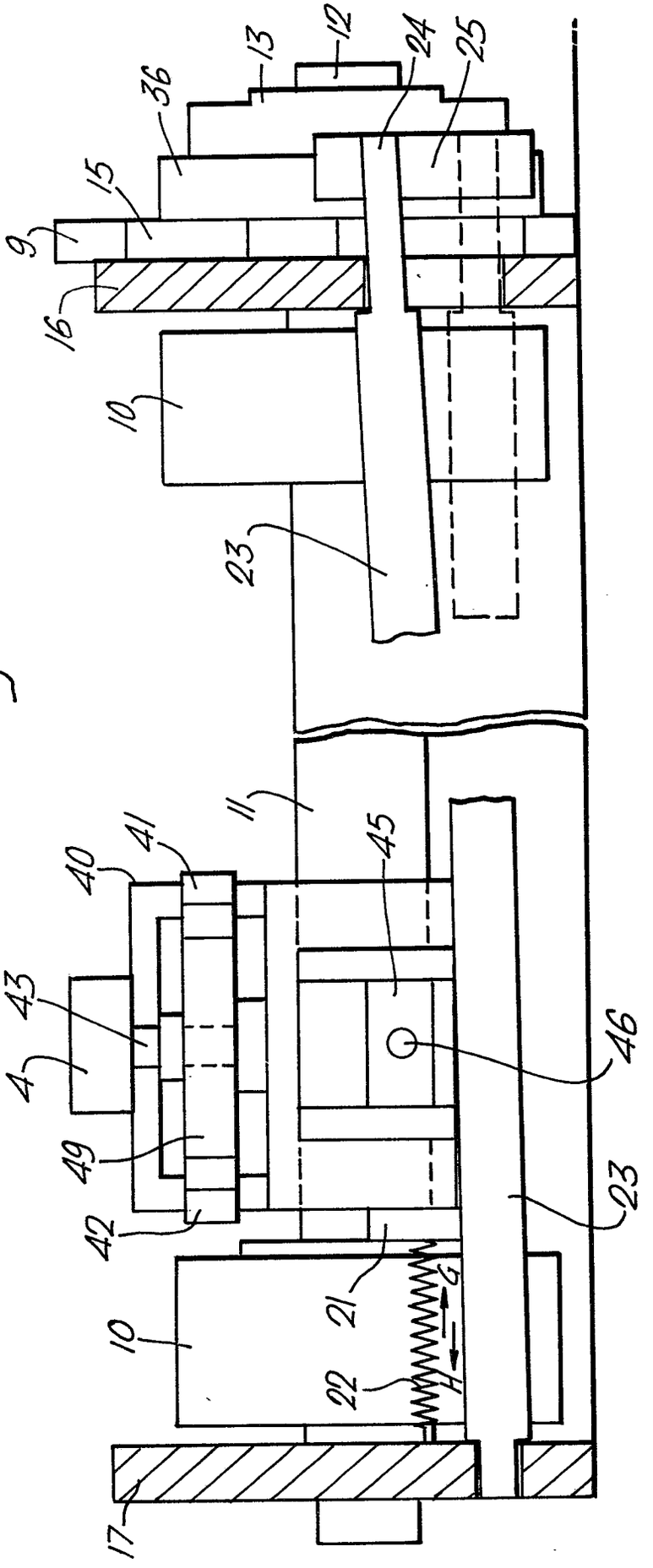


Fig. 6.

0052011

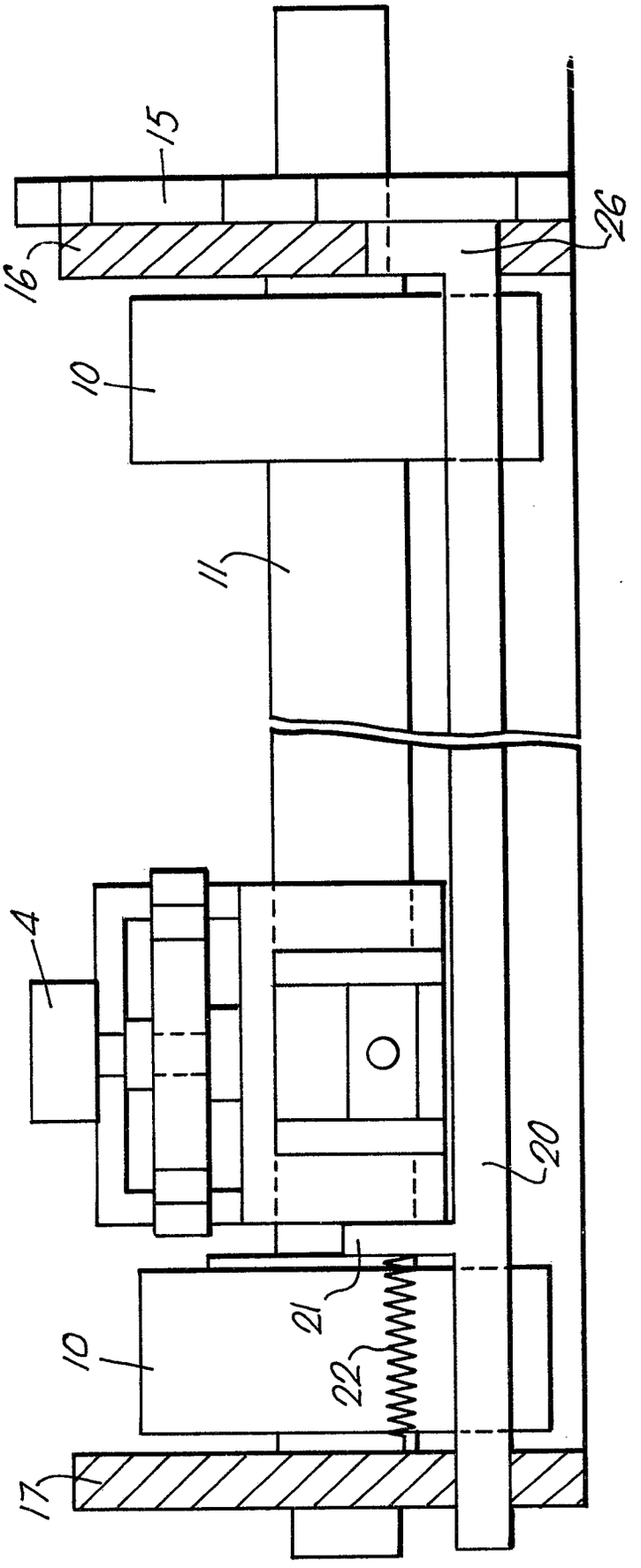


Fig. 7.

0052011

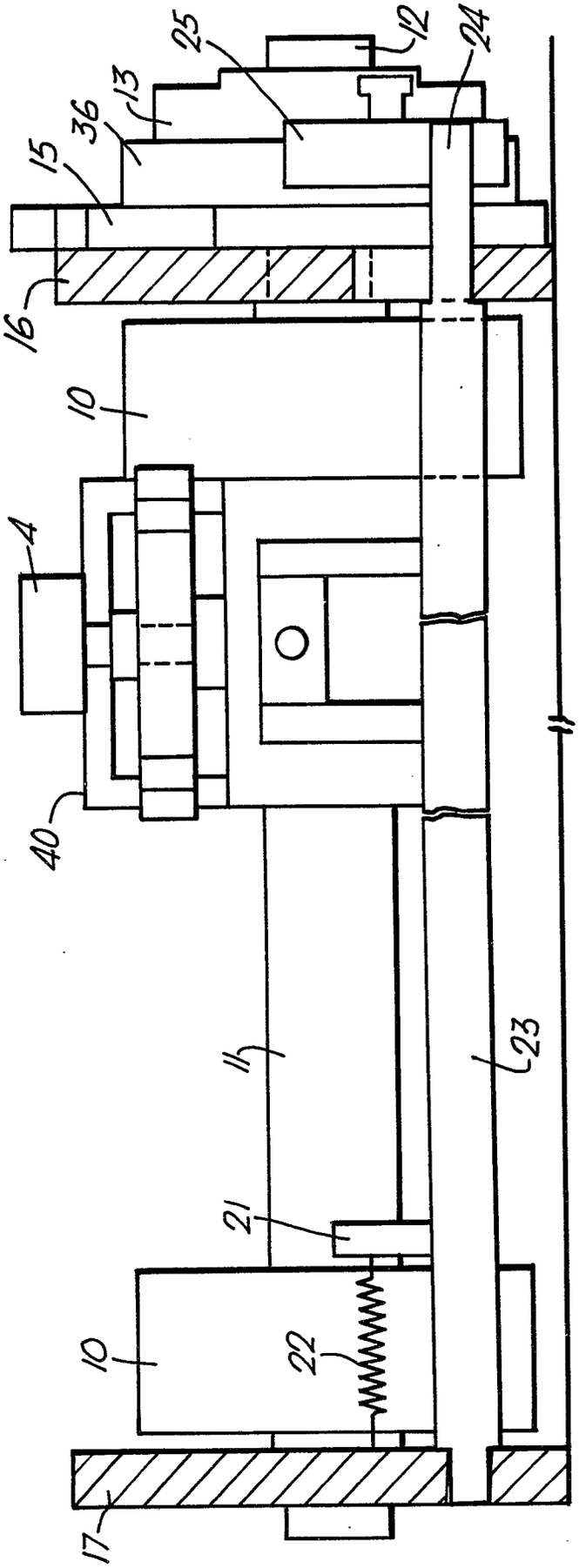


Fig. 8.

0052011

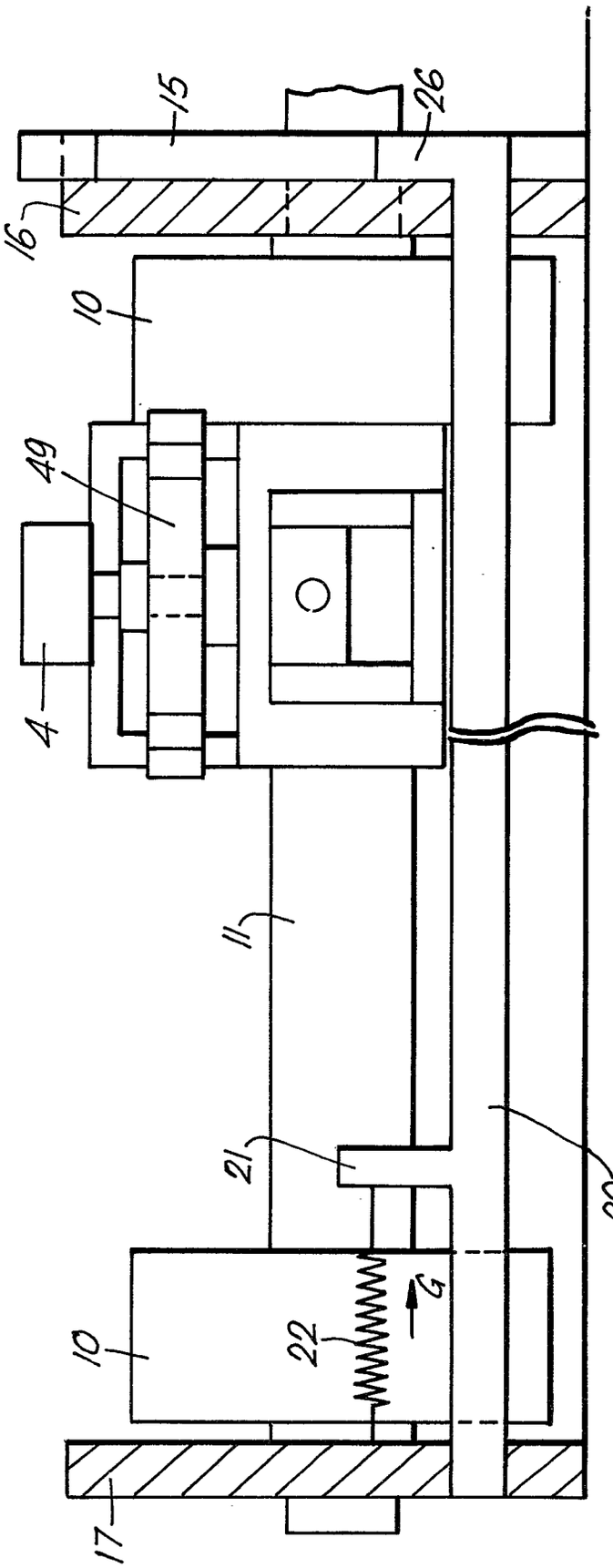


Fig. 9.

Fig. 10c.

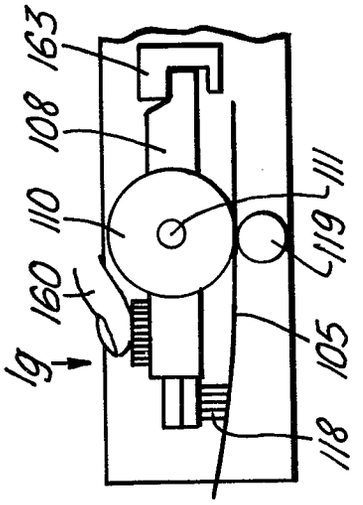


Fig. 10a.

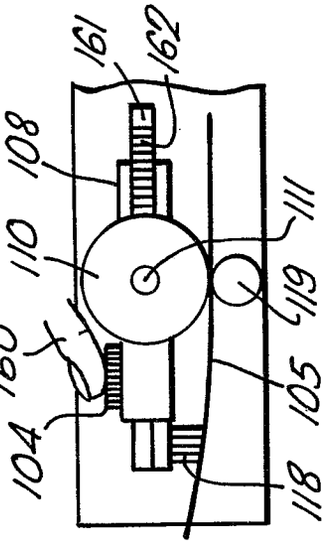


Fig. 10b.

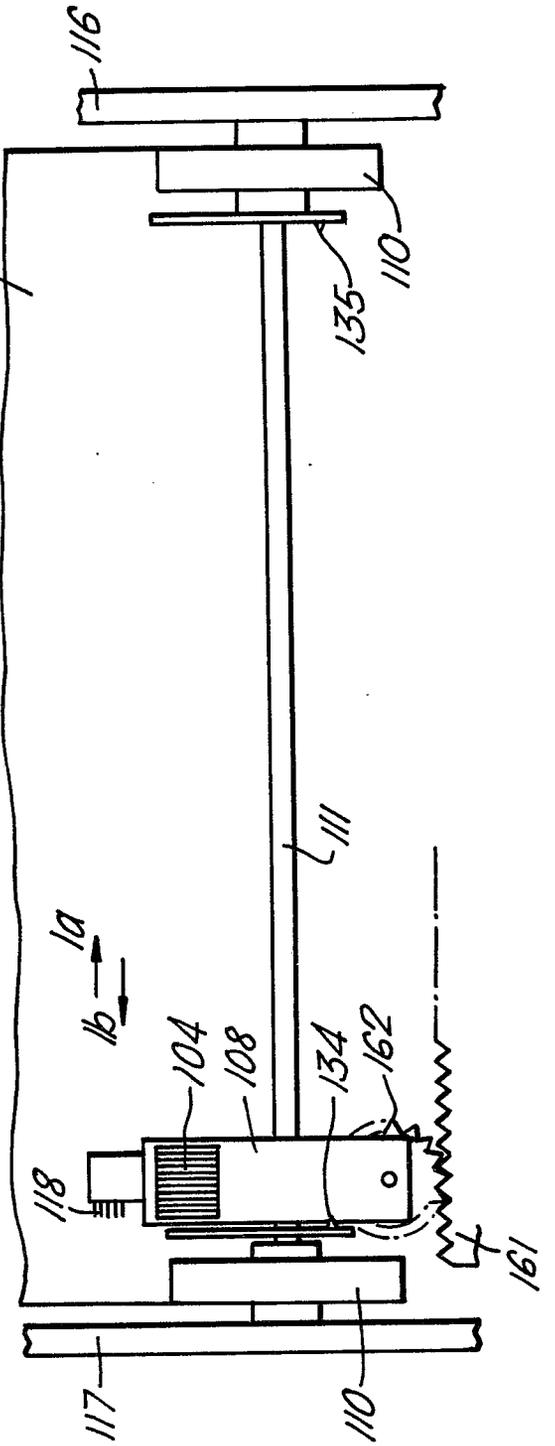
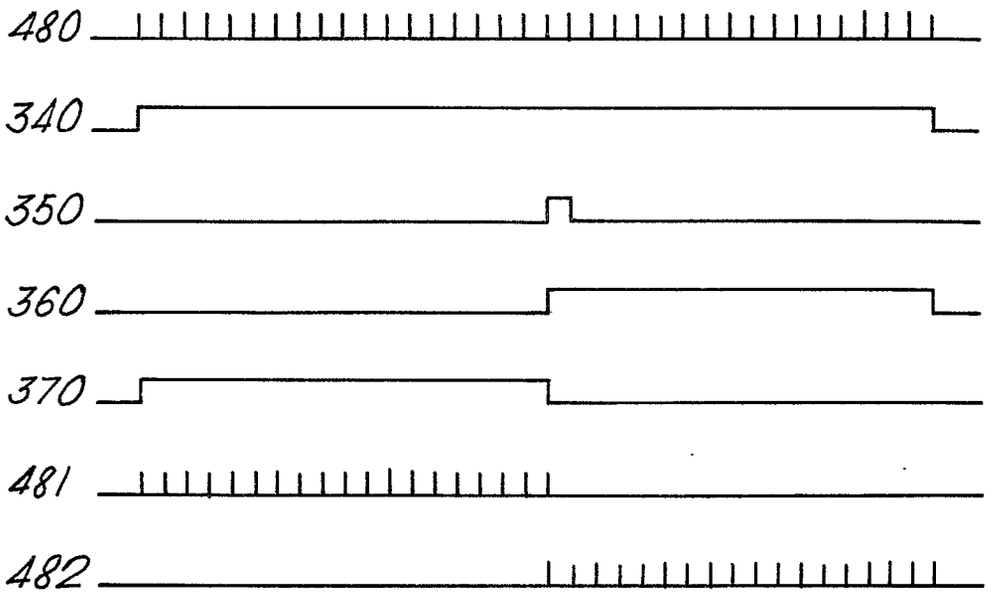


Fig. 10d.



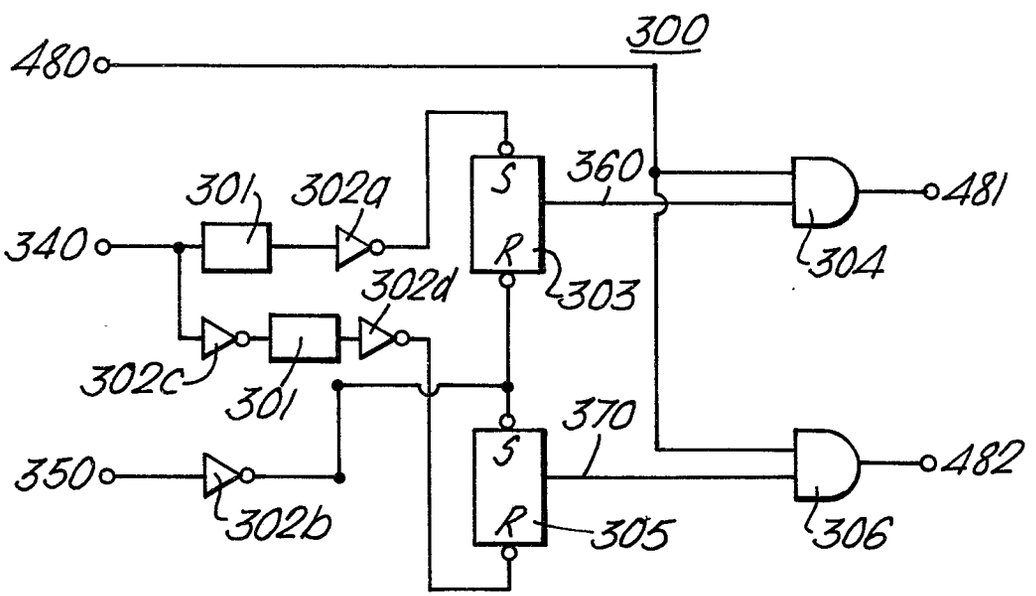
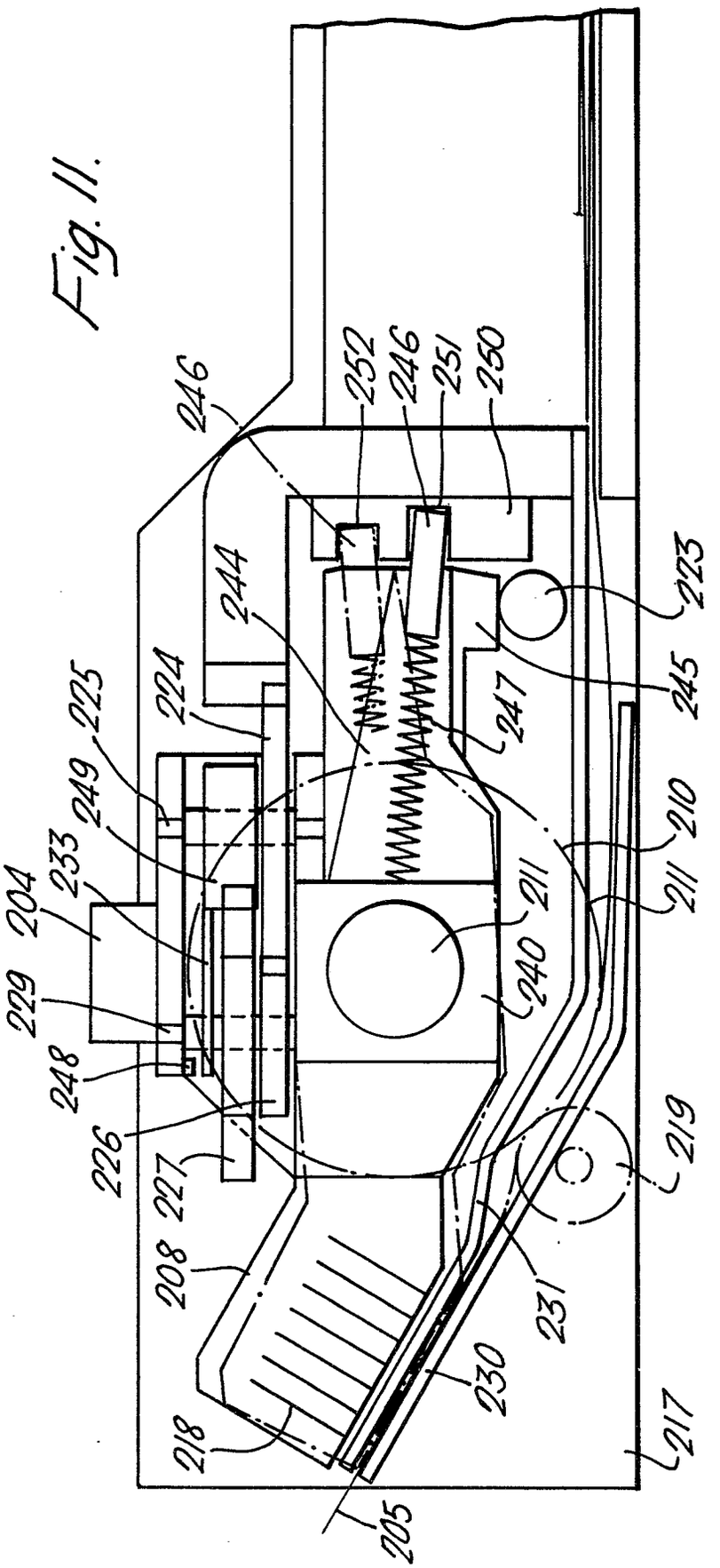


Fig. 10e.

Fig. 11.


246
252
246
251
250
244
223
224
225
247
245
249
233
204
210
211
211
229
240
248
226
227
219
208
231
230
218
217
205

0052011

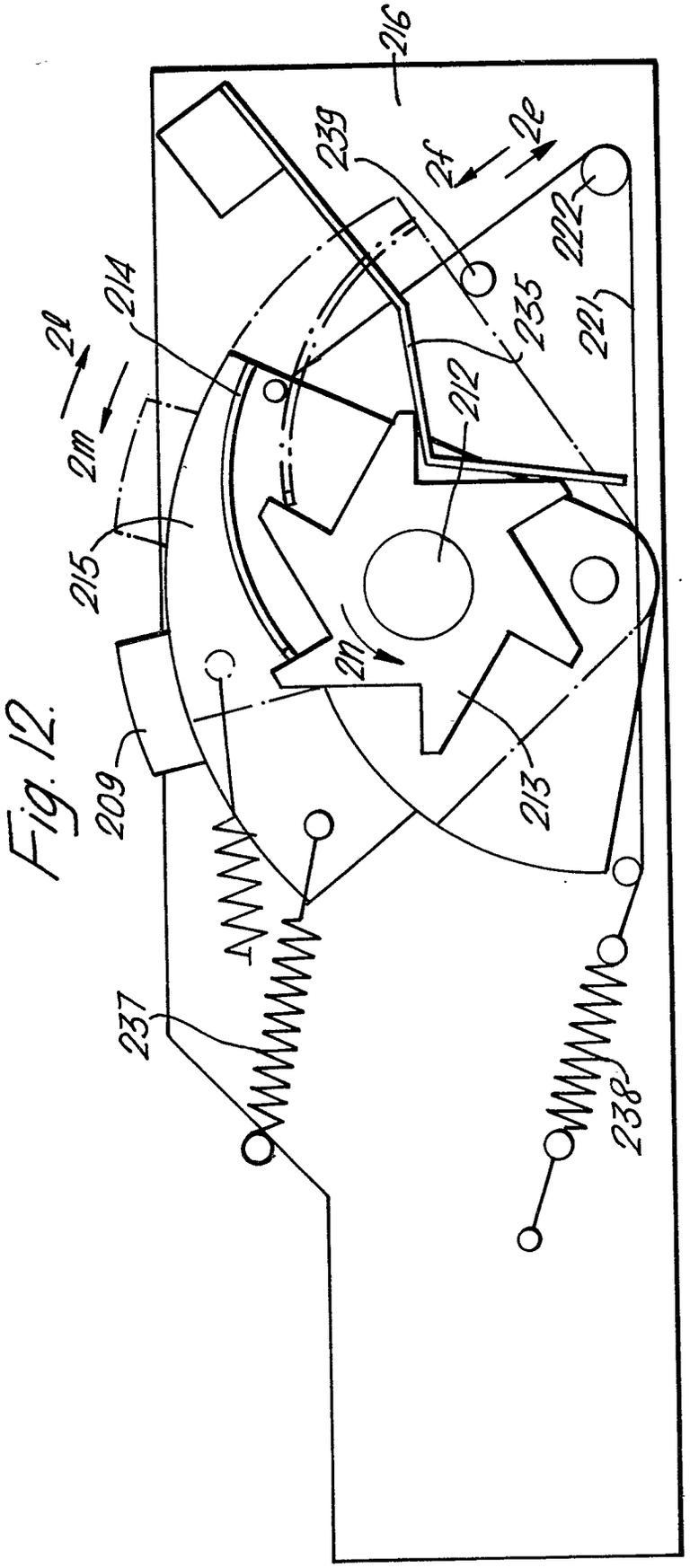


Fig. 12.

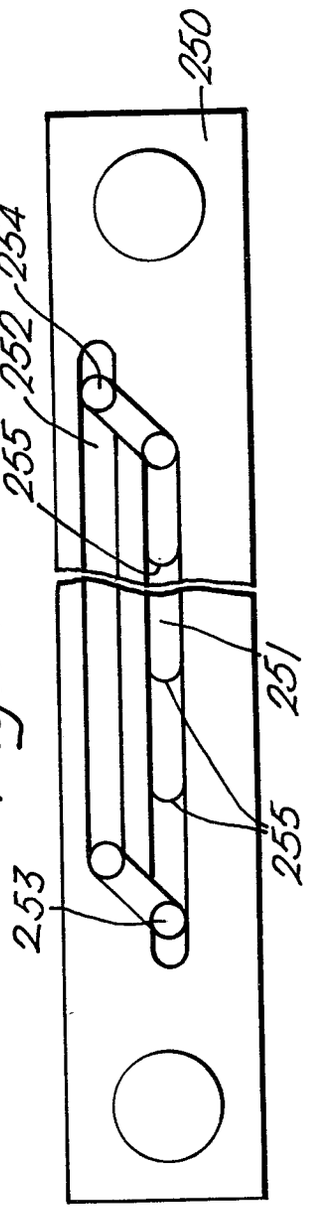
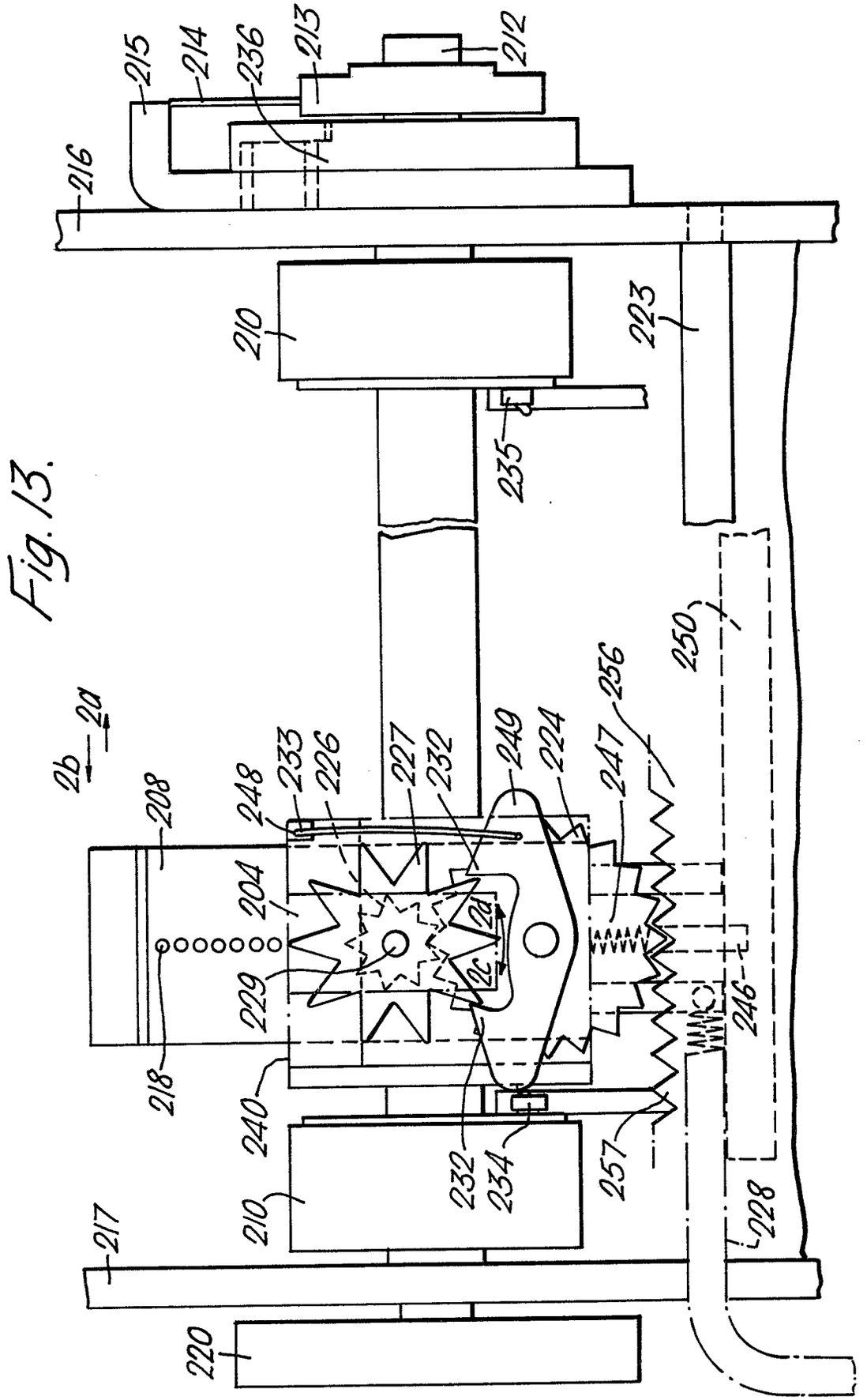


Fig. 14.

Fig. 13.


215
214
236
213
212
216
210
223
235
250
256
26
24
208
248
233
226
227
232
249
224
247
204
229
218
240
246
257
232
234
210
228
217
220

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0052011
EP 81 30 5329

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	FR - A - 2 344 896 (R. BOSCH) * page 2, line 24 to page 5, line 38; page 9, line 17 to page 11, line 1; figures 1-7 *	1,12, 13,16
Y	& GB - A - 1 532 114	9
A	US - A - 3 767 020 (T.H. ROWE) * column 5, lines 16-32; figure 2 *	3
A	US - A - 3 656 169 (T. KASHIO) * column 4, lines 1-44; figures 1-2 *	5,6, 17
Y	FR - A - 2 152 152 (ING. L. OLIVETTI) * page 3, line 24 to page 5, line 6; figures 7,8 * & GB - A - 1 398 400	9
A	US - A - 3 739 898 (C.E. ROONEY) * column 1, lines 45-58; column 3, line 5 to column 4, line 65; figures 1-4 *	2

./.

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

B 41 J 3/36
3/12
19/36

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 41 J

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	03-02-1982	VAN DEN MEERSCHAUT

EPO Form 1503.1 06.78

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	
A	DE - A - 592 419 (TRIUMPH-WERKE) * the whole document * --	4	
A	FR - A - 2 446 722 (C.I.I. HONEYWELL BULL) * page 2, lines 15-25; figures 1-2 * ----		TECHNICAL FIELDS SEARCHED (Int. Cl.³)