

March 15, 1960

G. DIRKS

2,928,896

HIGH SPEED PRINTING DEVICES

Filed Aug. 24, 1956

20 Sheets-Sheet 1

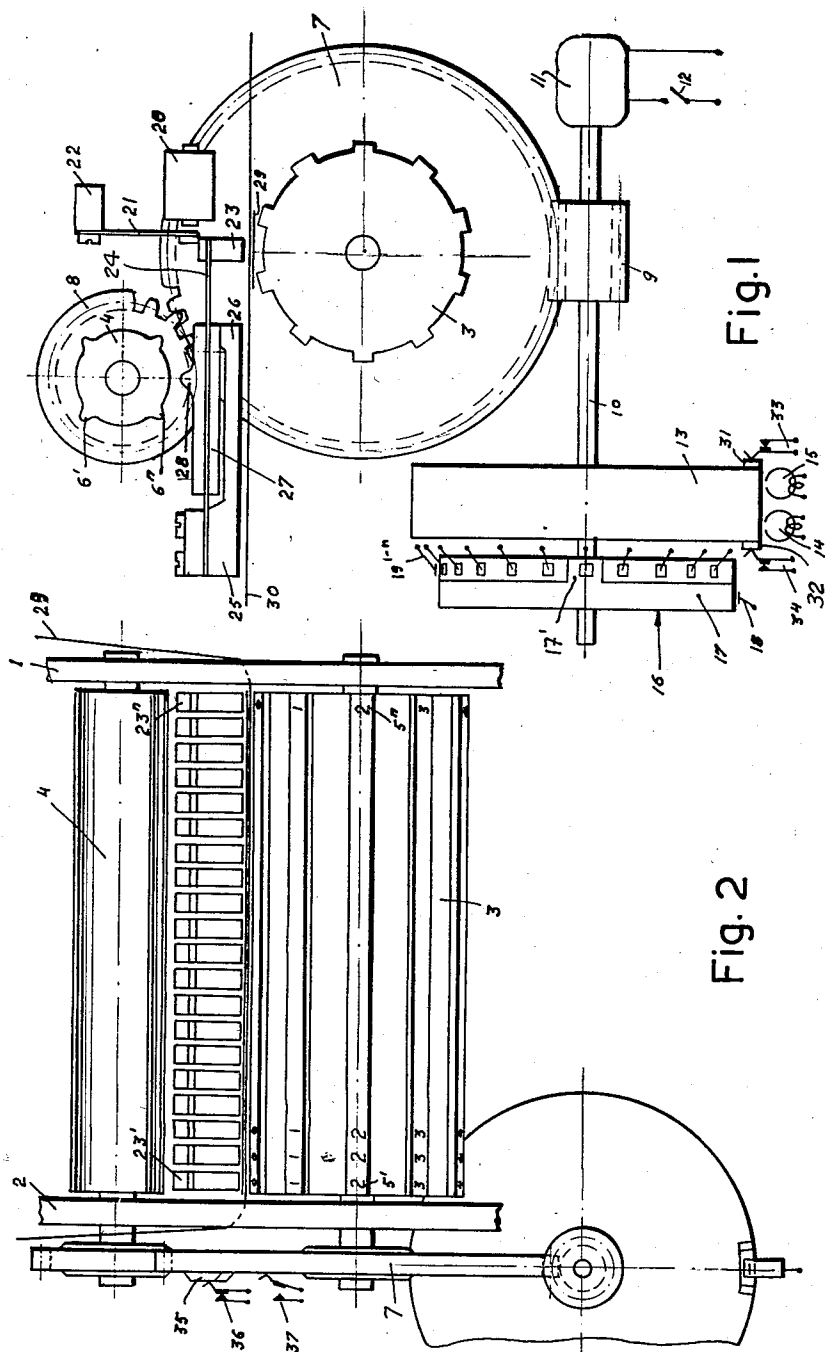


Fig. 1

Fig. 2

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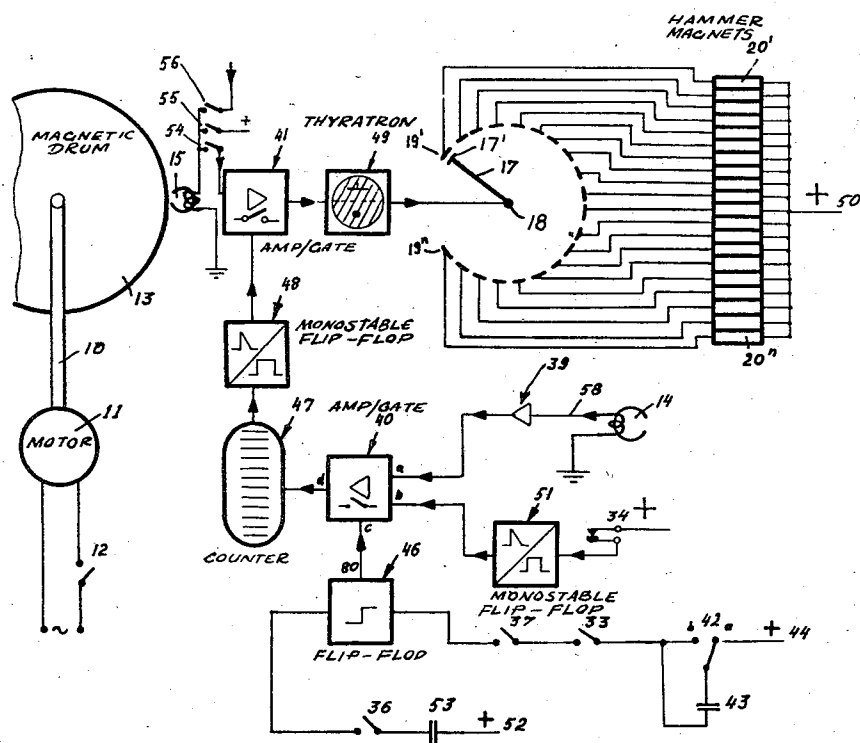
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Fig. 3



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Fig. 4

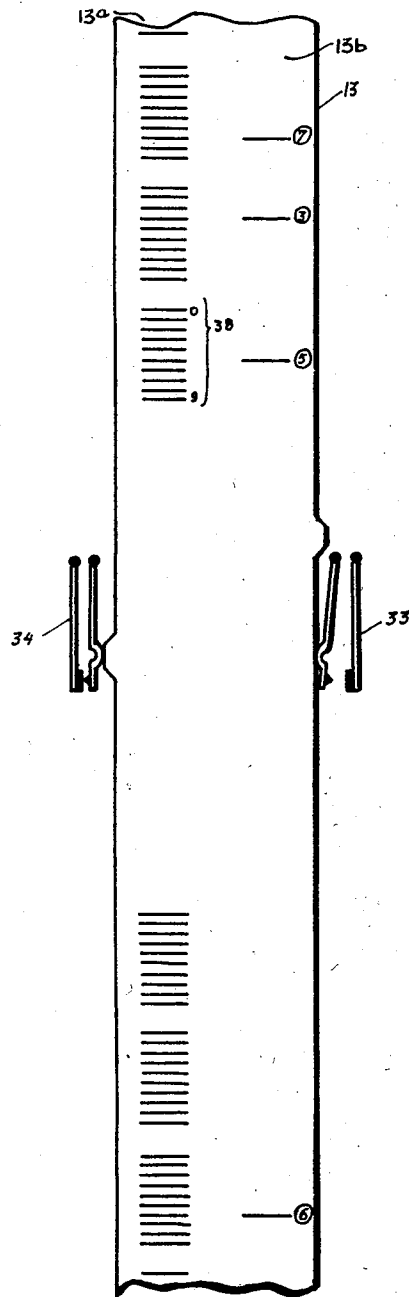
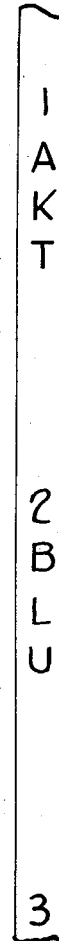


Fig. 20



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Fig. 5

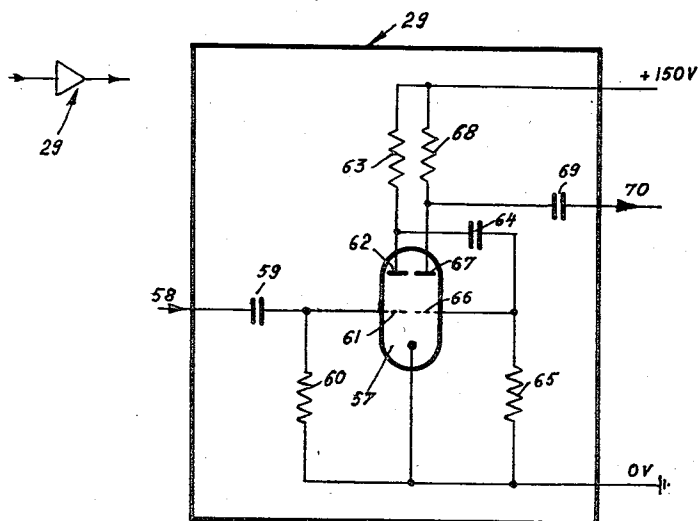
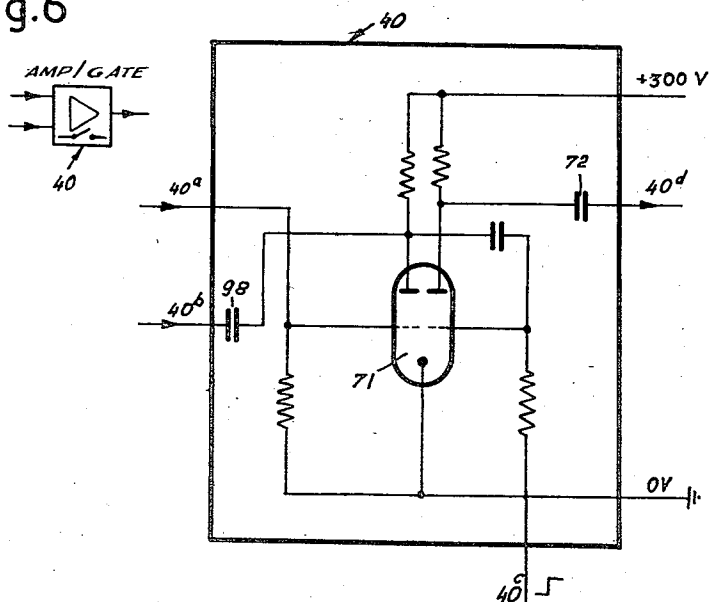


Fig. 6



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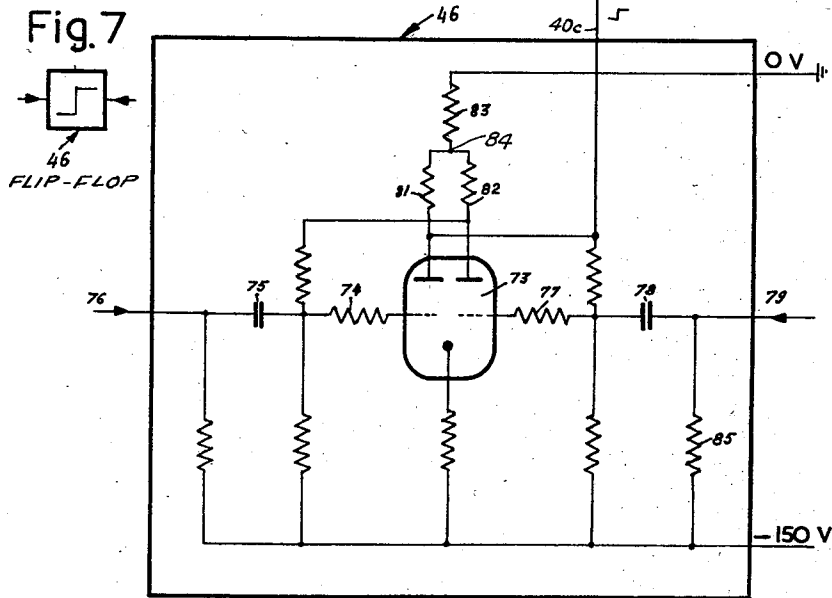
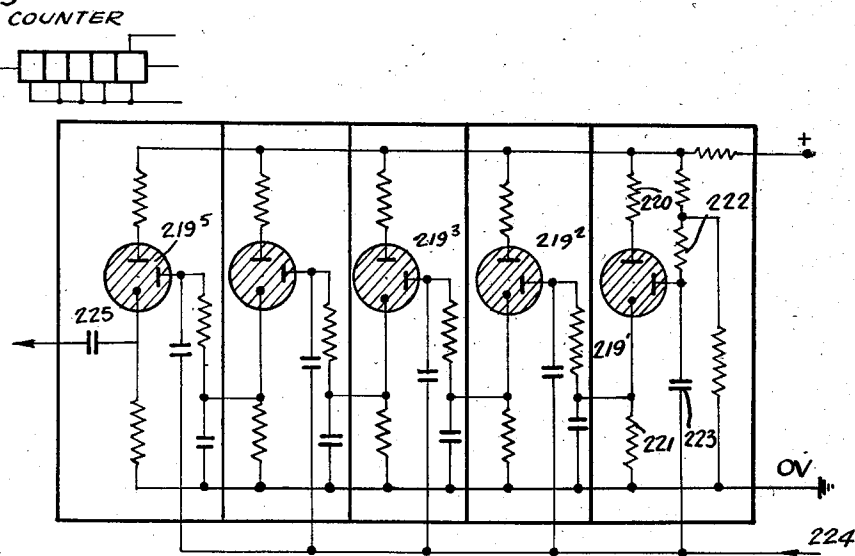


Fig. 24



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Fig. 9

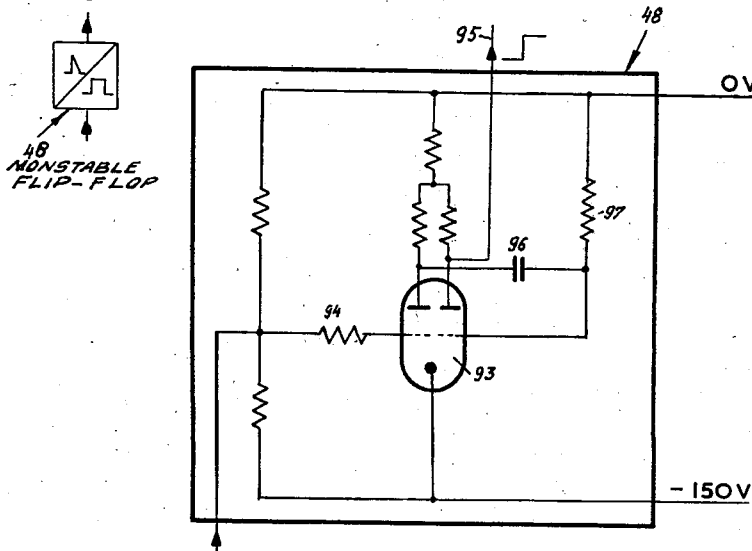
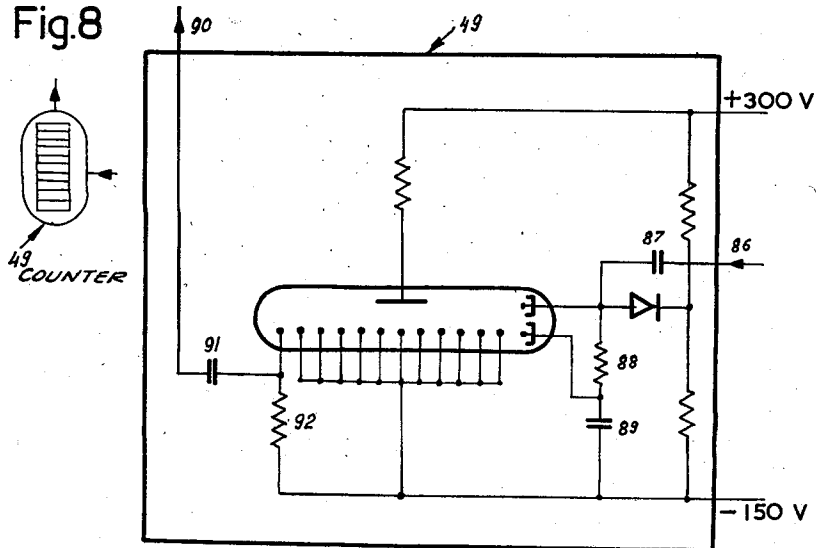


Fig. 8



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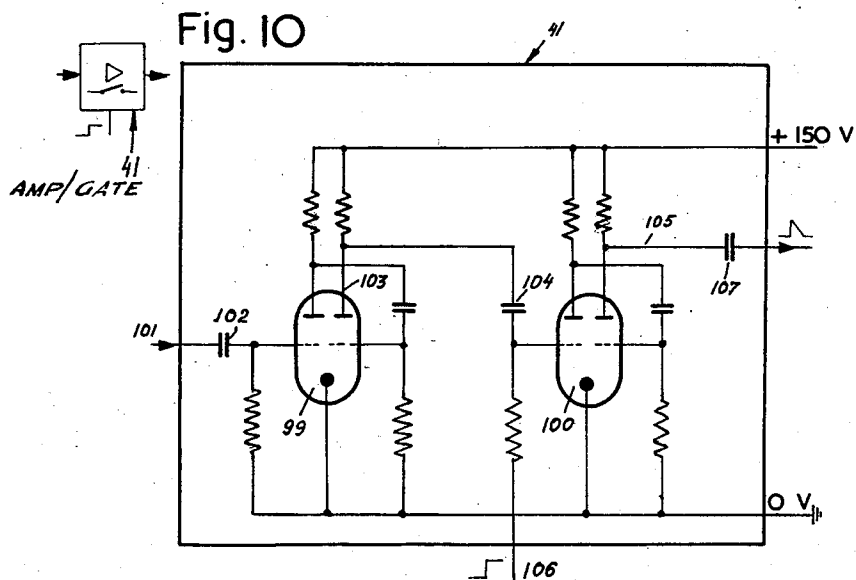
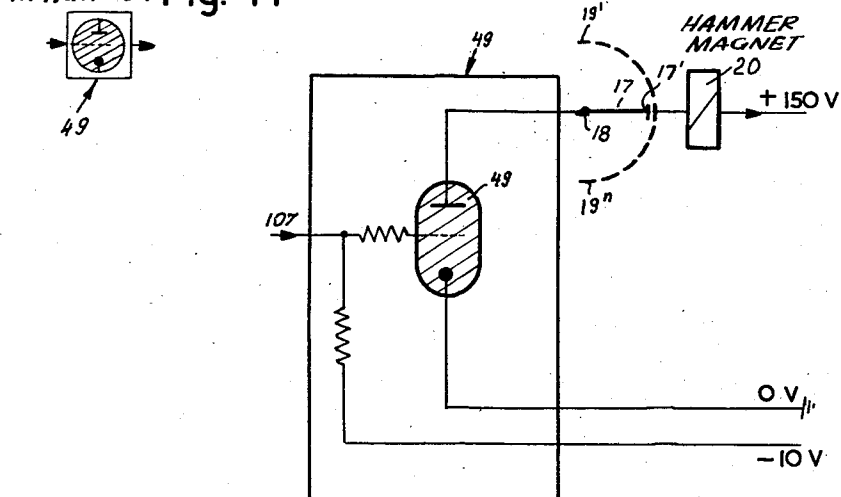


Fig. 11



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Fig.13

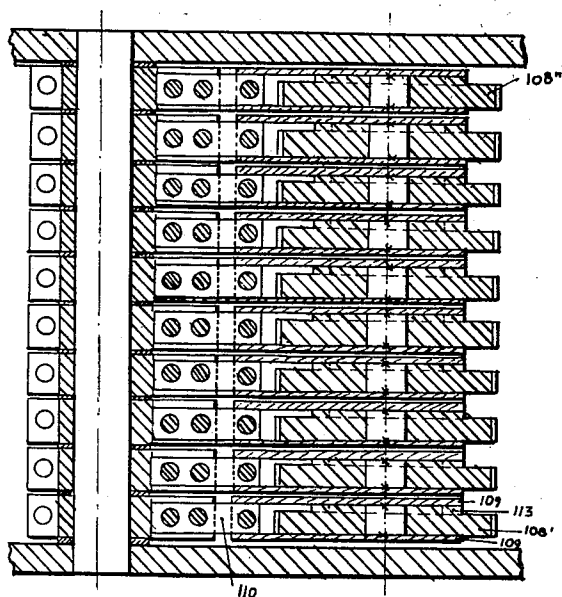
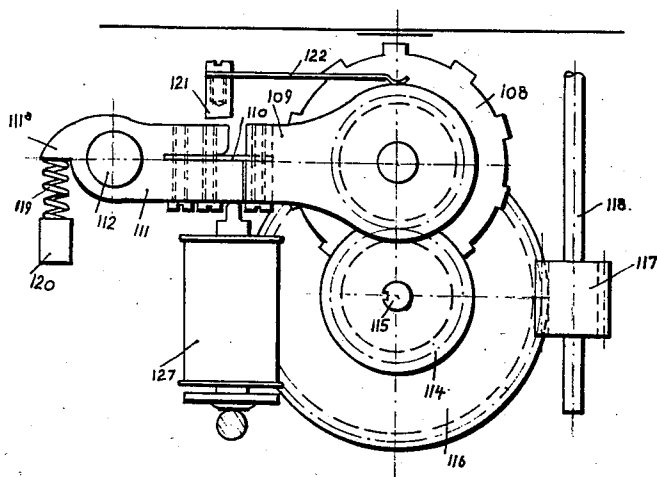


Fig.12



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Fig.14

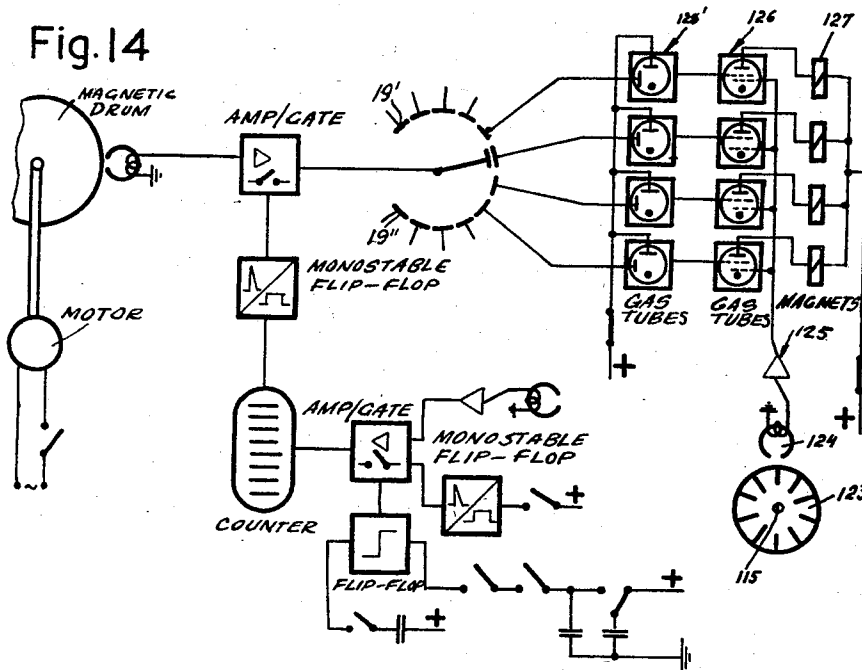
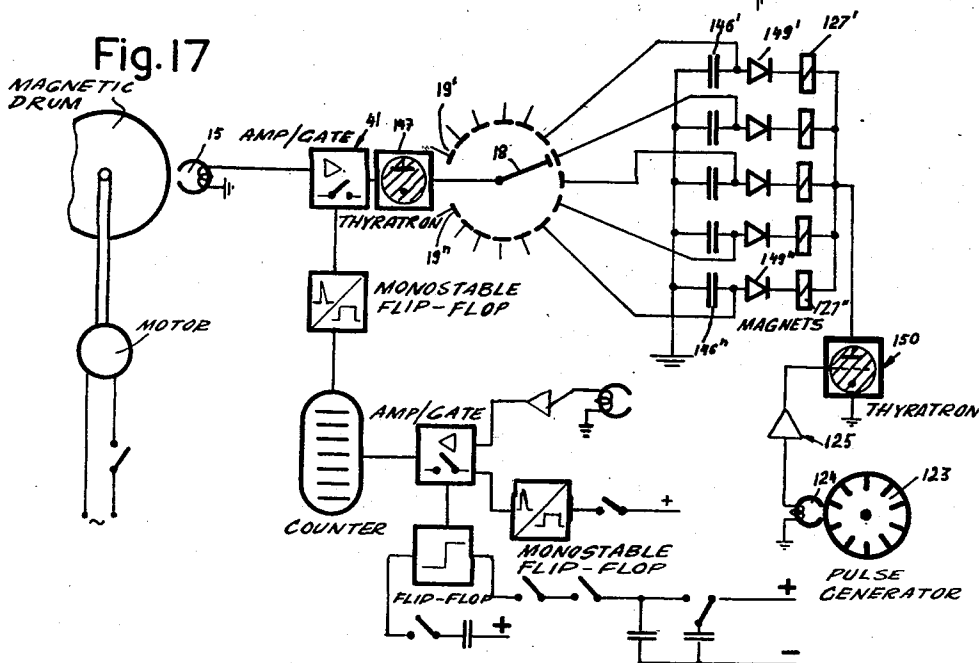


Fig.17



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Fig. 16

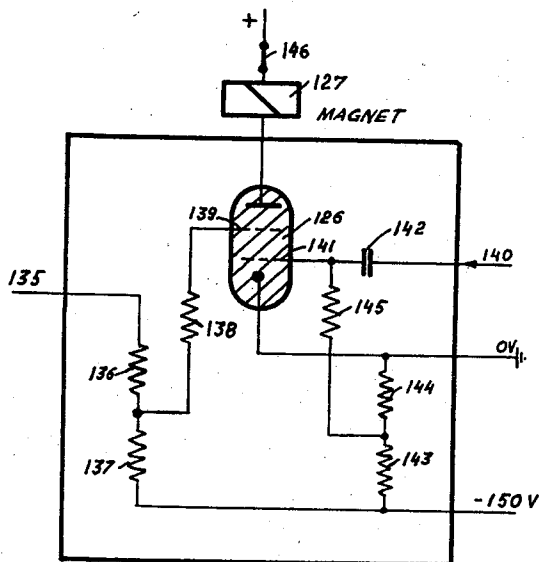
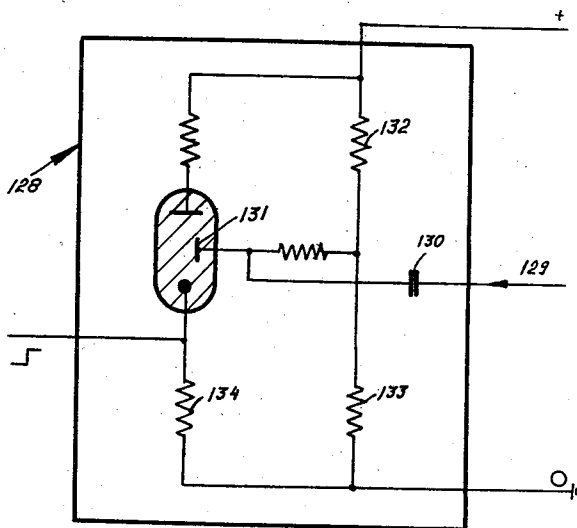
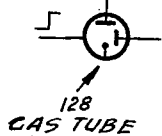


Fig. 15



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Fig. 17a

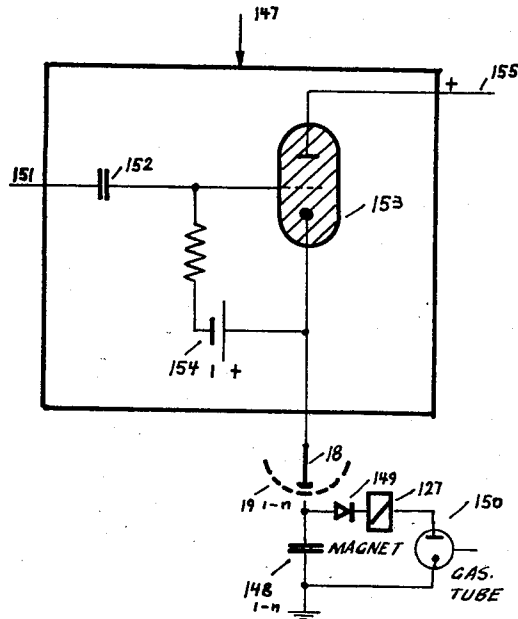
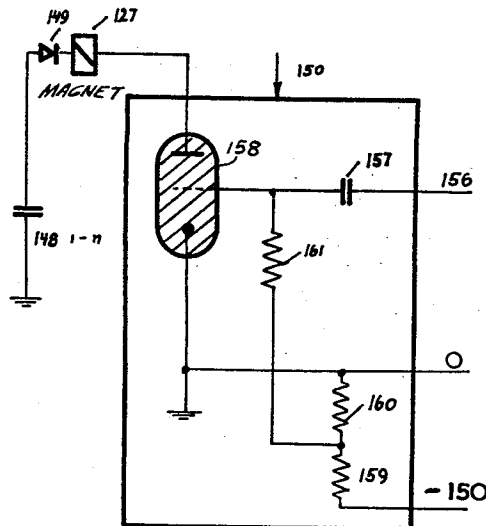


Fig. 18



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Fig. 19

	1	2	3	4
1	O	/	+	-
2	I	A	K	T
3	2	B	L	U
4	3	C	M	V
5	4	D	N	W
6	5	E	O	X
7	6	F	P	Y
8	7	G	Q	Z
9	8	H	R	.
10	9	I	S	;

	1	2	3	4	5	6	7
1	O	/	+	-	£	\$	DM
2	I	A	K	T	a	k	t
3	2	B	L	U	b	l	u
4	3	C	M	V	c	m	v
5	4	D	N	W	d	n	w
6	5	E	O	X	e	o	x
7	6	F	P	Y	f	p	y
8	7	G	Q	Z	g	q	z
9	8	H	R	.	h	r	!
10	9	I	S	;	i	s	?

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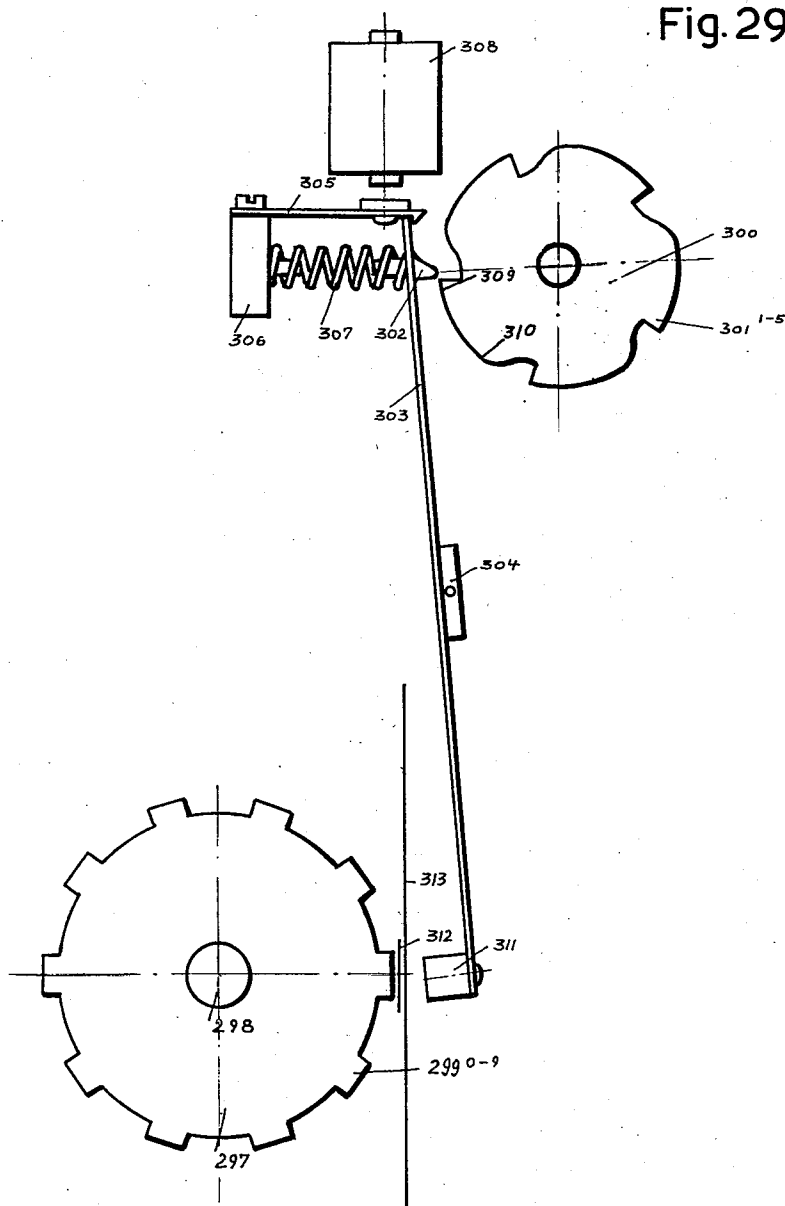
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Fig. 29



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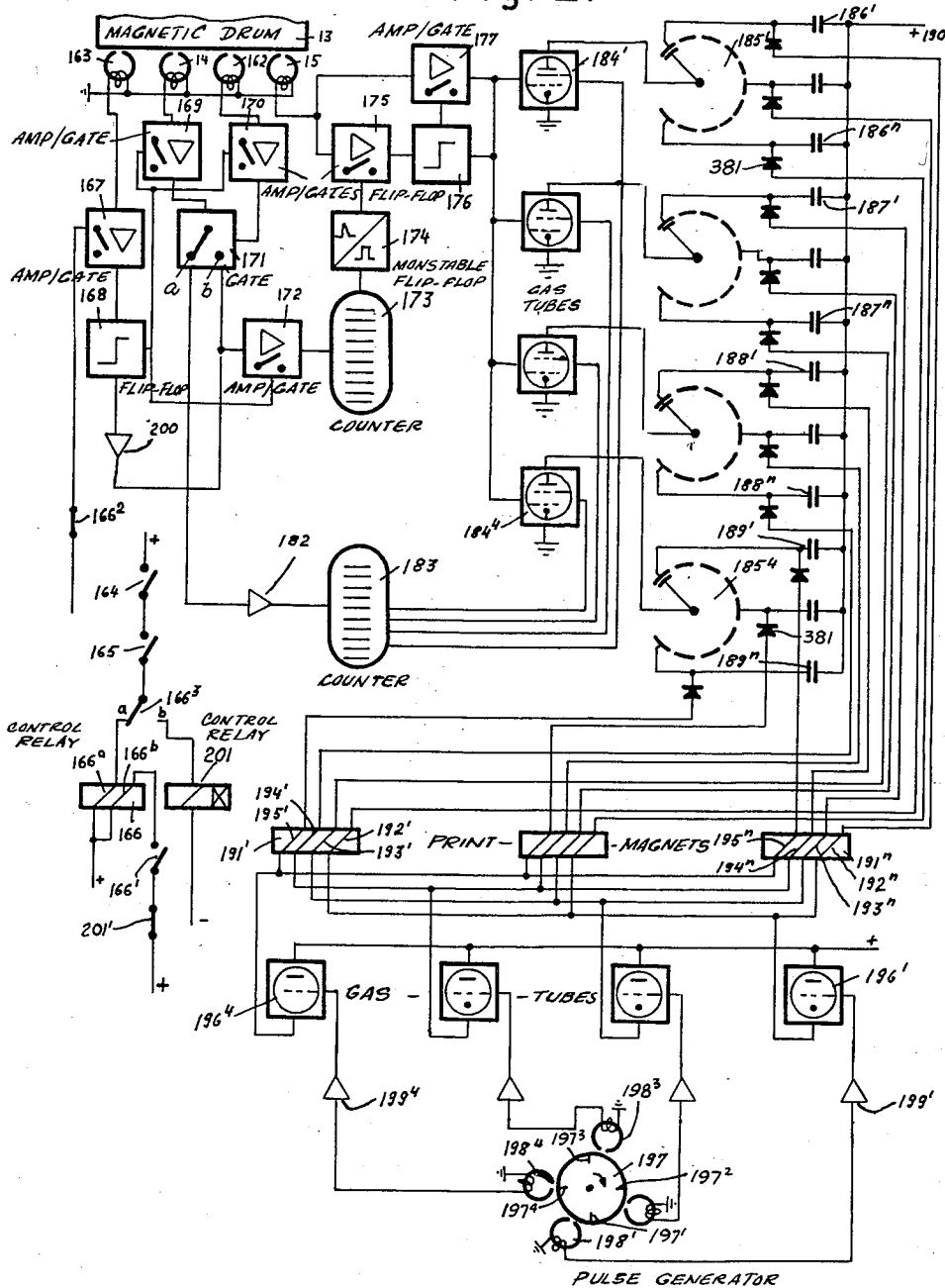
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Fig. 21



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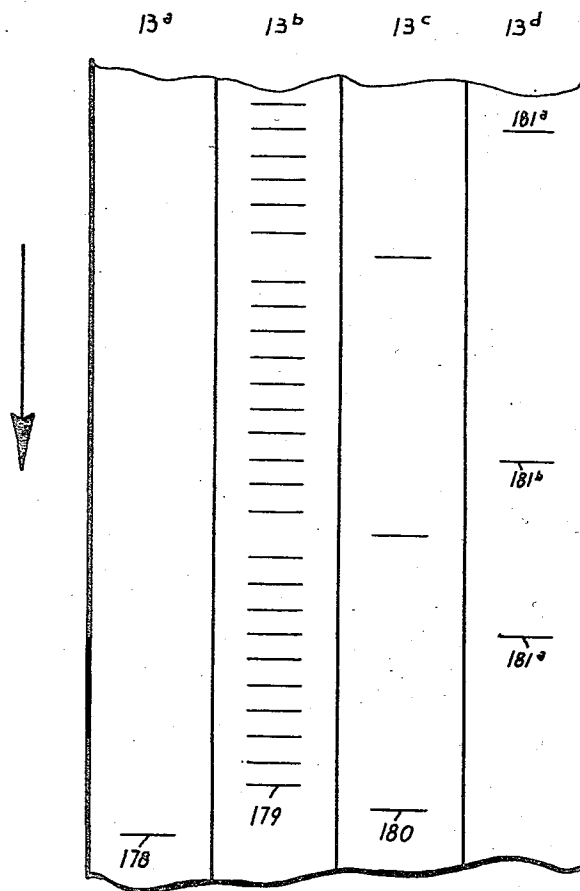
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Fig. 22



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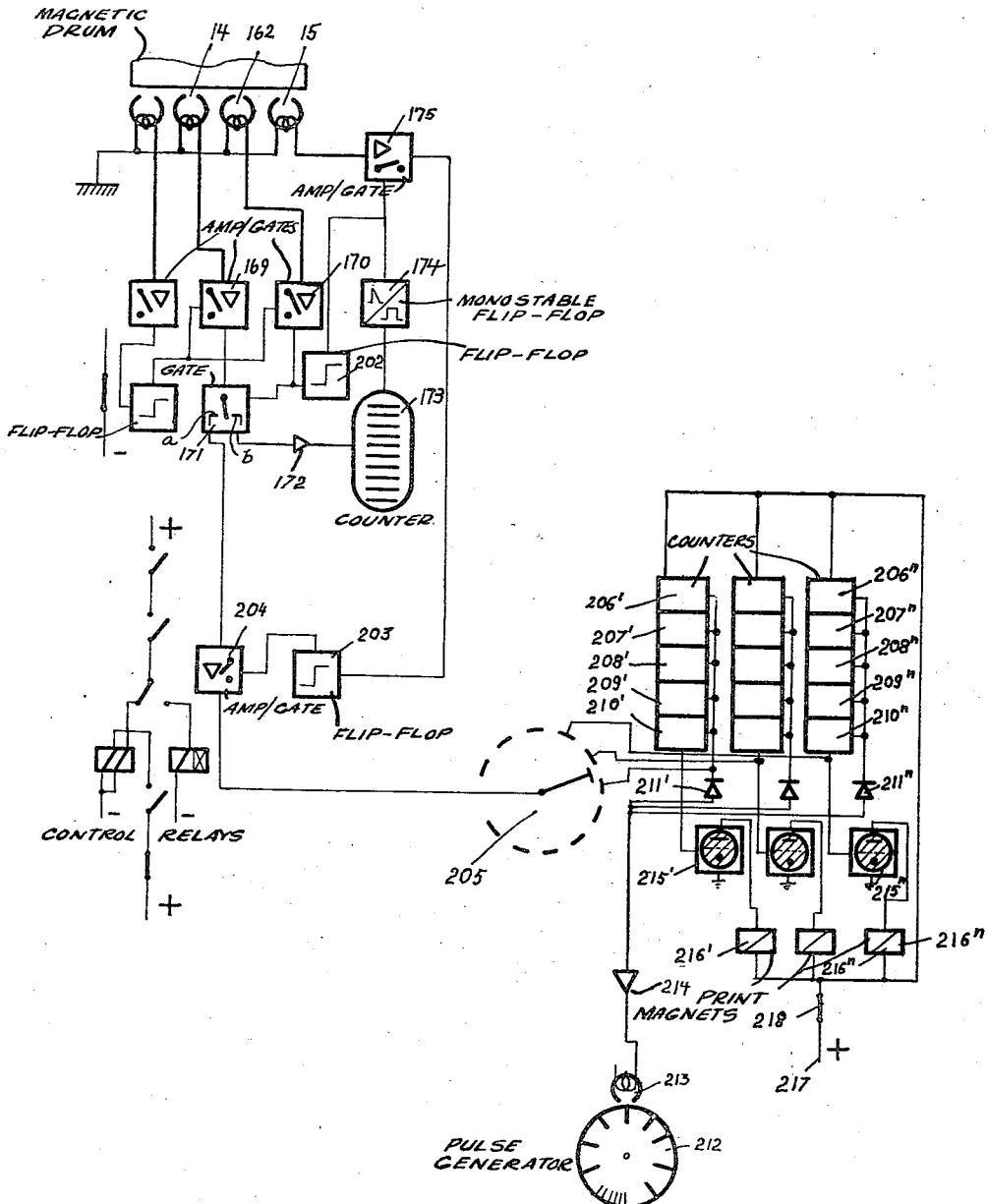
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Fig. 23



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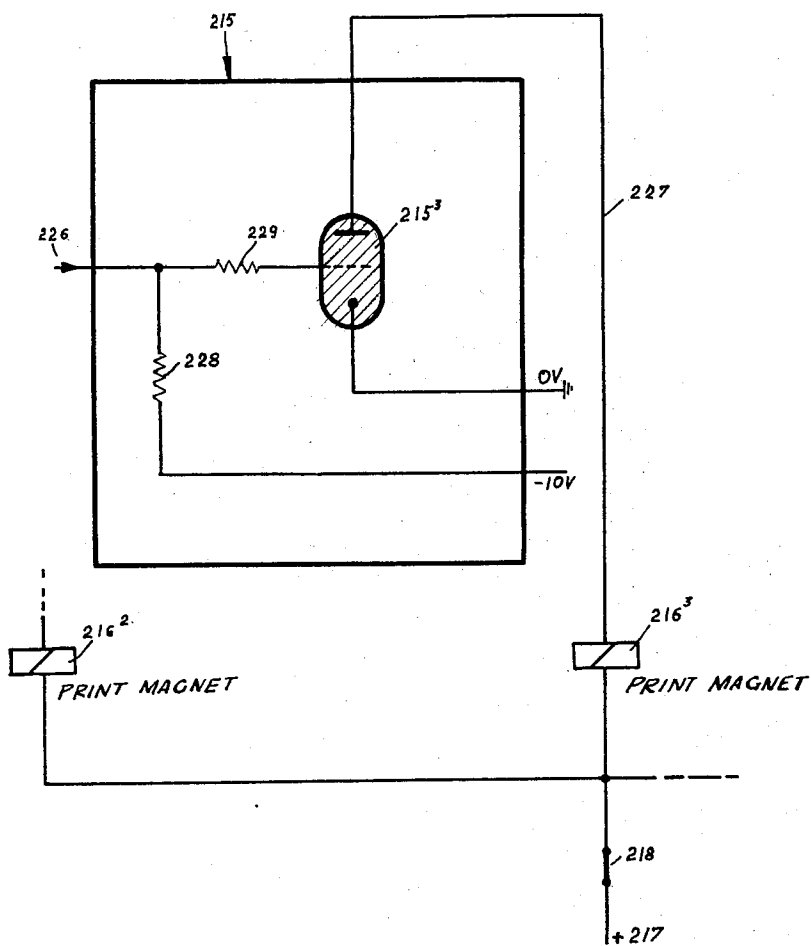
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Fig. 25



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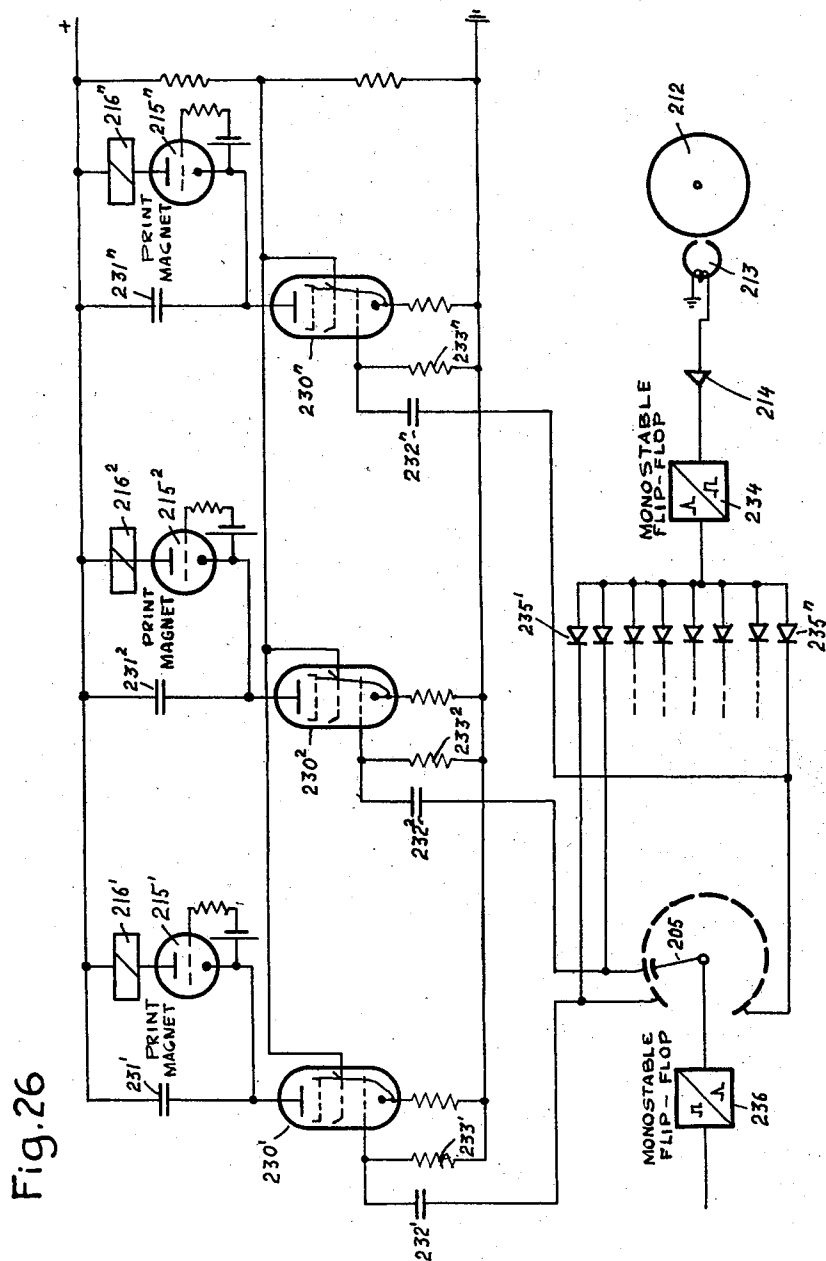
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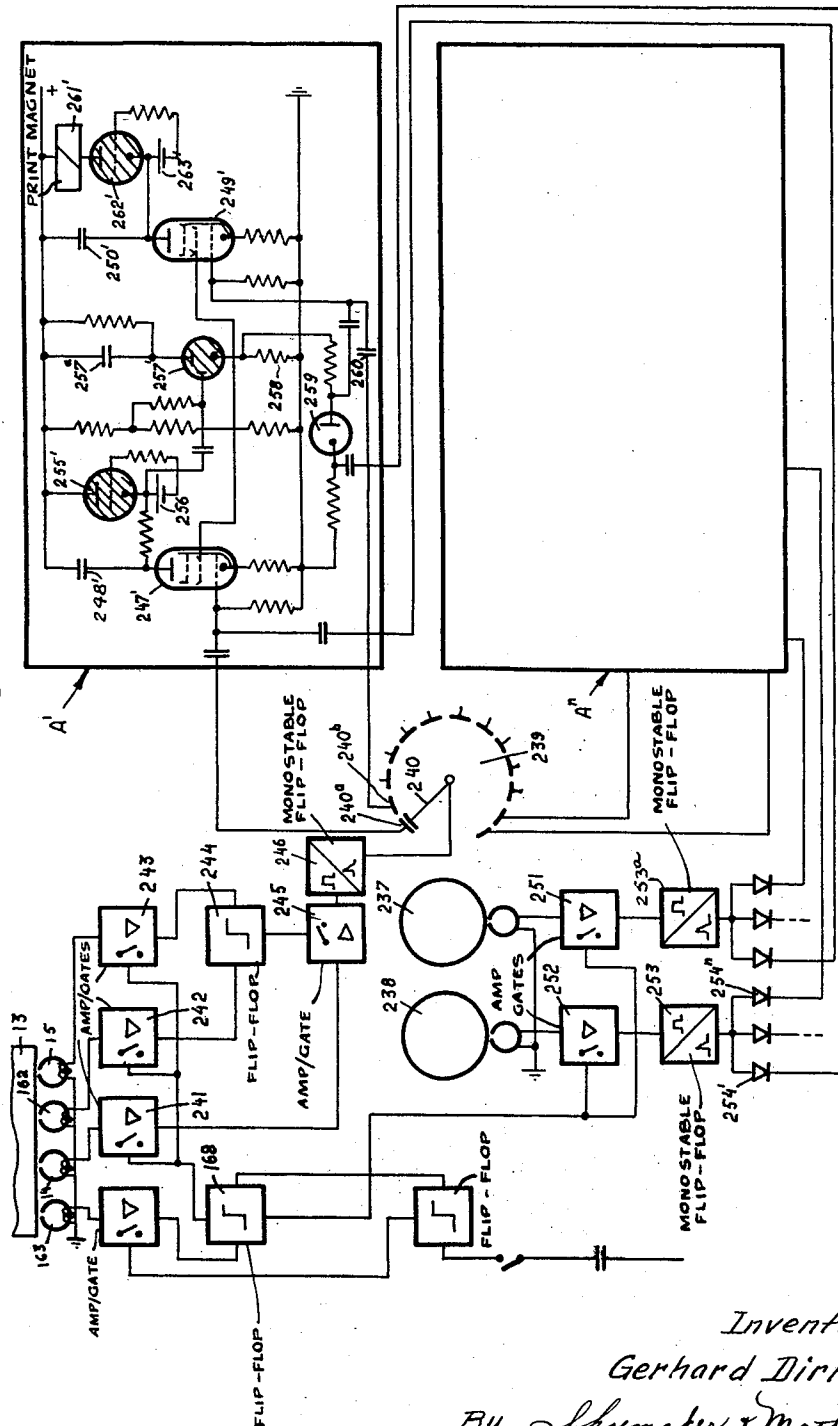
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Fig. 27



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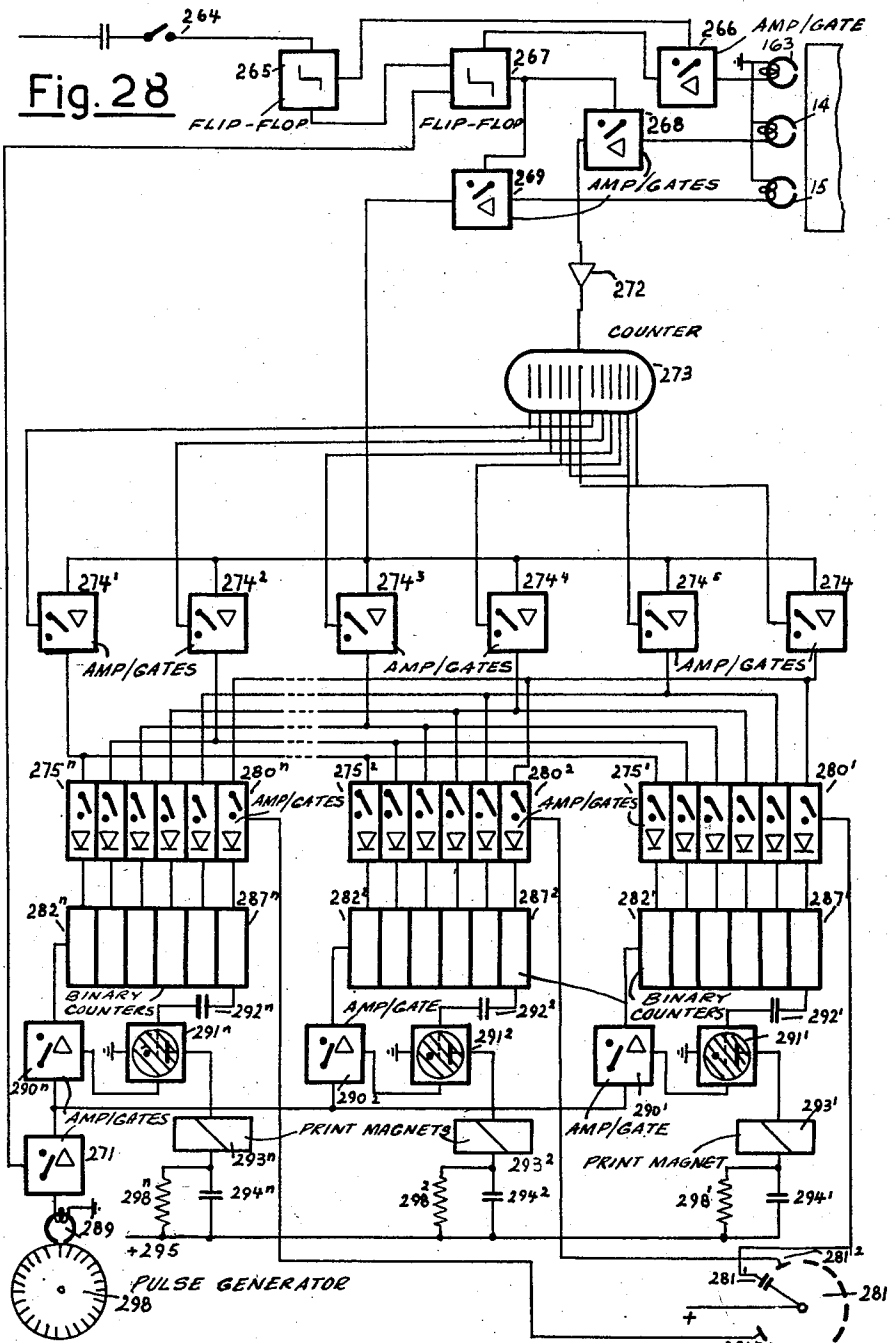
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2,928,896

HIGH SPEED PRINTING DEVICES

Gerhard Dirks, Frankfurt am Main, Germany

Application August 24, 1956, Serial No. 606,047

Claims priority, application Great Britain
August 25, 1955

22 Claims. (Cl. 178—34)

This invention is concerned with printing devices for use in high speed printing, for example in teleprinting, teletyping, and the like, and also for use as a printing device in association with an electronic computer or other high speed mechanism where it is necessary to record information at a very high rate.

Parallel printing mechanisms, using a plurality of type wheels or bars to print simultaneously in a multiplicity of columnar positions, are well known in conjunction with punched card equipment. As the speed of such equipment has increased; and as the use of electronic computers has extended, it has become desirable to increase the speed of parallel printing mechanisms. In order to reduce the inertial effects in the printing mechanism it is convenient to employ a form in which the type wheels are rotated continuously and a particular character is printed by selectively timing the impact between the type wheel and the paper. The control circuits for generating signals, under control of data to be printed, to selectively time the impact of each type wheel comprise a considerable quantity of equipment.

It is a prime object of the invention to provide a simplified parallel printing mechanism in which the timing signals for a plurality of type wheels are generated in succession for each character which may be printed.

It is a further object of the invention to utilize a serially sensed data storage device, which is synchronised with the movement of the type wheels, to control the generation of the timing signals for character selection.

It is one object of the inventor to provide a printer having a continuously-moving type-carrier with type faces thereon arranged in series in the direction of said movement, having means for effecting a relative approach between a type character and the paper or the like, at a printing position, and having control means synchronised with the said movement of the type-carrier for effecting such relative approach at precise time instants for selected type faces. The said continuous movement may be, and usually will be a rotary movement, but it may be a reciprocating or oscillatory movement in some cases. Also, whilst it will usually be an uninterrupted movement, it may be in some cases a stepwise movement.

It is another object of the invention to provide a rotary type-carrier which rotates on a fixed axis and with which the paper or the like is pressed against the respective type faces, when in printing position, by an impression member in dependence on said control means. Such impression member may be spring loaded away from the type face and be moved towards the paper or the like against the resistance of the spring load. Such impression member may be moved against the paper by momentum after having been primed, e.g. by compression means, against the resistance of the said spring load, rather than be positively moved through the whole approach movement. In other words, the said member is thrown freely against the paper similarly to the type levers in a typewriter.

A further object of the invention is to provide a con-

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trol means for effecting the printing movements in a high speed printer which comprises a pulse generator operating synchronously with the rotation (or other movement) of the type-carrier and controlling discharge elements or equivalent devices to actuate magnetic means for effecting a relative approach between the impression member and the type faces in dependence on signals representing the characters to be printed, which signals will usually be recorded in a storage operating synchronously with the printing means. Such pulse generator may comprise a non-magnetic rotary member having permanent magnets embedded in its surface, the respective magnets being co-ordinated to the respective type faces of the type carrier and co-operating with sensing means controlling the said discharge elements or the like. Such a pulse generator is described in more detail in my co-pending application 617,524, filed October 22, 1956.

It is a still further object of the invention to provide a control means for effecting the printing movement which comprises a mechanical trip device adapted to operate the impression member at precise time instants and having means for interrupting or reversing the trip action in dependence on signals representing the characters to be printed. Preferably, such trip device has a tripping possibility for each type face on the type carrier and the control means is of a kind which is made effective selectively by said signals, determining for which type faces the tripping is to be effected.

The invention will be described in more detail with reference to the accompanying diagrammatic drawing in which:

Fig. 1 is a side view of one example of the improved high speed printer in which the printing is controlled by mechanical means in dependence on signals;

Fig. 2 is a longitudinal section of the same taken on the line indicated in Fig. 1;

Fig. 3 illustrates a distributor and associated circuits employed in the control of the printing operation in the device according to Figs. 1 and 2; and

Fig. 4 is a diagram illustrating the disposition of signals in the storage;

Fig. 5 is an amplifier circuit illustrating a portion of Fig. 3;

Fig. 6 is another amplifier circuit illustrating another portion of Fig. 3;

Fig. 7 is a flip-flop circuit, explaining a portion of Fig. 3;

Fig. 8 illustrates a counting tube-circuit in further explanation of Fig. 3;

Fig. 9 shows the circuiting of a mono-stable flip-flop shown in Fig. 3;

Fig. 10 is a further amplifier circuit, explanatory of Fig. 3;

Fig. 11 shows details of a discharge tube circuit explanatory of Fig. 3;

Fig. 12 is a side view of a second example of the improved printer in which the printing is controlled by electromagnetic means in dependence on signals;

Fig. 13 is a longitudinal section of the same, taken on the line indicated in Fig. 12;

Fig. 14 illustrates the central circuit employed in the arrangement of Fig. 12;

Fig. 15 shows the circuit of a discharge tube which appears in Fig. 14;

Fig. 16 shows the circuit of another discharge tube which appears in Fig. 14;

Fig. 17 illustrates a modified embodiment of the electromagnetically acting control means for the printer;

Fig. 17a shows the circuit of a discharge device shown in Fig. 17;

Fig. 18 shows the circuit of another discharge device shown in Fig. 17;

Fig. 19 shows a schematic arrangement of type characters, with which a double selection of the printing time instant is required;

Fig. 20 shows a portion of the type-character that would be used with the scheme of Fig. 19;

Fig. 21 is a diagram illustrating a central circuit for use with the arrangement represented by Fig. 19;

Fig. 22 is a diagram showing the disposition of signals on the storage element in Fig. 21;

Fig. 23 shows a control circuit for a still further embodiment of the invention, and in which counting chains are employed;

Fig. 24 shows the circuit of one of those counting chains;

Fig. 25 shows the circuit of one discharge tube in the arrangement of Fig. 23;

Fig. 26 shows a modification of the embodiment illustrated in Fig. 23, in which counting chains are replaced by charging tubes and capacitors;

Fig. 27 illustrates a modification of the arrangement of Fig. 26;

Fig. 28 illustrates a control circuit for arrangement operated by combination signals, such as the international teletype signals; and

Fig. 29 shows diagrammatically a purely mechanical form of the improved printer.

Referring first to Figs. 1, 2 and 3, the machine includes frame members 1 and 2 in which there are mounted on parallel axes a cylindrical type-carrier 3 and an operating roller 4. The cylindrical type-carrier has sets of type characters 5¹⁻ⁿ the characters in each set being arranged in the direction of rotation of the type-carrier and, in the form illustrated, comprising the digit 0-9. These sets of type characters are adapted for printing in a corresponding series of parallel columns or denominations.

The operating roller 4 is provided with a number of longitudinal ribs 6¹⁻ⁿ for a purpose described below. The operating roller and type carrier are geared together by gears 7 and 8 and, in the arrangement shown, the ratio is 1 to 2.5. The large gear wheel 7 is driven by a worm 9 fixed on a shaft 10 driven by electric motor 11 which is under the control of an operating switch 12. The shaft 10 also carries a cylindrical storage member 13 e.g. a magnetisable storage, and such storage has two circumferential signal tracks opposite which are respectively signal heads 14 and 15.

Shaft 10 also carries the cylindrical movable member 16 of a distributor, this distributor including a continuous common contact 17 with a lateral projection 17¹. The continuous contact 17 cooperates with a single contact member 18 whereas the lateral projection 17¹ cooperates successively in each rotation of the distributor with a series of distributor contacts 19¹⁻ⁿ, there being a distributor contact for each of the said sets of type characters on the type-carrier 3.

Adjacent each set of said type characters, namely for each denomination, is a printing impression effecting arrangement which includes a relay coil 20 with spring armature 21 anchored at 22. There is also an impression member 23 carried on the free end of a spring 24 whose other end is gripped at 25 in a fixed part of the machine. Such part, has a forward extension 26.

Said spring 24 is clamped between rigid members 27 over the center part of its length the upper member being formed with a hump 28. Normally the parts lie as shown in Fig. 1 with the impression member 23 held down by the lower end of the spring armature 21, in which position said hump 28 is out of the path of the longitudinal ribs 6¹⁻ⁿ. When, however, the relay coil 20 is energised as described below and the armature 21 is drawn back to release the impression member 23, the spring 24 asserts itself to lift the parts 27, which brings the hump 28 into the path of the ribs 6¹⁻ⁿ. Therefore, on rotation of the operating roller 4 the next

rib 6 to approach the hump 28 impels downwards the part 27 and with them the spring 24 until such parts 27 are obstructed by the forward end of the extension 26. However, by reason of the free forward part of the spring 24 the momentum of the impression member 23 causes it to continue a downward movement and eventually to effect printing by its contact with the type ribbon 29 and by the type face which is then in printing position.

As the impression member 23 reaches its lowermost position the spring armature 21 is free to return to its initial position and again obstruct the rising of the impression member 23 until the said relay coil 20 is energised the next time. A paper sheet or other printable material is indicated at 30, this material lying between the said type ribbon 29 and the impression member 23 to receive the impression from the type faces in the sets of type 5¹⁻ⁿ as they come into printing position.

The type ribbon 29 is fed through an opening in the frame member 1 and, after passing over the various impression members 23¹⁻ⁿ it passes out through a similar opening in the frame member 2. This ribbon may be carried on spools as in normal typewriter and printing practice.

On the side faces of the storage element 13 are projections 31 and 32 the former of which is effective to close contacts 33 and the latter of which is effective to close contacts 34. There is also a single projection 35 on one side face of said gear wheel 7 which co-operates with two pairs of contacts 36, 37 and makes them effective successively in each rotation.

The signal storage 13, as above mentioned, has two circumferential signal tracks which, in Fig. 4, are marked 13^a and 13^b. The signal track 13^a is made up of a number of sectors around the storage, which correspond with the number of relays 20 for the impression members 23¹⁻ⁿ. Each such sector contains a number of permanent signals 38 corresponding to the number of characters 5¹⁻ⁿ. Signals sensed from the track 13^a by sensing head 14 are amplified in the amplifier 39 (Fig. 4) and fed to the controlled amplifier 40.

In the track 13^b are signals, one signal in each sector of the track, these having been recorded say from a keyboard, or punched card machine, computer or other source delivering the information which is to be printed. These signals in track 13^b occupy a position dependent upon their significance but in all cases they are in register with one or other of the signals in track 13^a. The storage element rotates in the direction of the arrow indicated, and the significance of the signals is dependent upon the time instants in the rotation at which they pass the signal head beginning from "9" to "0" in each sector.

The signals in track 13^b, sensed by sensing head 15, are fed to the controlled amplifier 41. Referring now to the lower part of Fig. 3, there is a control switch 42 in series with a capacitor 43 and having switch positions 42^a and 42^b. The changing over of the switch 42 from position 42^a to 42^b initiates a printing operation. This switch may be manually operated, or it may be operated electro-magnetically under control of signals from the device from which information to be printed is derived.

In the switch position 42^a, as shown, the capacitor is loaded by voltage from the positive pole 44. When contact 33 is closed with the storage in zero position, and contact 37 is closed with the type-carrier in the zero position, the charge from condenser 45 is passed to the flip-flop 46. The consequent change-over of flip-flop 46 opens the controlled amplifier 40 so that the signals sensed by sensing head 14 and amplified in the amplifier 39 are passed to a counting tube 47. When the counting tube 47 is full a positive pulse is passed to the mono-stable flip-flop 48 and from there to the controlled amplifier 41 to open the same. The mono-stable flip-flop 48 insures an exact timing of the opening

of said amplifier 41. Signals are passed through amplifier 41 only when there is a coincidence between the sensing of a signal in track 13^b by sensing head 15 and the opening of the amplifier 41 by a positive pulse from the flip-flop 48.

Signals leaving the controlled amplifier 41 are passed to the grid of the discharge tube 49 which tube is then ignited. This allows a complete circuit between positive pole 50, one or other of the relay coils 20, the corresponding distributor contact 19¹⁻ⁿ, the common distributor contacts 17, 17¹, contact 18, and the plate circuit of the discharge tube 49.

The counting tube 47 is adapted to receive additional pulses from the closing of the contact 34 by the storage element 13. The closing of such contact 34 applies a pulse to the mono-stable flip-flop 51, and from there a pulse passes to the amplifier 40 and into the counting tube 47. The amplifier 40 has two entries 40^a and 40^b the former of which receives the pulses from the signal head 14 and the latter of which receives the additional pulses from the contacts 34.

For the printing of the first character in the series e.g. digit zero, the first pulse from signal head 14 is applied to the counting tube 47 when it is empty so that a complete count of ten stages is effected before a pulse is passed forward to the flip-flop 48. This occurs repeatedly for all the sectors of the storage element representing all the denominations to be printed, so that in any sector where there is a signal zero in track 13^b a print of the digit "0" is effected, in consequence of the coincidence at those time instants ("0" in each sector) of the sensing of the signal in track 13^b and the opening of the amplifier 41. Upon the completion of one rotation of the storage element 13 the contact 34 is closed whereby the counting tube 47 is already moved one stage before the counting of pulses from signal head 14 begins, so that a count of only nine stages is effected, whereby the coincidence of sensing a signal by sensing head 15 and the opening of the amplifier 41 can occur only in the time instant "1" of each sector. This is repeated throughout the rotation of the storage element so that in each sector where there are signals "1" the printing of the character 1 can be effected in the corresponding column.

At the end of the second rotation of storage element 13 a further additional pulse is fed from contact 34 to the counting tube 47 so that the counting tube is full after a count of only eight stages, whereby a coincidence of the opening of the amplifier 41 and the sensing of a signal by sensing head 15 takes place in time instant 2 in each sector of the storage element. This cycle of operations is repeated for each of the ten stages of the counting tube for the ten characters on the printing element, the time instant of the said coincidence being advanced by "1" in each cycle.

Just prior to the completion of the rotation of the type-carrier 3, the contacts 36 are closed which allows a pulse from the positive pole to be fed through condenser 53 and contacts 36 to the flip-flop 46, to change the flip-flop to its other condition and thereby close the amplifier 40. At this stage all signals in track 13^b have effected printing in the corresponding columns.

The overall operation of the printing mechanism may be summarised as follows: Firstly, signals representing a line of data characters to be printed are recorded on the storage drum 13. The characters are recorded serially round the periphery of the drum, so that, as the drum rotates, the signals representing the characters to be printed in the first, second, third, etc., columns are sensed in succession.

A printing operation is started by operating the switch 42 to allow signals sensed by the head 14 to be passed to the counter 47. The counter renders the amplifier 41 operative at selected intervals to pass the data signals sensed by the head 15 to the brush 18 of the distributor

and thence through the contacts 19¹⁻ⁿ to the hammer control magnets 20 for the different column printing positions.

The gears 9 and 7 provide a 10:1 reduction, so that the drum 13 completes one revolution for each type face of a type wheel passing the printing position. The operation of a magnet 20 merely selects the associated hammer or impression member 23 for operation and the selected hammer does not effect printing until one of the projections 6 strikes the projection 28 of the hammer. The relative positioning of the signals on the drum 13 and the type faces on the type wheels is such that a line of type faces is in printing position at the moment when one of the projections 6 operates the selected hammers and the sensing of all the signals on the drum 13 has just been completed.

During the first revolution of the drum 13, the counter 47 renders operative the amplifier 41 at "0" time in each sector, that is, at the time when a "0" value signal would be sensed by head 15. Recorded signals other than "0" will occur at times when the amplifier 41 is inoperative and will not operate the tube 49. The tube 49 will be operated once for each "0" signal sensed by the head 15, and through the distributor will operate one of the magnets 20. Since the distributor is synchronized with the drum 13, each sector corresponds to one of the magnets 20.

When all the sectors have been sensed, all the sectors which contained a "0" recorded signal will have caused operation of the magnets 20 in the corresponding columns. Immediately after this, one of the projections 6 will strike the projections 28 of the selected hammers and the members 23 will impel the paper and ink ribbon against the "0" type faces. The contacts 33 and 37 ensure that the printing cycle starts at the correct time to ensure that the "0" type faces are in printing position at this time.

During the second revolution of the drum 13, the magnets 20 are operated which correspond to sectors containing a recorded "1" signal. By the end of the sensing, the type wheels will have moved one tenth of a revolution to bring the "1" type faces into printing position. The remaining eight revolutions of the drum 13 are similar except that a different character is printed on each revolution.

Between the sensing head 15 and the amplifier 41 is a manually operated switch 54 which is normally closed when sensing is to be effected. Two further manually operated switches 55, 56 are provided so that with switch 54 open either switch 55 may be closed for the erasing of the record or switch 56 may be closed for the recording of a new record according to any of the input means mentioned above.

Between the distributor contacts 19¹⁻ⁿ and the relay coils 20 may be provided a plugboard of the kind commonly used with punched card machines, to allow each sector of the storage 13 to be associated with any desired columnar set of the type characters 5.

The amplifier 29 is shown in more detail in Fig. 5. It consists in the main of the double triode 57. The input signals from sensing head 14 enter at lead 58 through capacitor 59 to grid resistor 60 whereby grid 61 produces an amplified signal at anode 62. This amplified pulse appears across the anode resistor 63 and capacitor 64, and from there to the grid resistor 65 and grid 66 of the right hand system, whereby a second amplification is effected at the anode 67 and anode resistor 68, the amplified pulse being fed out through capacitor 69 and lead 70.

The controlled amplifier 40 is shown in more detail in Fig. 6. This amplifier has two entries 40^a and 40^b, the former of which is for negative pulses from the sensing head 14 and the latter of which is for positive pulses from the mono-stable flip-flop 51. There is a further entry 40^c for control pulses from the flip-flop 46. There is a single exit from this controlled amplifier at 40^d for

negative pulses only, these being pulses passed forward to the counting tube 47. The negative pulses entering at lead 40^a are subject to a double amplification in the double triode 71 in a similar manner to the double amplification described with reference to Fig. 5. The positive pulses entering at lead 40^b are amplified at the right hand system only in the double triode 71, the amplified pulses going out through capacitor 72 to exit 40^c. The double triode 71 is controlled according to the more or less negative condition of the control grid of the right hand system in dependence upon the state of the flip-flop 46.

The flip-flop 46 in Fig. 3 is shown in more detail in Fig. 7. This flip-flop includes the double triode 73, the grid of the left hand system of which is connected with grid resistor 74 capacitor 75 and, through lead 76, with the switch 36 shown in Fig. 3. The grid of the right hand system is connected through grid resistor 77, capacitor 78 and lead 79 with the switch 37 shown in Fig. 3. The flip-flop 46 has an exit lead 40^c which is connected with the lead 40^c of the amplifier 40 shown in Fig. 6.

The cathode of the double triode 71 (Fig. 6) is shown at earth potential. The two anodes of the flip-flop 73 are connected with earth potential through the respective anode resistors 81, 82 and the common resistor 83. With no current flowing in the left hand system of the double triode 73, the potential at the anode of that system is substantially the same as the potential at the dividing point 84 between the resistors 82 and 83, since current is then flowing through the right hand system of the double triode. Because of this, the potential applied to the grid at the right hand system of the double triode 71 (Fig. 6) is a little less negative than the cathode of that double triode, and the right hand system is open (i.e. conductive).

If current is flowing in the left hand system of the double triode 73, the potential at the anode circuit becomes much more negative because an additional voltage drop is effected at the anode resistor 81. This much more negative potential is now applied to the grid of the right hand system in double triode 71 and that system is closed (i.e. non-conductive).

In a normal condition of the circuit, the current is flowing in the left hand system of the flip-flop and the right hand system of the amplifier is closed. As soon as the right hand system of the flip-flop 73 receives a positive pulse via lead 79 from the switch 37, current flows in the right hand system, and the left hand system is now closed, because of the more negative bias from the anode circuit of the right hand system, as is well known in a flip-flop circuit.

When current is flowing in the right hand side of the double triode 73, no current flows in the left hand side and there is no voltage drop at the anode resistor 81 so that the right hand system of the double triode 71 (Fig. 6) again opens. When, as described above, the closing of contact 36 supplies a positive pulse through lead 76 to the left hand system of the double triode 73, the left hand system opens and the right hand side closes and, because of the voltage drop in the anode circuit, the right hand system of the double triode 71 is closed.

The counting tube 47 is shown in more detail in Fig. 8. In the form shown it comprises a usual Dekatron counting tube having ten stages. There is a separate cathode for each of the ten stages. Between each two stages of the tube is a pair of electrodes which, in dependence on received pulses, effect the change of the glow discharge from one cathode to the next. These pulses are received at entry lead 86 which is connected with the exit 40^d of the controlled amplifier 40, the said pulses being applied through capacitor 87 to the respective electrodes, in the one case directly and in the other case through the electrode resistor 88. The resistor 88 forms an integrating circuit with capacitor 89.

Each delivered negative pulse from the entry lead 86

effects the advance of the glow circuit from the previous cathode to the next and, after ten stages, the glow discharge is at the tenth cathode. At this stage a positive pulse is delivered to the capacitor 91 and out through exit lead 90 to the mono-stable flip-flop 48.

This mono-stable flip-flop is shown in detail in Fig. 9. It comprises the double triode 93, the grid in the left hand system of which is connected with the said exit lead 90 of the counting tube through grid resistor 94. Normally the right hand system of the double triode 93 is open and, because of the negative potential at the exit lead 95, the controlled amplifier 41 is closed (non-conductive). However, on a positive pulse from the counting tube entering the left hand system of the double triode 93, the triode is momentarily switched over so that the current flows in the left hand system instead of in the right hand system and, as the potential of the exit lead 95 becomes less negative, the controlled amplifier 41 is opened (i.e. is made conductive). The time of opening is governed by the time constant circuit comprising the capacitor 96 and the resistor 97. This type of circuit is well known in mono-stable flip-flops.

The circuit of the mono-stable flip-flop 51 (Fig. 3) is the same as that shown in Fig. 9 for the mono-stable flip-flop 48.

Fig. 10 shows the details of the controlled amplifier 41 of Fig. 3. This amplifier consists of two double triodes 99 and 100 arranged in series to provide a four-stage amplifier. Signals from the sensing head 15 enter at lead 101 through capacitor 102 to the grid in the left hand system of double triode 99 in which double triode there is a double amplification. The amplified signals leaving at the anode circuit 103 are fed through capacitor 104 to the grid of the second double triode 100 where there is a second double amplification, and the eventual positive pulses leave at the anode circuit 105.

However, the second double triode 100 is under the control of the mono-stable flip-flop 48 so that no signal can pass through that double triode unless the grid in the left hand system has been affected by the pulse from the exit of said mono-stable flip-flop 48. The amplified pulses from the anode circuit 105 pass through the capacitor 107 as positive pulses to the grid of the discharge tube 49, details of which are shown in Fig. 11.

As already explained, the delivery of a pulse from lead 107 to the grid of the discharge tube 49 ignites that tube and allows current to flow to the wiping contact 18 of the distributor so that, at the moment of igniting of the discharge tube, that relay 20 which through the distributor contact 19¹⁻ⁿ is then in association with the contact 18 is energized and a print is effected at that instant in the corresponding column. On the passing of the contact 18 from one of the distributor contacts 19¹⁻ⁿ to the next the discharge tube 49 is extinguished as the current is interrupted in the interval between the two adjacent contacts 19¹⁻ⁿ.

In a modification, the counting tube 47 may have more stages than the number of type characters in a series 5¹⁻ⁿ, so as to allow a time interval for control operations and the like. Also, instead of the magnetisable storage 13 other types of storage element may be adopted for example a matrix of magnetic cores, flip-flop chains in electronic or magnetic arrangement, or the storage may take the form of a plurality of multi-stage tubes, sets of capacitors or the like. The sensing means will of course be altered to correspond with the type of storage used. Further, instead of a contact distributor such as is illustrated any other suitable type of distributor may be used, for instance an electronic distributor.

Referring now to Figs. 12, 13 and 14 a modification of the invention is illustrated. As shown more clearly in Fig. 12, there is in this case a separate type-carrier for each column, these being shown at 108¹⁻ⁿ. Each type-carrier 108 is carried by a holder 109 which in turn is carried by a spring 110 anchored in a radial arm 111 on

a shaft 112. Each type-carrier 108 is formed on one face with a toothed wheel 113 which is in mesh with a corresponding toothed wheel 114 of the same size on shaft 115, such shaft being rotated by the worm wheel 116 and worm 117 on the motor shaft 118 which corresponds with the motor shaft 10 in Fig. 1.

The radial arm 111 has an extension 111a to take the thrust of a spring 119 which reacts against a fixed part 120. The effect of this spring is to hold the gear wheels 113 and 114 in closest mesh, with the printing faces withdrawn from the printing ribbon. However, when the radial arm is rotated counter-clockwise in Fig. 12 as explained below, the arm 111 meets a stop 121 but the momentum of the printing element and its associated parts causes it to move still further forward, flexing the spring 110, and to bring the printing face into contact with the printing ribbon to make an impression on the paper.

In order to prevent idle movement of the printing element 108 because of the play between the intermeshing wheels 113 and 114 a spring blade 122 is provided, the free end of which acts as a brake on the rotating type-carrier. In order to effect a more exact registering of the type face in the printing position, this spring blade may be shaped at the end to enter between teeth on the wheel 113.

In this embodiment of the invention, an electronic control of the selective operation of the type-carriers is shown and is explained below. This form of control may be used also with the construction of printer already described in connection with Figs. 1-11.

Further, not only may this electronic control be used instead of the mechanical arrangement in Fig. 1-3, but the mechanical arrangement shown in Figs. 1-3 could be used with the type of printer shown in Figs. 12-13.

Referring in particular to Fig. 14, there is shown on shaft 115 a pulse-generator 123 which in each rotation generates a pulse corresponding to each printing face on the printing element 108. This pulse-generator is sensed by signal head 124. It is formed by a drum of a nonmagnetisable material having small permanent magnets embedded in slots in its periphery.

The signals sensed by sensing head 124 are amplified in the amplifier 125 and are fed to one of the grids of each of a number of discharge tubes 126. There is a discharge tube 126 for each type-carrier 108 and the anode circuit of each includes the corresponding relay coil 127.

The control circuit shown on the left hand side of Fig. 14 is the same as that already described with reference to Fig. 3 except that the distributor contacts 191¹⁻ⁿ instead of being connected directly to the printing coils 20 are connected each to the grid of a corresponding discharge tube 128. There is a tube 128 for each of the before mentioned discharge tubes 126 and the exits from the tubes 128 lead to auxiliary grids in the respective tubes 126.

The circuit of a discharge tube 128 is shown in more detail in Fig. 15. The pulse from the distributor contact 191¹⁻ⁿ enters at lead 129 and through capacitor 130 to the ignition electrode 131. Such ignition electrode 131 is biased by the voltage dividers 132, 133 to a voltage which is below the ignition voltage of the tube. When the tube is ignited by the coming in of a pulse at 129, the main current flows in the main circuit of the tube to the cathode resistor 134 thereby building up a more positive voltage which is fed to the respective grid in the tube 126.

The circuit of tube 126 is shown in more detail in Fig. 16. The control voltage from the respective discharge tube 128 enters at lead 135 and, through the voltage divider 136 and the resistor 138, makes the control grid 139 less negative than it was but insufficient in itself to ignite the tube. The pulse from the amplifier 125 enters at

the lead 140 and is applied to the pre-biased control grid 141 through capacitor 142. The control grid 141 is pre-biased by the voltage divider 143, 144, and grid resistor 145. When there is a coincidence between a less negative potential at grid 139 because of an applied voltage at the lead 135 and a less negative potential at grid 141 from a pulse entering at 140, the tube 126 is ignited and current goes through to the respective coil 127. This type of switch control is well known in the art.

The main circuit through the coil 127 includes a switch 146 which is opened at each interval between the successive type faces on the type-carrier 108 coming into the printing position.

In the operation of the device the control grids 139 first receive their less negative potential in those cases where a signal has been distributed from the contacts 191¹⁻ⁿ, and at the end of the rotation of the distributor a pulse is generated at 123, amplified at 125 and applied to the grids 141 of all the tubes 126. However only those tubes are effective where there is a change of potential on both grids 129 and 141 of a tube.

Referring now to Fig. 17 a further embodiment of the invention is shown. In this case signals sensed by the sensing head 15 and amplified in the controlled amplifier 41 are fed to the discharge device 147 and from there to the contact 18 of the distributor. In this case, however, the distributor contacts 191¹⁻ⁿ are connected to respective capacitors 148¹⁻ⁿ, each such capacitor being in circuit with a diode 149 of the series 149¹⁻ⁿ and with a coil 127 of the series 127¹⁻ⁿ. Therefore, in one rotation of the distributor, only those capacitors 148¹⁻ⁿ will be charged which correspond to columns for which signals have been sensed by the sensing head 15.

The pulse-generator 123 and signal head 124 are provided as in Fig. 14 together with the amplifier 125 and the amplified signals are fed to the grid of a discharge device 150. The pulse from generator 123 is provided at the end of the rotation of the distributor and the ignition of the discharge device 150 then allows the discharge of all those condensers 148¹⁻ⁿ which had been charged, the discharge current passing through the corresponding coils 127¹⁻ⁿ and operating the printer for the respective columns. The distributor and the type-carrier are so related that the type face is in printing position at the end of the rotation of the distributor.

The circuit of the discharge device 147 is shown in more detail in Fig. 17a. The pulse from the amplifier 41 passes through lead 151, through capacitors 152, to the grid of the tube 153. The grid has a negative bias from a voltage source 154. On ignition of the tube the main circuit current flows from the positive pole 155 through the tube to the distributor contact 18, the contact 191¹⁻ⁿ then in contact position and to the before mentioned capacitor 147¹⁻ⁿ which is thereby loaded.

The circuit of the discharge device 150 is shown in more detail in Fig. 18. The pulse from the amplifier 125 enters at lead 156 and goes through capacitor 157 to the grid of the tube. The grid is pre-biased by means of the voltage divider 159, 160, and the grid resistor 161. When a pulse enters at the lead 156 from the generator 123 the tube 158 is ignited and closes a discharge circuit for the capacitor 148, which discharges through the diode 149 with the coil 127 and through the tube to earth.

As will be seen, in this form of the invention only one discharge tube 150 is required and only one discharge device 147, whereas there is a capacitor 148 and a diode 149 for each column in which printing may take place.

In order to print both alphabetic and numeric characters, the total number of characters is divided into several groups, and selection is effected by selecting one of the groups and then selecting a character within that group. The table of the upper part of Fig. 19 shows the

characters divided into ten groups, corresponding to the ten horizontal rows, each group consisting of four characters.

The selection of one of the ten groups of characters is similar to the selection of one of the ten digits 0-9 in the numerical printing mechanism already described. A second selection is then necessary to specify the particular character within the selected group. Since the type wheels are continuously rotating, both selections are based on timing. To select the letter A, for example, the second group of characters is selected, as in the selection of digit "1" in the case of the numerical printer. The second time interval within this group is then selected, since the letter A is in the second vertical column of the table.

The layout of part of a type wheel is shown in Fig. 20. It will be seen that each group of characters occur together on the type wheel, so that a coarse subdivision of the rotation of the wheel specifies one of the groups of characters of Fig. 19, and a fine subdivision within that group specifies a particular character within that group.

The lower part of Fig. 19 shows a similar table in which ten groups each containing seven characters is shown. This arrangement provides sufficient selections to accommodate small letters as well as capitals. A type wheel for use with this character arrangement is similar to that of Fig. 20, except that each group of characters contains seven characters.

In Fig. 21 the storage element 13, instead of having only two signal tracks as in the previous examples has four signal tracks 13^a , 13^b , 13^c , 13^d and these are opposite the respective signal heads 163, 14, 163 and 15. The arrangement of the signals in the storage element 13 is illustrated in Fig. 22.

The first track 13^a opposite signal head 163, has only one signal recorded in it and this is a start signal as explained below. The second track 13^b opposite signal head 14, contains groups of permanent signals with ten signals in each group similarly to those in track 13^a of the first example, and these operate as counting signals. In the third signal track 13^c , opposite signal head 162, are switching signals for selecting the character to be printed in the scheme shown in Fig. 19. Each peripheral sector in said third signal track is made up of two areas arranged in the direction of sensing and such switching signals marks the division between one of the successive sub-areas and the next. These signals have a switching over purpose described below.

In the fourth signal track 13^d , of which, opposite signal head 15, are the information signals of which, for each character to be printed, there are two in the corresponding denominational sector, one in the first sub-area indicating the series of characters to be selected, that is to say the respective horizontal row in Fig. 19, whereas in the second sub-area is a signal indicating the time instant at which printing is to be effected, namely the respective vertical row concerned in the scheme of Fig. 19.

As shown in Fig. 20 the type faces on the type-carrier are arranged in groups corresponding to the respective horizontal rows in Fig. 19 but they are all arranged in sequence in the direction of rotation of the type-carrier.

The apparatus is started by the manual closing of switch 164 and by the subsequent mechanical closing of switch 165 by contacts operated in the zero position of the storage similarly to those explained with reference to Fig. 1. The closing of these two switches completes a circuit to the winding 166^a of the relay 166. Thereupon the relay contact 166' is closed, this being in the hold-on circuit including the winding 166^b. At the same time, the relay 166 opens the contact 166^c which thereby opens the amplifier 167 by removing the normally applied voltage from the negative voltage source and the start signal in the first signal track 13^a sensed by the

sensing head 163 may pass through the amplifier 167 to the flip-flop 168 which is thereby changed over. This changing over of flip-flop 168 opens the three amplifiers 169, 170 and 172 so that signals sensed by the sensing heads 162 and 14 are passed through the respective amplifiers. First a switching signal sensed in the third signal track 13^c by sensing head 162 passes through the amplifier 170 to the two way switch 171.

The two-way switch 171 is thereby changed over from switching position *a* as shown to the switching position *b*, so that pulses sensed by sensing head 14 pass through amplifier 169, through the two way switch in position *b* to the further amplifier 172 and from there to the counting tube 173. This counting tube has ten stages corresponding to the ten groups of characters on the type-carrier. When the counting tube 123 is filled, a pulse is supplied to the mono-stable flip-flop 174 and from there to the amplifier 175 to open the same, so that information signals then sensed by signal head 15 may pass through the amplifier 175 to switch over the flip-flop 176 which opens.

The two way switch 171 is returned to the position *a* at the next sensing of a switching signal by sensing head 162 in the third signal track 13^c on the storage element. Therefore, with amplifier 169 open and switch 171 in position *a* the counting signals sensed by sensing head 14 in the second signals track 13^b are passed through to the further counting tube 183. This counting tube needs to have only so many stages as there are characters in each group which, in the scheme of Fig. 19 is four. However since four-stage counting tubes are not commercially available a ten-stage tube is shown the first six stages of which are ineffective for the operation of this device.

The four last stages of the counting tube 173 are in series respectively with switches 184¹⁻⁴ and each such switch 184 is in series with a switch 185¹⁻⁴ and a group of diodes 381 in series respectively with capacitors 186¹⁻ⁿ, 187¹⁻ⁿ, 188¹⁻ⁿ and 189¹⁻ⁿ.

Referring again to Fig. 22 there are four parallel signal tracks 13^a-d .

The signal track 13^a contains only one signal 178 which is a starting signal as described above. The signal 178 indicates the termination of one cycle of sensing (in this case one rotation of the storage) and the beginning of the next. The signal track 13^b contains groups of counting signals 179 each group including ten signals, and there is a space between the end of each group and the beginning of the next. The signal track 13^c has switching signals 180 indicating the beginning of the two sub-areas of each denominational sector.

These signals 180 lie opposite the spaces between the groups of signals 179. The signals 181 in track 13^d are the information signals indicating the matter to be printed and will have been recorded from any appropriate source such as a computer, a punched card machine or the like.

This arrangement is of course repeated in each denominational sector in the storage.

Each signal 181 in track 13^d consists of two parts, one in each of the two areas of the sector. The first signal 181^a in the first area of the sector indicates the horizontal row in the scheme of Fig. 19 in which the corresponding character is found, whereas the second signal 181^b in the second area of the same sector indicates the vertical row of the scheme of Fig. 19 in which the corresponding character is to be found.

Now coming back to Fig. 21, in the next time instant of sensing of the storage after the switching over of flip-flop 176, the next switching signal 180 is sensed by sensing head 162 and is passed through amplifier 170 to change over the two way switch 171 to position *a*. Thereupon the next counting signals 179 in the signal track 13^b are passed through amplifier 169 and the two way switch 171 in position *a* to the further amplifier 182 and then to the counting tube 183. At the counting tube 183 only four counting stages are necessary if there are only four

characters in each group, but in order that the two counting tubes 173 and 183 may be controlled by the same counting signals 179, and because four stage counting tubes are not commercially available, only the first four stages of the ten stage tube 183 are used in this device.

The first four stages of the counting tube 183 are connected respectively to one grid of each of four discharge devices 184¹⁻⁴. Another grid of each of these devices 184¹⁻⁴ is connected to the output from the controlled amplifier 177. Therefore only that discharge 184¹⁻⁴ will be ignited where there is a coincidence between the entry of the pulse from amplifier 177 and from one or other of the stages of the counting tube 183. This coincidence of signals is dependent on the coincidence of a particular time instant in the counting and the same time instant in the sensing of an information signal at sensing head 15. The pulse coming from the amplifier 177 is applied also to the flip-flop 176, changing it over to its previous position and thereby closing the amplifier 177.

For each of the discharge devices 184¹⁻⁴ is a distributor 185¹⁻⁴ having a number of switching ways corresponding to the number of denominations in which printing is to be effected.

In each such distributor 185 each switching way leads to a corresponding capacitor in each of a series of capacitors 186¹⁻ⁿ, 187¹⁻ⁿ, 188¹⁻ⁿ and 189¹⁻ⁿ. The other side of all the capacitors leads to the plus pole 190. Therefore, for the particular discharge device 184¹⁻⁴ which is ignited, a pulse is supplied to the corresponding capacitor then put in circuit by one of the switching ways of the corresponding distributor 185¹⁻⁴.

For each of the denominations in which printing has to be effected, there is a magnet coil 191¹⁻ⁿ, each having four windings. These magnet coils operate the printing device and correspond e.g. to the coils 127 in Fig. 14, shown also in Fig. 12 and in Figs. 14 and 16.

The first windings 192¹⁻ⁿ of the several magnets 191¹⁻ⁿ are connected with the respective capacitors 186¹⁻ⁿ in the first distributor 185¹. Similarly, the second windings 193¹⁻ⁿ of the several magnets 191¹⁻ⁿ are connected with the respective capacitors 187¹⁻ⁿ in the second distributor 185². Again the third windings 194¹⁻ⁿ are connected with the capacitors in the third distributor 185³ and the fourth windings 195¹⁻ⁿ are connected with the capacitors in the fourth distributor 185⁴. The other side of the windings of the magnets 191¹⁻ⁿ are connected in parallel and go respectively to the cathode of the discharge tubes 196¹⁻⁴. Therefore all the windings 192¹⁻ⁿ are connected to the cathode of the discharge tube 196¹, all the windings 193¹⁻ⁿ are connected to the cathode of a discharge tube 196², all the windings 194¹⁻ⁿ are connected to the cathode of discharge tube 196³ and all the windings 195¹⁻ⁿ are connected to the cathode of the discharge tube 196⁴.

A plurality of pulse generators 197¹⁻⁴ is provided each having permanent signals such as small permanent magnets in slots in a carrier of non-magnetic material, and these signals are sensed respectively by the sensing heads 198¹⁻⁴. Instead of the four separate pulse generators a single generator could be employed sensed by the four sensing heads in succession, but in such case the sensing heads will be spaced around the generator in a vernier arrangement so as to operate successively. The signals sensed by the sensing heads 198¹⁻⁴ are amplified in the respective amplifiers 199¹⁻⁴ and are applied to the grids of the discharge tubes 196¹⁻⁴.

The pulse generators 197 operate synchronously with the type-carrier and the generated pulses correspond with the time instants at which type faces come into printing position.

The counting tube 173 is filled at the same time instant in each sector but, in successive cycles of sensing (in this embodiment in successive rotations of the storage) it is filled at successively earlier time instants, as explained with reference to Fig. 3. During the second

cycle of sensing the start signal 178 in track 13^a, sensed by sensing head 163, changes over flip-flop 168. The changing over of flip-flop 168 to its previous position closes the amplifiers 169 and 170 and 172 so that in the cycle of sensing then operative, no sensing of counting signals and switching signals takes place in the tracks 13^b and 13^c. The changing over of flip-flop 168 to such previous position also allows a pulse to pass through the amplifier 200 and through the controlled amplifier 172 to the counting tube 173, to advance the filling of the tube by one time instant as previously explained. However, the closing of amplifier 172 by the changing of flip-flop 168 is delayed by an integrating circuit on the control input line of the amplifier 172 in order to allow of sufficient time for such pulse to pass from the amplifier 200 to the counting tube.

The first part 181^a of the information signal 181 in track 13^d is effective in the counting tube 173 to select the group of characters in which the wanted character (i.e. the character to be printed) is to be found. The second part 181^b of such signal 181 is effective in the counting tube 183 to select the time instant at which the wanted character in the selected group is in printing position. If, for example, and referring to Fig. 19, it is desired to print the character A say in the first and third columns or denominations, there will be corresponding information signals 181, each in two parts, in the first and third sectors of track 13^d.

During the sensing of the first part of the denominational area the first part 181^a of the signal 181 will be sensed at the time instant corresponding to the digit value "1" as A is in the horizontal row for time instant "1" in the scheme of Fig. 19. That is to say, the sensing of counting signals 179 in track 13^b will have filled the counting tube 173 at the same instant that information signal 181^a is sensed by sensing head 15. Therefore the pulse resulting from signal 181^a goes through the amplifier 177 to the grids of the discharge tubes 184¹⁻⁴.

Since the character A is in the second time instant position of Fig. 19, that is, it is in the second vertical row, a signal from amplifier 177 will be passed through the discharge tube 184² from the sensing of the second part 181^b of the information signal in track 13^d. That is to say, in the second time instant of sensing the second sub-area of this denomination, the second grid of the selected discharge 184² is biased by the counting tube 183.

The signal from the discharge tube 194² passes to the distributor 185² and, in the first area of the sensing of the storage, which coincides with the effectiveness of the first distributor switching way, to capacitor 187¹ to charge it. In the third denominational area of sensing on the storage the same effect takes place with the third distributor switching way open so that capacitor 187³ is charged.

During the second cycle of sensing as above described flip-flop 168 is switched over, to prevent sensing in tracks 13^d and 13^e in this cycle and, as described above to provide a pulse to counting tube 173 in preparation for the next sensing cycle. Also during this second sensing cycle signals from the generator 197 are fed in succession from the sensing heads 198¹⁻⁴ through the respective amplifiers 199¹⁻⁴ to the grids of the respective discharge tubes 196¹⁻⁴. The charged capacitors 187¹ and 187³ are discharged through the magnets 191¹ and 191³ and through the discharge tube 196² which is ignited at that time instant by the signal fed through the amplifier 199². Since at this time instant type face A is in printing position because the drum 13 has already completed one rotation to bring the second group of characters to the printing position and the ignition of the tube 196² has occurred at the second time interval, printing of character A takes place in the first and third columns. This cycle of sensing and printing is repeated until the type-carrier has been completely sensed (in this case has

made one complete rotation) at which time all the selected characters have been printed in the selected denominations, and the operation then re-commences for the next printing line.

When the start switch 164 is closed it remains closed for a period longer than one complete sensing (i.e. rotation) of the type-carrier but not so long as two complete sensings. The energizing of the relay 166 also effects the change over of two way switch 166³ from position *a* to position *b*.

The closing of contacts 165 by the type-carrier is effective only for a sufficient time to allow for the energizing and holding-on of relay 166 and the changing over of switch 166³. On the second closing of switch 165 at the end of the first complete rotation of the type-carrier, the switch 166³ is already in position *b* and therefore the relay coil 201 is immediately energized. The energizing of relay 201 opens the switch 201¹ which de-energizes the relay 166. The relay 201 is a delayed relay and the opening of contact 201¹ takes place at the end of the closing of contacts 165. The opening of switch 201¹ de-energizes relay 166, which releases the contact 166³ and allows it to return to position *a* but by the time this contact has reached position *a* the contacts 165 have opened. The new series of sensing cycles for the next printing line is commenced by the closing of switch 164 and the closing of contacts 165 by the type-carrier as explained above.

The de-energizing of relay 166 also re-closes switch 166² and closes the amplifier 167 and therefore prevents a new start from the signals sensed at signal head 163. For the next series of cycles the record in track 13^d will be erased and replaced by a new series of information signals. There may also be a switching over to another storage or to other areas of the same storage from which information signals will operate the same printing means.

It may be stated here that the various embodiments of the invention may be used with other decimal systems.

A further embodiment of the invention is illustrated in Fig. 23. The storage element 13 with its associated signal heads is the same as in Fig. 21, the storage being provided with signals as illustrated in Fig. 22. The sensing of start signal 178 in track 13^a commences the sensing cycle as previously described. The sensing of the first switching signal in track 13^c by the corresponding sensing head provides a pulse passing through the controlled amplifier 170 and from there to the two way switch 171 moving it to position 171^b. At the same time a pulse is applied to the flip-flop 202 to close the amplifier 175. Thereupon the counting of pulses from track 13^b of the storage begins, the signals being sensed by sensing head 14 and the pulses passing to controlled amplifier 169 and through the two way switch 171 in position *b* to amplifier 172 and from there to the counting tube 173.

Thereafter, the next switching signal in track 13^c is sensed by sensing head 162 which passes a signal through the amplifier 170 to the two way switch 171, returning that switch to position *a* and at the same time the flip-flop 202 is switched over to open the amplifier 175, its previous opening from the mono-stable flip-flop 174 having been merely a temporary opening.

Now the counting of signals from track 13^b of the storage begins in sensing head 14, the consequent pulses passing through the amplifier 169, through switch 171 in position *a*, through the amplifier 204 and to the distributor 205. This counting is terminated upon the sensing of the second part 181^b of the information signal in track 13^d in sensing head 15, which passes a pulse through amplifier 175 to the flip-flop 203 switching it over to close the amplifier 204.

The distributor 205 operates synchronously with the cyclic sensing of the storage 13 there being a switching way in the distributor corresponding to each second part of an area in signal track 13^c. For each denomination in which printing is to be effected there is a counting chain

having a number of stages one more than the number of characters in the horizontal row in the scheme illustrated in Fig. 19. The stages in each chain have a common entrance connected with the corresponding switching ways 205¹⁻ⁿ of the distributor 205 and with the corresponding diodes. The first stages in the counting chains are 206¹⁻ⁿ, the second stages are 207¹⁻ⁿ, the third stages 208¹⁻ⁿ, and so on, the fifth stage being 210¹⁻ⁿ and the diodes are 211¹⁻ⁿ.

There is a pulse generator 212 sensed by a single sensing head 213 the pulses from which pass through amplifier 214 to the input side of the diodes 211¹⁻ⁿ. Pulses are generated in groups of four, one group for each group of type faces on the type-carrier, and there is a coincidence between the generation of a signal and the bringing of the corresponding type face into printing position.

The exits from the counting chains lead to the grids of the respective discharge tubes 215¹⁻ⁿ the anode circuits of which are connected with the windings of the magnet coils 216¹⁻ⁿ these leading to a common plus pole 217 through a switch 218 which is opened and re-closed, after each group of characters has passed through the printing position.

After the first cyclic sensing of the storage 13 there is a count in the various counting chains corresponding to the counting signals which have been sensed in track 13^b of the storage coincident with the passing of a pulse from the counting tube 173. Where there was no signal in the first sub-area and therefore no coincidence between such a signal and the filling of the tube 173, there is no count in the corresponding counting chain. During the second time period of the cycle in which no sensing of signals from the storage takes place as explained above, signals from the generator 212 are fed to the counting chains through the respective diodes 211¹⁻ⁿ. When any counting chain is filled a carry pulse from the last stage is delivered to the grid of the corresponding discharge tube 215¹⁻ⁿ which tube is thereupon ignited and current flows through the winding of the corresponding printing magnet 216¹⁻ⁿ to effect printing in the corresponding denomination. This current flows from the plus pole 217, through the corresponding magnet coil winding 216 and discharge tube 215 to earth. There is a switch 218 the opening of which extinguishes the discharge tubes and counting chains.

The circuit of a counting chain is shown in more detail in Fig. 24. Each stage includes the discharge tube 219 with anode resistor 220, cathode resistor 221 and grid resistor 222 with capacitor 223. The chain illustrated is a cold cathode chain, e.g. a glow-discharge chain. The pulses from the distributor 205 enter the chain at the input lead 224 and, because of the voltage applied to the starting electrode of the first stage, the first tube 219 is ignited through capacitor 223. The ignition of the first tube 219 causes a voltage drop at cathode resistor 221 which effects a biasing of the starting electrode of the next tube 219². Therefore the next pulse entering at the input lead 224 applies a sufficient voltage to the starting electrode of the second tube 219² to ignite such tube which, in the same way, biases the starting electrode of the third tube 219³. The ignition of each subsequent tube 219¹⁻ⁿ effects the extinguishing of the preceding tube in a manner well known in this type of counting circuit.

At the end of the first cycle of sensing of the storage, that tube 219¹⁻ⁿ remains ignited which indicates the number or value of the information signal which has been sensed in track 13^d. The pulses from the signal generator 212 enter the chain at the same entry lead 224 and effect the successive ignition of the remaining stages of the chain. When the last stage of the chain is ignited a pulse is delivered through the capacitor 225, which passes to the grid of the respective discharge tube 215¹⁻ⁿ to operate the printing magnet.

The circuit of a discharge tube 215 is shown in more detail in Fig. 25. It comprises, in addition to the actual

tube 215, entry lead 226 from the last stage of the corresponding counting chain. The anode circuit passes from the anode through lead 227 to the printing magnet 216 and from there to switch 218 to the plus pole 217. In the known way there is a negative bias for the grid through the grid resistors 228, 229 and the cathode is connected to earth as shown. The extinguishing of the tube takes place by the opening of the contact 218 as previously described.

A modification of the embodiment shown in Fig. 23 is illustrated in Fig. 26, where the counting chains are replaced each by a charging tube and a capacitor. For the respective denominations there is shown a pentode 230¹⁻ⁿ and a capacitor 231¹⁻ⁿ, the capacitors being in the anode circuits of the pentodes. The pulses from the distributor 205 (see Fig. 23) are fed to the control grids of the pentodes through capacitors 232¹⁻ⁿ and grid resistors 233¹⁻ⁿ. Each pentode is negatively biased in the usual way so that there is substantially no current flowing in the tube at times when no pulse is being supplied. The pulses from the distributor 205 cause the pentodes to conduct and charge the respective capacitors 231¹⁻ⁿ to values dependent upon the value of the corresponding signals being sensed, each sensed pulse charging the capacitor by one unit, similarly to the counting from stage to stage in the counting chains of Fig. 23.

A signal generator 212 is provided as in Fig. 23 with sensing head 213 and amplifier 214. There is also a mono-stable flip-flop 234 connected between amplifier 214 and diodes 235¹⁻ⁿ, one for each switching way of the distributor 205. The pulses from the signal generator are applied to the control grids of the pentodes in the same as pulses from the distributor 205, eventually to charge the capacitors to a predetermined maximum value. Upon such maximum value being reached the capacitor is discharged through the corresponding magnet coil 216¹⁻ⁿ, and discharge tube 215¹⁻ⁿ. The ignition voltage of the tube 215 is determined by a pre-selected negative bias of the grid.

In the input to the distributor 205 is a mono-stable flip-flop 236 giving to the signals a determined wave form of precise length agreeing with those from the mono-stable flip-flop 234, so that each pulse, from whatever source, charges the capacitor to a precise extent.

The signal generator 212 in Fig. 26 delivers pulses in groups of five as distinct from the groups of four in Fig. 23. The generation of the fifth pulse in each group coincides with the coming into printing position of a space between successive groups of type faces in the type-carrier so that, in these instants the respective condensers 231¹⁻ⁿ in the denominations where no printing is effected can be discharged.

When the capacitors have been discharged they stand at a potential equal to the arc voltage of the corresponding discharge tubes and when charged to the said pre-determined maximum they are at a potential equal to the ignition voltage of the respective discharge tubes. For example the arc voltage may be ten volts and the ignition voltages 250 volts.

Fig. 27 illustrates a modification of the arrangement shown in Fig. 26. In the embodiment shown in Figs. 1-18 each cycle of the sensing of the storage corresponded to the movement of the type-carrier from one printing face to another in the printing position. On the other hand, in Figs. 19-26 each cycle of sensing corresponded to the movement of a group of printing faces through the printing position. Now in Fig. 27, and in the following figures a cycle of sensing corresponds to a cycle of movement of the type-carrier. These cycles may be arranged in an alternate sequence so that, in the first cycle sensing of the storage takes place and in the second cycle printing from the type-carrier takes place, and so on.

In Fig. 27 the storage 13 and its sensing heads 14, 15, 162, and 163 are the same as in the previous embodiments. The start signal is sensed by sensing head 163

and changes over flip-flop 168 so that sensing by the sensing heads 14 and 162 may then take place as described above. At the same time the changing over of flip-flop 168 prevents the sensing of signals at the pulse generators 237, 238 described below.

The distributor 239, which corresponds to the distributor 205 in the previous embodiment, has two switching ways for each storage area on the signal track 13^b, that is one for the first half of the storage area, within each denomination area. When the first half of a denomination area is passing the signal head 15 the distributor arm 240 closes the first switching way 240^a for the corresponding denomination. The switching over of flip-flop 168 has opened the three amplifiers 241, 243, 242, and thereafter, the sensing of a first signal by sensing head 162 in signal set 13^c applies a pulse to the flip-flop 244, which opens the amplifier 245, and the information signals then sensed by sensing head 14 in track 13^d pass through amplifier 241 through the amplifier 245 to the mono-stable flip-flop 246 and to the distributor arm 240 and then through the switching way 240^a to the control grid of pentode 247¹. Each such signal sensed in track 13^b in this first half of the denomination area applies a unit of charge to the capacitor 248¹ through the associated pentode 247¹.

Next, the sensing of a signal in track 13^d by signal head 15 passes a pulse through amplifier 243 to switch over the flip-flop 244 and close the amplifier 245 so that no further pulses from signal head 14 can pass through to the distributor. By the time the second half of the storage area has come to sensing position, the distributor arm 240 has moved to position 240^b so that the sensing of the next signal in track 13^c by signal head 162 applies a pulse to flip-flop 244 to switch it over and open amplifier 245. Thereafter, further sensing of signals by signal head 14 passes pulses through amplifier 241, amplifier 245, mono-stable flip-flop 246 and distributor arm 240 to the switching way 240^b of the corresponding denomination area and to the control grid of the second pentode 249¹. Further pulses are now sensed by sensing head 14 and each signal sensed in track 13^d applies a unit of charge to the capacitor 250¹. This charging of the capacitor is terminated by the sensing of the next signal in track 13^d by signal head 15, which passes a pulse through amplifier 243 to switch over flip-flop 244 and thereby close the amplifier 245. At this stage the capacitors 248¹ and 250¹ are charged to extents corresponding respectively with the first and second parts of the denominational signal in the storage area.

This operation is repeated, storage area by storage area, until the complete storage is sensed. At the end of the cycle, all the information signals in track 13^d are now represented by the charge state of the two capacitors of the respective denomination circuits.

This effects a transfer or transposition from a serially-read storage to a parallel-operated storage. This serial reading of signals in a cyclically-sensed storage and charging of capacitors for the several denominations, allows of a parallel out-put for a parallel printing operation. At the end of the cyclic sensing of the storage, the start signal 178 is again sensed by sensing head 163, which applies a pulse to flip-flop 168 through the intermediate amplifier, to switch the flip-flop back to its initial position thereby closing the three amplifiers 241, 242, and 243 and preventing any further charging of the capacitors. At the same time the switched-over flip-flop 168 opens the amplifiers 251 and 252 which receive signals from the respective pulse generators 237 and 238. The pulses from generator 257 pass through the mono-stable flip-flop 253, through the diodes 254¹⁻ⁿ to the control grids of the pentodes 247¹⁻ⁿ. These pulses are amplified in the pentodes 247¹⁻ⁿ and apply corresponding charge units to the capacitors 248¹⁻ⁿ, eventually completing the charging to a pre-determined maximum of those capacitors where there has been a previous charging by signals from the storage.

The capacitor 248¹ leads to the anode of a discharge tube 255 which is pre-biased by a voltage source 256. The igniting of the tube 255 applies a voltage to the electrode of the further discharge tube 257, the main circuit from which thereupon effects a voltage drop at the cathode resistor 258 and prepares the diode 259. The discharge tube 257 is automatically extinguished in known manner through the capacitor 237^a, that is to say after a group of four signals has been generated at the generator 238. The distributor arm 240, at the second switching way 240^b and the pulses are delivered therefrom through the capacitor 260 to the grid of the second pentode 249¹ to charge the capacitor 251 with a number of units of charge corresponding to the number of pulses sensed at the storage 13. This number of units is determined by the opening of amplifier 245 by the second switching signal in track 13^c and the closing of that amplifier by the sensing of the second part 181^b of the information signal in track 13^d.

With the pulse generators 237 and 238 rotating at the same speed as the type-carrier the generator 237 will generate eleven signals in each rotation, that is one signal of the first ten for each of the ten groups of characters on the type-carrier and an eleventh signal for a purpose described below. The time instants for the delivery of the ten signal are those which obtain between the passing of the last type face of one group and the first type face of the next group through the printing position.

The generator 238 will generate forty signals in each rotation i.e. four signals for each group of characters on the type-carrier. These pulse generators may for example comprise small permanent magnets held in slots in carriers of non-magnetic material or they may comprise permanently recorded magnetic signals, optically-sensible signals or the like. In the case of optically-sensible signals photo-cells would be used as sensing means.

The signals from the generator 238 may pass through to the pentode 249¹ only if the diode 259¹ has been prepared as described above by a discharge from the capacitor 248¹ after it has been charged to its predetermined maximum value. The signals from generator 238, after passing through the diode 259¹, are fed to the control grid of the pentode 249¹ and apply further charge units to the capacitor 251 until it has reached its pre-determined maximum value. Upon this capacitor 251 attaining its pre-determined maximum charge it is discharged through the printing magnet coil 261¹.

At the end or near the end of the rotation of the type-carrier, the eleventh signal is generated by generator 237 and passed through amplifier 251, mono-stable flip-flop 253^a and the diodes 254¹⁻², to the control grid of pentode 247¹. The signals from the pentode 247¹ complete the charging of capacitor 248¹ which is then discharged through the discharge tube 55¹. Of course, the capacitor 248¹ is completely charged by this eleventh signal only if it had not been charged by the sensing of signals from the storage 13.

The groups of four signals in the generator 238 are arranged in ten elevenths of the circumference, corresponding to ten only of the signals in the generator 237. The eleventh part of the circumference in 238 generates no signals. Also, on the type-carrier, the type faces are distributed throughout ten elevenths of the circumference, the eleventh area being without type faces and corresponding to that part of generator 237 which generates the eleventh signal.

Fig. 28 illustrates an arrangement which can be used when the information is recorded in the storage 13 in the form of combination signals, for example a six-code combination. The device is started by the closing of the switch 264, which switches over the flip-flop 265 to open the amplifier 266, so that the next sensing of the start signal 179 by sensing head 163 feeds a pulse through amplifier 266 to the flip-flop 267, switching it over to open the amplifier 268 and the amplifier 269. The

switching over of flip-flop 267 also closes the amplifier 271 for a purpose described below.

After the opening of amplifiers 268, 269 the sensing of signals by sensing head 14 in the second signal track 13^b of storage 13 feeds pulses through the amplifier 268 and a further amplifier 272 to the counting tube 273. The signals in such second track 13^b are in groups of six corresponding to the six-code combination being used. The counting tube 273 has twelve stages, the first six of which are filled in the sensing of a group of signals by sensing head 14. The second six stages in the tube 273 are filled by the sensing of the second group of signals by sensing head 14. The said first six stages and the second six stages of the tube 273 are connected in parallel respectively to the controlled amplifiers 274¹⁻⁶. These amplifiers, therefore, are opened (i.e. made conductive) successively as the six signals in each group are sensed.

The out-puts from the amplifiers 274¹⁻⁶ are supplied in parallel each to one diode of a group of diodes 275¹⁻ⁿ-280¹⁻ⁿ, there being one such group of diodes for each denomination for which printing is to be effected. There is a distributor 281 having switching ways 281¹⁻ⁿ for the respective denominations in which printing is to be effected. For the first switching way 281¹ the diodes in group 275¹-280¹ are open. For the second switching way 281² the diodes in the group 275²-280² are open, and so on.

The combination signals representing the matter to be printed are sensed by sensing head 15, the pulses from which pass through amplifier 269 to the several amplifiers 274¹⁻⁶, that is to the common in put of those amplifiers. But such pulse can pass through only that amplifier 274 which at the same time instant is open because of the simultaneous sensing of a signal by the sensing head 14. After passing through one or other of the amplifiers 274¹⁻⁶, the pulse is fed to the several groups of diodes but can only pass through a diode in that denomination for which at that time instant a switching way on distributor 281 is operative.

For each group of diodes there is a binary accumulator having six stages one for each diode of the group. These accumulators are shown at 282¹-287¹ to 282ⁿ-287ⁿ. The stages of the accumulators are illustrated as stages of a flip-flop chain, although cold cathode tubes could be used, or magnetic core chains or other accumulator device.

After the sensing of the first storage area in the storage 13, there are in the first binary accumulator 281¹-287¹ signals corresponding to those recorded in such first storage area. In the sensing of the second storage area of the storage 13 the signals recorded in the third track are passed through to the second binary accumulator 282²-287², and so on, and at the end of a complete sensing of the storage there are in the several binary chains, signals in parallel corresponding to those recorded as combinations in the several storage areas in the storage 13.

At the end of the complete sensing of the storage, the start signal 179 is again sensed by sensing head 163, the consequent pulse passes through amplifier 266 to the flip-flop 267 switching it back to its original position and thereby closing the amplifiers 268 and 269. The switching over of flip-flop 267 also applies a pulse to flip-flop 265 which closes the amplifier 266. When the amplifiers 268, 269 are closed by the switching over of flip-flop 267 the amplifier 271 is opened under the control of the same flip-flop.

A pulse generator 288 is provided moving synchronously with the movement of the type-carrier and the generated signals are sensed by sensing head 289 and passed to amplifier 271. If that amplifier has been opened as just described, the signals are passed through the controlled amplifiers 290¹⁻ⁿ which lead to the lowest stage (last denomination stage) of the corresponding

binary accumulators 282¹⁻²⁸⁷ to 282ⁿ⁻²⁸⁷. The pulse generator 288 is adapted to generate 64 pulses in each complete rotation, corresponding to 64 possible printings in one cycle of the movement of the type-carrier.

The said amplifiers 290¹⁻ⁿ are controlled by the respective discharge tubes 291¹⁻ⁿ and the amplifiers remain open so long as those discharge tubes are not ignited. When a discharge tube 291¹⁻ⁿ is ignited, as described below, the corresponding amplifier 290¹⁻ⁿ is closed. Each triode includes a capacitor which is loaded upon the ignition of the corresponding discharge tube. The discharge from this capacitor takes place during a period of the next cycle of sensing of the storage, so that the amplifier is again open when the next-but-one cycle of sensing begins. The voltage passing through the controlled diodes enters the lowest stage of the corresponding binary accumulator and effects a successive carry over from stage to stage until the final stage is reached and a final carry pulse is delivered through the capacitor 292¹⁻ⁿ to the grid of the corresponding discharge tube 291¹⁻ⁿ. Said final carry pulse is also taken to the lowest stage of the binary accumulator to re-set the accumulator for the next cycle. Because of the closing of the controlled amplifiers 290¹⁻ⁿ no pulses are delivered to the accumulators from the generator 288.

The ignition of a discharge tube 291¹⁻ⁿ effects an anode current through the corresponding printing coil 293¹⁻ⁿ to effect printing in the corresponding denomination. The windings of these coils lead through capacitors 294¹⁻ⁿ to the plus pole 295. The discharge tubes 291¹, 291ⁿ are extinguished by the charging of the capacitors 294¹⁻ⁿ, and these capacitors are discharged through the respective resistance 296¹⁻ⁿ.

The re-opening of amplifier 266 for the beginning of the operation for the next printing line is effected by a reclosing of switch 264 which may be effected for example from the storage or by switches on the type-carrier, or otherwise. If it is desired to print during each rotation of a type-carrier which has the type faces spread around the whole of its circumference, two sets of counting and intermediate storage means are required and in such case the coils of the printing magnets 293¹⁻²⁹³ will have two windings one from the one set of intermediate storage devices and the other from the other set of intermediate storage devices and these intermediate devices will be operated alternately in the successive rotations of the type-carrier. Similarly with the arrangement shown in Fig. 21 the magnet coils 191¹ to 191ⁿ could each be provided with two sets of four windings and the distributing and intermediate storage devices could be duplicated, one for one set of four windings and the other for other set of four windings, these operating alternately for the successive rotations of the type-carrier.

The continuous movement of the type-carrier referred to above need not necessarily be a permanently continuous movement but could be a step-wise movement with increments of continuous movement during the passage of the respective type faces through the printing position.

Fig. 29 shows the type-carrier as a rotatable member 297, having ten type faces 299⁰⁻⁹ and fixed on a spindle 298 by which it is continuously driven. A mechanical tripping device comprises a continuously-rotating toothed wheel 300 rotating in synchronism with the type-carrier 297, and a spring-loaded pawl 302 adapted to be displayed by the teeth 301¹⁻⁵ as that wheel rotates, the pawl being mounted on a pivoted spring blade 303 the end of which carries an impression member 311 to co-operate with whichever type face is in printing position. The interrupting means for interrupting the trip device is a latch 305 which holds the pawl out of the path of the teeth of said wheel 300 against the resistance of the spring 307. The latch 305 is withdrawn by a solenoid 308 under the influence of signals representing the character to be printed and allows the pawl to en-

gage the wheel. As the pawl jumps off a tooth the spring blade 303 acquires a momentum causing the impression member 311 to approach the type face sharply and shortly at a precise instant in the rotation of the type-carrier. The paper is shown at 313 with an ink ribbon 312 between it and the type face.

For very high speed printing, the arrangement may be characterised in that, from sensed signals representing the characters to be printed, the control means is primed for operation (e.g. by the pawl 302 falling on to a tooth of the wheel 300) but operates only at exact instants in a cycle (e.g. when the pawl passes from one tooth to another) in dependence on the rotation of the type-carrier 297. Adjustment means may be provided for advancing and retarding the said exact time instants relatively to the cycle of operation of the control means, say by varying the relative angular positions of the wheel 300 and the type-carrier 297.

The above-mentioned trip device in the said control means may have a less number of tripping possibilities than the number of type faces on the type carrier, and be arranged to operate at correspondingly higher speeds relatively to the rotation of the type carriers. For printing in side by side columns the control means is switched selectively to the respective printing devices in dependence on a selection of columns in which printing is to be effected. On the other hand, there may be a less number of printing devices than there are columns in which printing is to be effected, with means whereby the printing devices are moved to selected column positions for printing. Instead of moving the printing devices the paper or other material may itself be moved transversely to bring selected columns into register with the required printing devices.

The synchronism between the distributor and the type-carrier may be effected by a mechanical coupling or by electrically-synchronised driving means, or the use as driving means of synchronised motors in a common circuit. Still further, the synchronism may be effected according to a start-stop system controlling one or more of the relatively moving elements.

In a further embodiment of the invention, for printing in side by side columns, signals for a plurality of columns are sensed cyclically and successively and printing means for the several columns are operated by the sensed signals simultaneously with each other. Such sensed signals may be passed through a common amplifier and distributed selectively to a plurality of printing devices for the corresponding columns. A cycle of sensing may be co-ordinated to the movement of any two consecutive type faces into position, and sensing may be effected at a speed equal to the same multiple of the speed of movement of the type-carrier. For each cycle of sensing the next type face is brought into printing position.

In a preferred arrangement the record means has a rotation-symmetrical movement, each rotation representing one sensing cycle. In one arrangement of the printing device having side by side sequences of type faces for printing in side by side columns, the type faces in adjacent series are off-set angularly, relatively to each other, so that for the same character, the type faces for that character in all the sequences are brought into printing position successively column by column. In another arrangement there is means provided for delaying the selected control means, whereby the characters to be printed in all columns may be printed simultaneously. Such delay means may comprise a mechanical storage device for each sequence of type faces, or it may comprise a capacitive storage or an electro-mechanical relay or an electronic storage.

What I claim is:

1. A high speed printer for printing in a plurality of denominations comprising a type carrier with a plurality of type wheels each having a plurality of type faces thereon, means for advancing the type carrier to bring succes-

sive type faces through a printing position, means for holding a print receiver in said printing position, means for effecting a mutual approach between the print receiver and the type face in the printing position, control means operating synchronously with the advance of the type carrier to actuate the said mutual-approach means at precise time instants in said advance to effect a print from corresponding type faces, a serially operating signal storage device for signals representing characters to be printed, means for deriving output signals from said storage device, and signal distributing means synchronized with the type carrier and said storage device and operative to distribute said output signals in turn to the control means cooperating with different ones of said type wheels.

2. A high speed printer according to claim 1, wherein said type carrier is a rotary member with the type faces on its periphery and the said mutual approach means includes a movable impression member at the printing position for moving the print receiver towards the type.

3. A high speed printer according to claim 2, wherein said impression member is a spring member and wherein the mutual approach means includes a limited displacement member and a spring armature to retain it in inoperative position and electro-magnetic means to withdraw the armature in dependence on the characters to be printed.

4. A high speed printer comprising a serially operating storage for signals representing the characters to be printed, means for the cyclic sensing of said storage, a type carrier including a plurality of type members moving through a printing position synchronously with said cyclic sensing of the storage, impression means for each type member operable by electric pulses, and distributing means supplying the sensed signals as pulses to said impression means in succession at time instants in the sensing cycle corresponding to the presence of particular type faces in the printing position.

5. A high speed printer for printing in a plurality of denominations, comprising a storage for signals representing the characters to be printed and having storage areas for the respective denominations, means for the cyclic sensing of said storage through the said storage areas successively, a type-carrier for each denomination having type faces for the characters to be printed, means for advancing the respective type-carriers synchronously with the said cyclic sensing to pass the type faces through a printing position successively, means associated with each type carrier for effecting an impression from any type face in the printing position, and distributing means for the sensed signals operating the impression-effecting members selectively in dependence on sensed signals at time instants during the sensing cycle corresponding to the presence in the printing position of particular type faces.

6. A high speed printer according to claim 5, wherein the storage has at least two signal tracks lying in the direction of sensing, one for counting signals and one for signals representing the matter to be printed, and including signal-counting means controlling the effectiveness of said distributing means at a successively different time instant in each successive cycle of sensing.

7. A high speed printer according to claim 5, wherein each denominational area of the storage has two sub-areas in the direction of sensing, wherein the storage has at least four signal tracks lying in the direction of sensing, one for a start signal, one for counting signals, one for switching signals controlling said sub-areas, and one for signals representing the characters to be printed, and including signal counting means controlling the effectiveness of said distributing means at a successively different time instant in each successive cycle of sensing, operated by the sensing of said counting signals, intermediate storage means for the sensed character signals for the respective denominations, and switching means operated by said switching signals to control a sensing of character

signals at one period and a printing from the said intermediate storage at another period.

8. A high speed printer according to claim 7 and including pulse generating means complementing said signal counting means to effect the said printing from the intermediate storage.

9. A high speed printer for printing in a plurality of denominations comprising a storage for signals representing the characters to be printed and having successive storage areas corresponding to the respective denominations, means for effecting a cyclic sensing of signals in said storage areas successively, intermediate storage means for each said denomination, a type carrier with type faces moving successively through a printing position synchronously with said cyclic sensing, distributing means supplying to said intermediate storage means in each cycle of sensing the signals for a particular character in those denominations where such signal is sensed, and means for effecting a print of that character in said denominations from the corresponding intermediate storages in parallel.

10. A high speed printer according to claim 9, wherein the type faces on the type carrier are in groups, each group containing one character from a number of predetermined series of characters and wherein the distributing means includes means operating in dependence on sensed signals to select the group of type faces in which the character corresponding to a sensed signal is found and to select the time instant in the movement of the type faces at which that character is in printing position, to effect the print at that instant.

11. A high speed printer according to claim 9 wherein said intermediate storages are capacitors.

12. A high speed printer according to claim 9 wherein said intermediate storages are counting chains.

13. A high speed printer according to claim 9 wherein said intermediate storages are discharge tubes.

14. A high speed printer according to claim 9 wherein characters are recorded in the storage as combination signals, wherein sensing means counts the combinations as binary numbers and wherein the intermediate storages are binary accumulators.

15. A high speed printer according to claim 9 wherein characters are recorded in the storage as combination signals, wherein sensing means counts the combinations as binary numbers wherein the intermediate storages are binary accumulators and wherein pulse generators complement the count in said accumulators to select the said time instants and to effect printing at those time instants.

16. Apparatus for printing a plurality of characters in a plurality of columnar positions, comprising a type wheel for each columnar position, means for rotating the type wheels, a signal storage device for signals representing characters to be printed, means operable to read out the stored signals in synchronism with the rotation of the type wheels, all such signals being read out for the passage of each type character past a printing position, signal selecting means responsive to the read out signals to generate an output signal for each such signal corresponding to the particular character at the printing position, a hammer mechanism for each type wheel, and means responsive to said output signals to effect operation of said hammer mechanisms.

17. Apparatus as claimed in claim 16, in which said signal storage device comprises a rotatable member with a magnetizable signal storage surface thereon, and magnetic signal transducing means associated therewith, and having means operable to rotate said member once for each type character passing the printing position.

18. Apparatus as claimed in claim 17, having a signal distributing device operating in synchronism with said member and operable to connect operating means for the hammer mechanisms sequentially to the output of the selecting means.

19. Apparatus as claimed in claim 18, having a ham-

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mer, retaining means holding the hammer in an inoperative position, electro-magnetic means operable in response to an output signal applied thereto to release the hammer from the retaining means and means operating in synchronism with the rotation of the type wheels and cooperating with a released hammer to cause it to effect printing of a character.

20. Apparatus as claimed in claim 17, in which said selecting means includes a signal gate to which the read out signals are applied, a counter, means interconnecting the counter and the gate to render the gate operative each time the counter registers a predetermined count and means for applying pulses to operate the counter in synchronism with the rotation of the storage member.

21. Apparatus as claimed in claim 20, in which the storage member has a control signal track thereon, a magnetic sensing head associated with said track and means responsive to signals induced in said head to generate said pulses applied to the counter.

22. Apparatus for printing a plurality of characters in a plurality of columnar positions, comprising a type

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wheel for each columnar position, a hammer mechanism located at a printing position for each type wheel, means for rotating the type wheels, a rotatable member with a magnetisable signal storage surface thereon for storing character representing signals, means operable to rotate said member once for each different type character on the type wheels passing the printing position, magnetic signal transducing means cooperating with said member to read out the stored character representing signals in sequence, signal selecting means operable to generate an output signal in response to the occurrence of a read out signal corresponding to the character at the printing position and signal distributing means operating in synchronism with said rotatable member and effective to distribute said output signals serially to said hammer mechanisms.

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