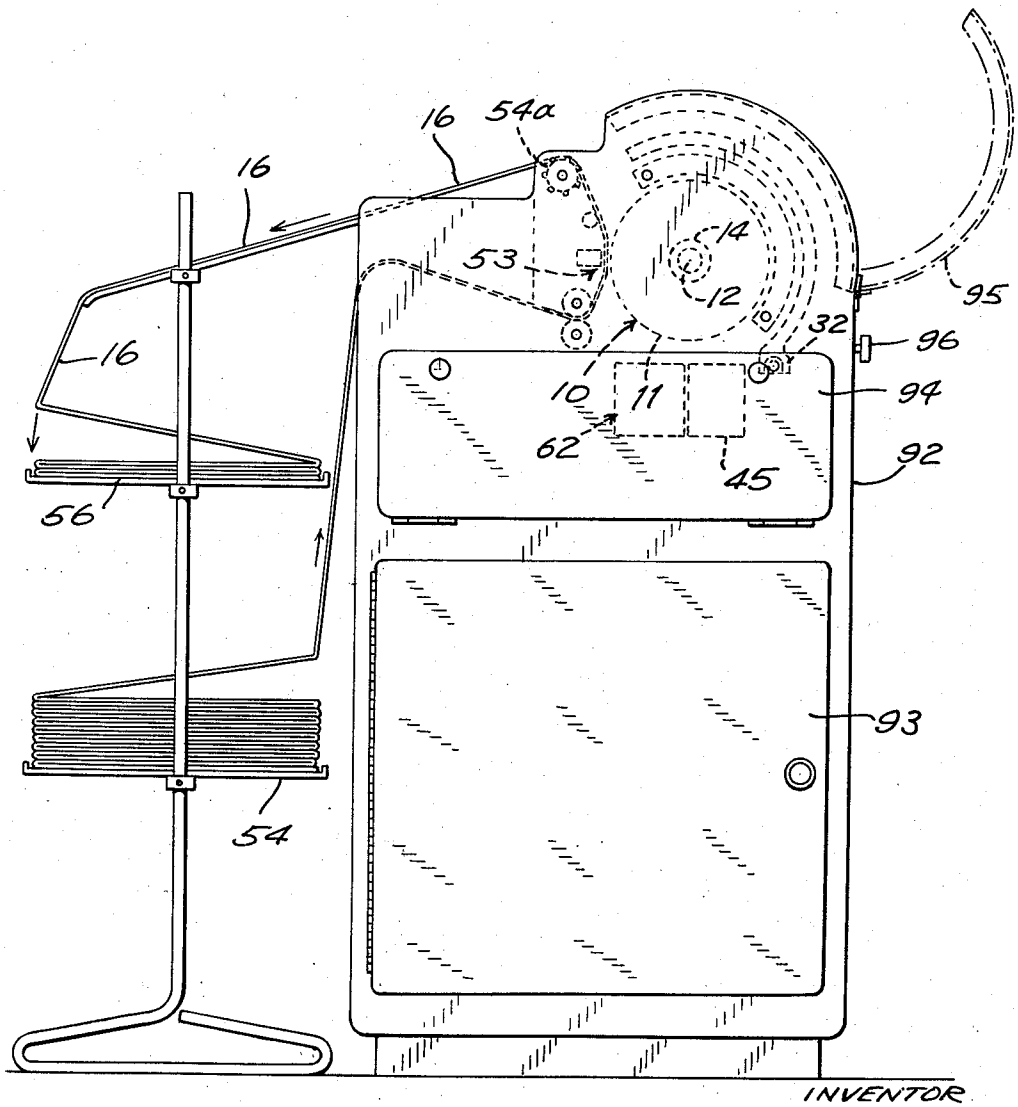
July 29, 1958 R. C. STIEFEL 2,845,019

MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 1

Fig. 1.



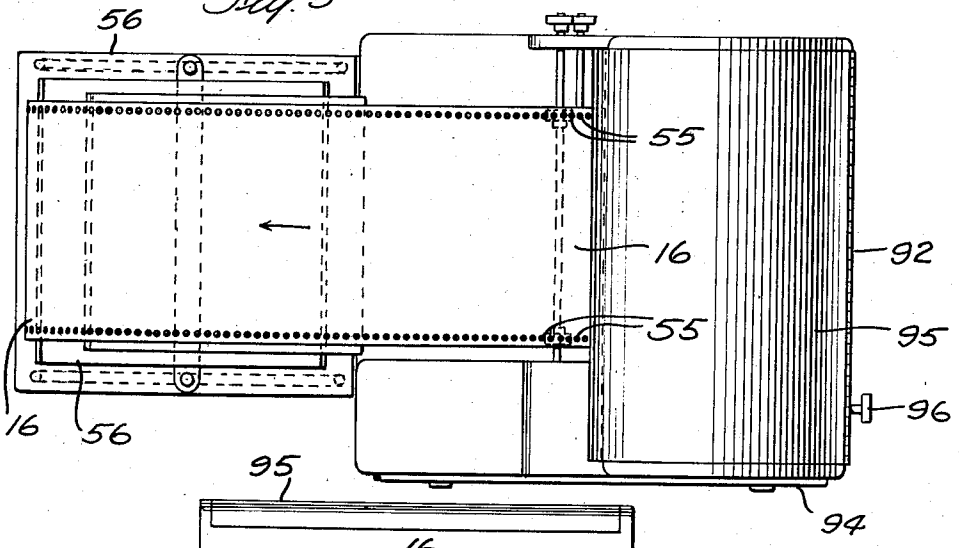
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MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 2

Fig. 3



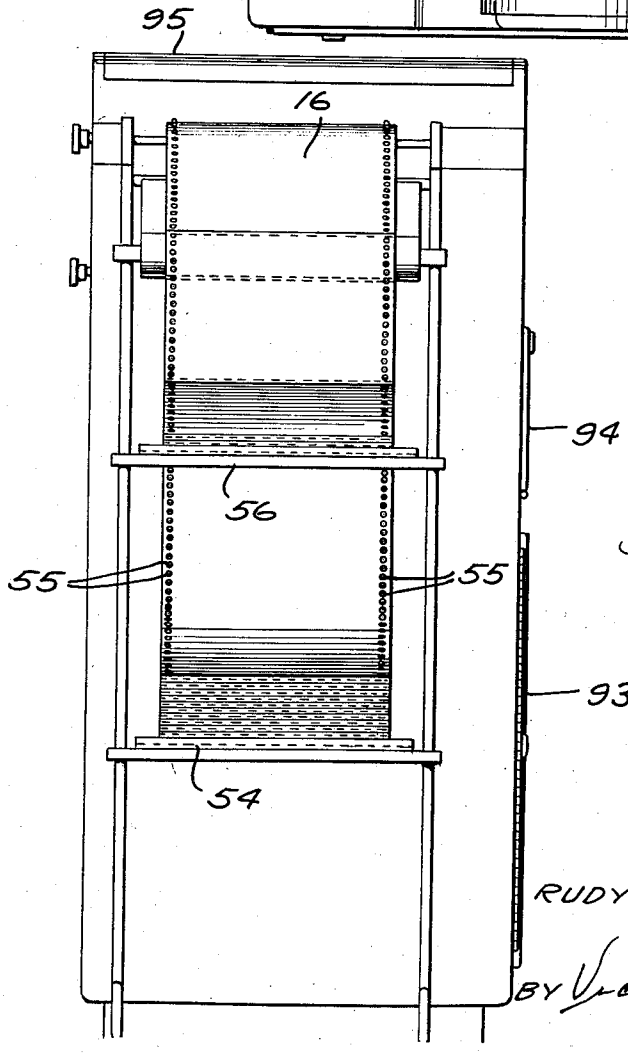


Fig. 2.

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MEDIUM SPEED PRINTER

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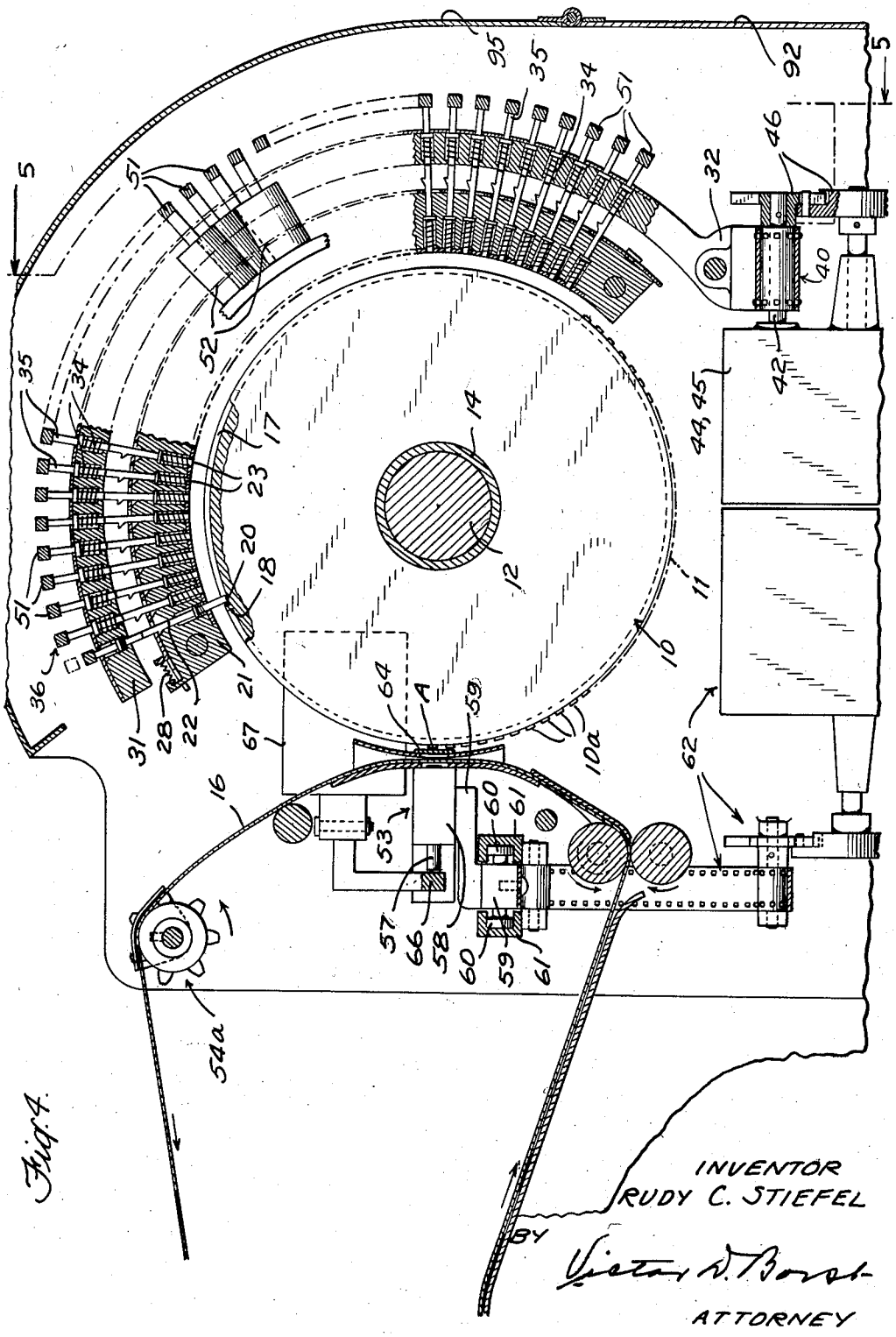


Fig. 4.

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July 29, 1958 R. C. STIEFEL 2,845,019

MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 4

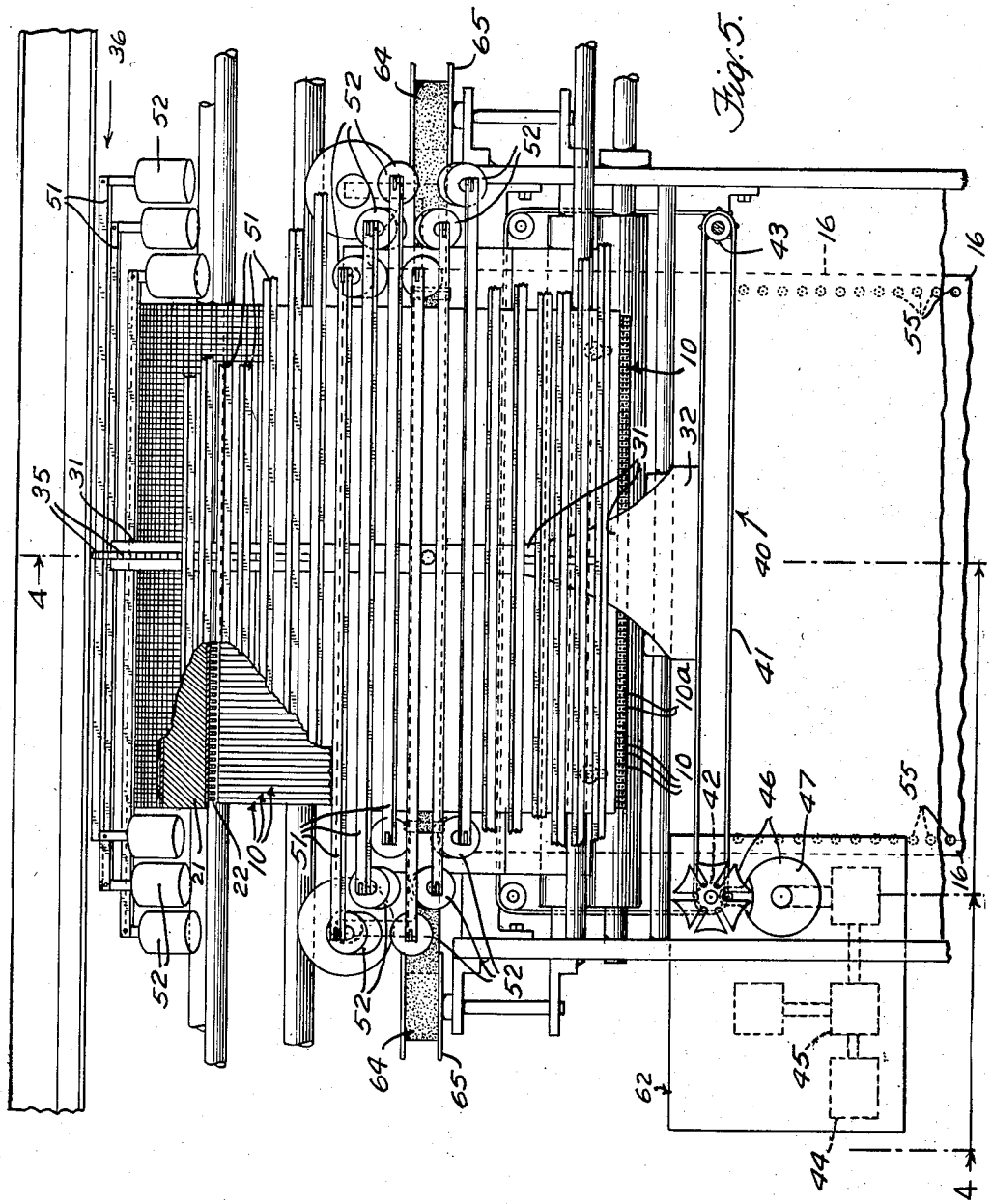


Fig. 5.

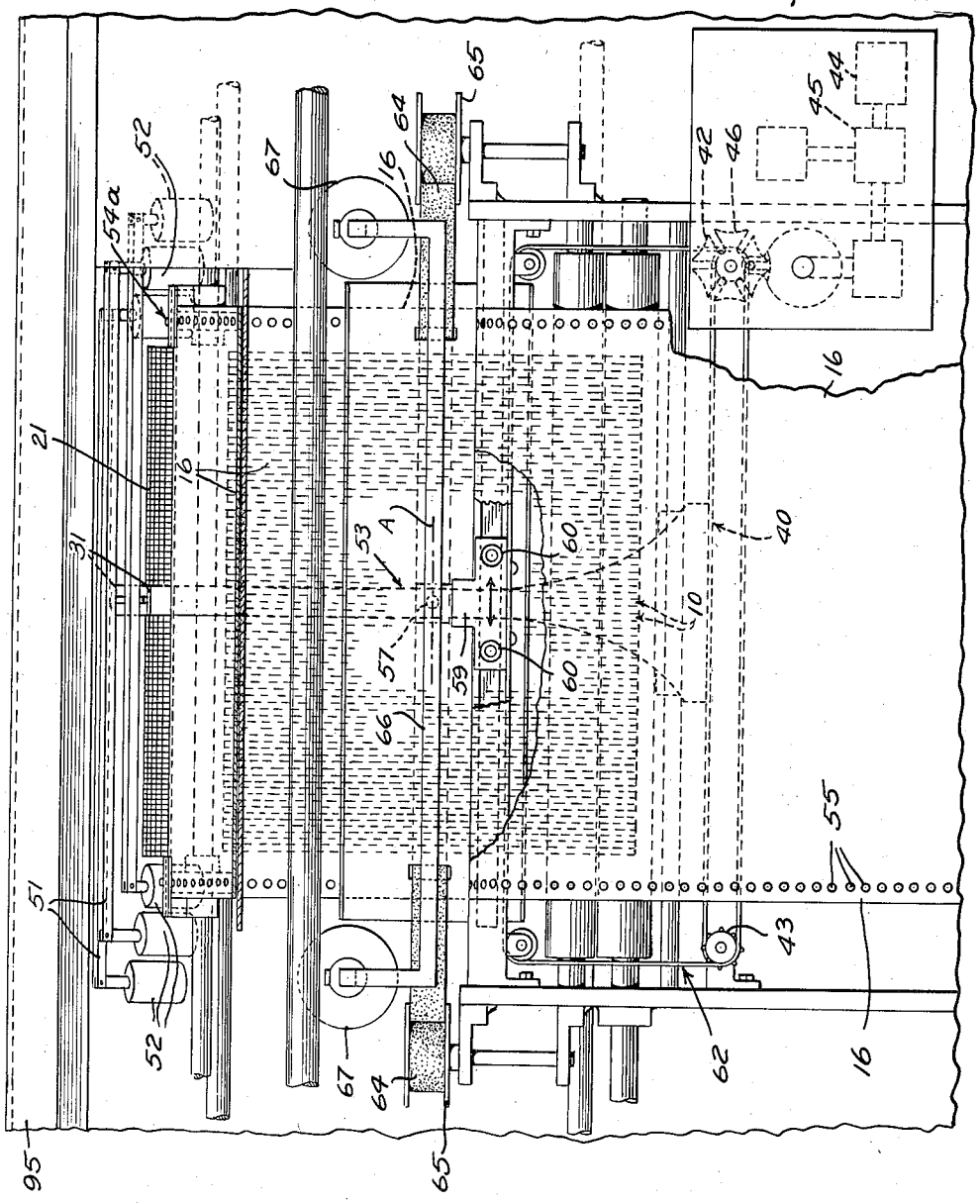
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July 29, 1958 R. C. STIEFEL 2,845,019

MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 5

Fig. 6.



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July 29, 1958 R. C. STIEFEL 2,845,019

MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 6

Fig. 7

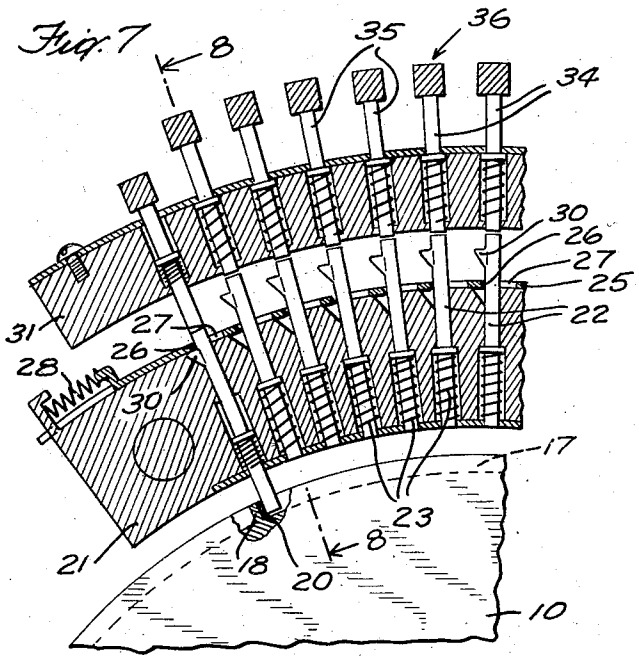
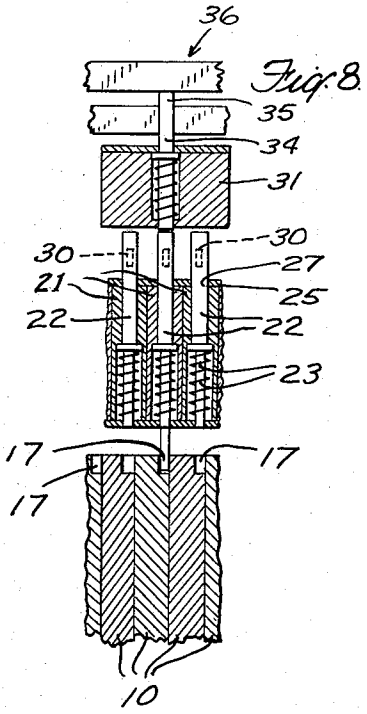
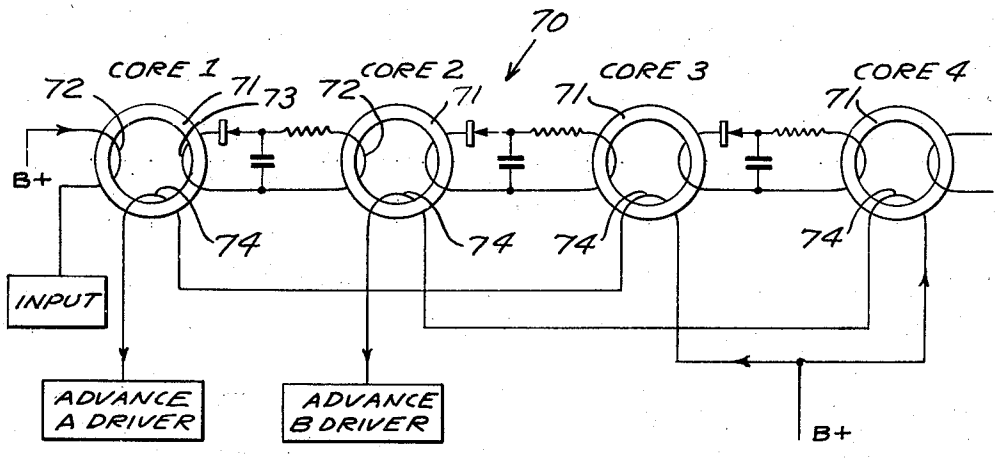


Fig. 8





PART OF COUNTER REGISTER

Fig. 9.

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July 29, 1958 R. C. STIEFEL 2,845,019

MEDIUM SPEED PRINTER

Filed May 16, 1955 7 Sheets-Sheet 7

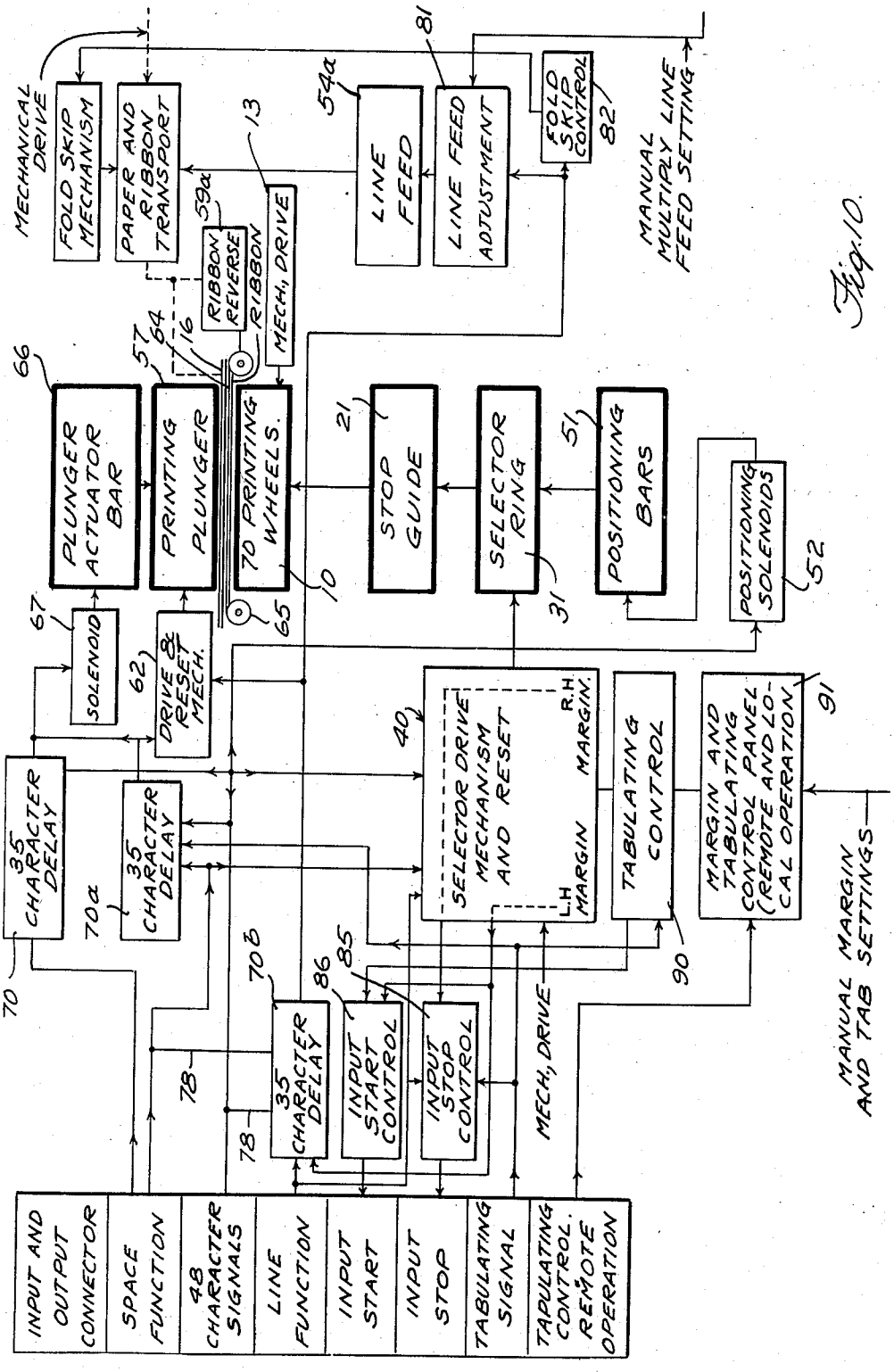


Fig. 10.

United States Patent Office 2,845,019 Patented July 29, 1958

2,845,019

MEDIUM SPEED PRINTER

Rudy C. Stiefel, Woodside, N. Y., assignor to Sperry Rand Corporation, a corporation of Delaware

Application May 16, 1955, Serial No. 508,427

11 Claims. (Cl. 101—96)

The present invention relates to printers operable at high speeds.

One object of the present invention is to provide a printer, which although occupying a comparatively small space, can operate a great deal faster than teleprinters and electric typewriters now in operation, which is comparatively simple and highly dependable, and which although printing at high speeds, has its critical parts operating at low speeds.

In accordance with the present invention, the printing function of the present machine is accomplished by two operations, namely selection of characters and printing of characters. A time delay is introduced between selection and printing to afford ample time for selection without undue stresses in the mechanism.

More specifically, the printing is effected in accordance with the present invention by a deck of similar printing wheels mounted on a common continuously rotating shaft and carrying duplicate sets of printing characters. These printing wheels are mounted to rotate with the shaft but have slip connections therewith permitting the wheels to be stopped independently of each other without stopping the shaft. Selection is made by a selector device which acts on the wheels successively to cause said wheels to stop in positions according to the character signal transmitted to the machine. In the position in which the wheel is stopped by the selector device, the selected character thereof lies on the line of action of a printing device. This printing device follows the selector device along this line of action and operates to impress the selected character along this line on a record sheet. A delay is introduced between the reception of a character signal causing the actuation of the selector device and the operation of the printing device, in order to allow the character wheels sufficient time to be positioned. The delay offset between the selector device and the printing device corresponds to a definite number of signals. At the beginning of printing operations, the character signals transmitted to the machine cause the selector device to operate successively on the character wheels, so that each signal causes a selection on a corresponding wheel. During this initial phase, the printing device remains inactive. After a predetermined number of signals have been received and a corresponding number of selections have been made on the wheels, the printing device starts to operate. Thereafter, the printing device operates successively on the selected wheels at the same speed as the selector device but at a later phase corresponding to the lag set into the machine by the offset described. This allows the wheels ample time to accelerate and decelerate into selected positions without undue speeds or stresses.

The printing machine is provided with means for transmitting line function signals by which the printing operation is transferred to a next successive line and input stop and start controls by which during the periods when the selector device or printing device is shifting for the

next line operation, stop signals are sent out to hold up the transmission of input information signals. After a delay sufficient to permit the selector device or printing device to return for the next line operation, an input start signal is generated causing the printing and selection operations to resume. In this manner, the necessary lag between selection and printing is maintained.

As a further feature, tabulating controls are provided operating in conjunction with the input stop and start controls described above, to permit the tabulating of characters or figures in predetermined columns on the record sheet.

By means of the printing machine described, it is possible to operate at a speed of as high as 50 to 100 characters per second.

Various other objects, features and advantages of the invention are apparent from the following particular description and from the accompanying drawings, in which

Fig. 1 is a side elevation of the printer embodying the present invention;

Fig. 2 is a rear elevation of the printer;

Fig. 3 is the top plan view of the printer;

Fig. 4 is the end view of the wheel assembly with associated selector and printing parts and taken approximately along the lines **4—4** of Fig. 5;

Fig. 5 is the rear elevation of the wheel assembly with associated selector and printing parts taken approximately along the lines **5—5** of Fig. 4;

Fig. 6 is the front elevation of the wheel assembly with associated selector and printing parts shown in Fig. 4;

Fig. 7 is a detail section of the wheels with associated selector parts;

Fig. 8 is a radial detail section of the wheels with associated selector parts taken approximately along the lines **8—8** of Fig. 7;

Fig. 9 is a diagram of a delay counter register which may be employed as part of the printer; and

Fig. 10 is a diagrammatic showing of the various parts of the printer indicating their functional relationship.

Referring to the drawings, the printing machine itself comprises a deck of character bearing wheels **10** (Figs. 4, 5, 6 and 7) (**70** being shown) all of the same size and each carrying a series of imprinting characters **10*a*** arranged along a section **11** of its periphery. These wheels **10** all carry the same characters similarly arranged. In a specific example, the wheels **10** may carry between 48 and 64 characters, including letters and numerals. For the purpose of illustration, the drawings show each wheel **10** carrying 48 different characters.

The wheels **10** are all centrally mounted on a shaft **12**, which is constantly rotated from a suitable drive **13** (Fig. 10) and the connection between each wheel and the shaft is such, as to permit the wheel to be stopped independently of the other wheels upon selection, without stopping the shaft. To that end, this connection is a friction slip device, which may comprise a bushing **14** (Fig. 4) affixed to each wheel **10** at the center and embracing the shaft **12** with sufficient friction to cause said wheel to rotate with said shaft, when said wheel is not blocked but to permit said wheel to be stopped in selected angular position without stopping the shaft.

The printing operation is carried on against a record sheet **16** (Figs. 4 and 6) along a line of action A parallel to the wheel shaft **12** in a manner to be more fully described. For stopping the wheels **10** in position to cause selected characters thereon to come to rest along the printing line of action A, each of said wheels has a recess **17** (Figs. 4 and 7) on one side extending around the entire periphery of the wheel except in one section to provide a radial stop **18** faced with a bumper pad **20** made of resilient material, such as neoprene. For co-

operation with this stop **18**, there is provided a fixed stop pin guide **21** (Figs. 4 and 7) in the form of a sector arm, partially encircling each wheel **10** in a region diametrically opposite the line of printing action A and arranged concentrically with said wheel. This stop pin guide **21** radially holds a series of spaced stop pins **22** corresponding in number to the number of characters on the wheel **10**, i. e. 48 stop pins in the example illustrated. A spring **23** encircles each of the pins **22** and normally urges it radially outwardly, with the end section of the pin projecting beyond the outer periphery of the stop pin guide **21**, to permit it to be depressed inwardly by a selecting operation to be described. This selecting depressing operation causes the radially inner end section of the stop pin **21** to project into the peripheral recess **17** of the rotating wheel **10** in the path of the stop **18**. When the wheel **10** is immobilized by engagement of its stop **18** with the depressed stop pin **22**, the character thereon which lies on the line of action A, will be the selected character. The wheel **10** will remain in this immobilized position, until the printing device to be described reaches this character and imprints it on the record sheet **16**, whereupon the printing device moves on to the next wheel stopped in selected position.

To assure the maintenance of the depressed selected stop pin **22** for the wheel **10** in depressed position until the printing device has reached this wheel, there is provided an arcuate lock bar **25** (Figs. 4, 5 and 7) on the outer periphery of each stop pin guide **21** concentric therewith and having a series of openings **26** through which the stop pins **22** project respectively with clearances **27** on one side of the pins. This lock bar **25** is mounted to move a small distance circumferentially along the fixed stop guide **21** and is urged towards one limiting position by a spring **28**. A bevel catch **30** on each stop pin **22** rides across the edge of the corresponding opening **26** as the pin is depressed by selection, causing the lock bar **25** to be moved circumferentially along its arcuate length against the action of the spring **28**. This allows the selected stop pin **22** to be depressed until the catch **30** extends radially inwardly of the lock bar **25**, whereupon the lock bar will be released by the action of the spring **28** in position to latch the selected stop pin **22** in depressed position, until liberated by the next pin depressing operation. This movement of the lock bar **25** not only causes the selected stop pin **22** to be latched in depressed wheel stopping position, but also releases the previously depressed and latched stop pin **22** under the action of its encircling spring **23**, so that the latter stop pin is restored into radially outward inactive position.

To depress any stop pin **22** on a wheel **10** according to a selection, there is provided an arcuate selector arm or ring **31** (Figs. 4 and 5) concentrically encircling the stop pin guides **21**. This selector ring **31** is just wide enough to span at the most only a few stop pin guides **21** and has a base **32** supported to move the selector ring step by step into stop pin selecting positions in relation to the stop pin guides **21**, as will be more fully described. Carried on the selector ring **31** are spaced spring-pressed selector plungers **34** corresponding in number to the number of characters on each wheel **10**, i. e. 48 plungers in the specific example illustrated. The heads **35** of the plungers **34** normally project radially outwardly beyond the selector ring **31** to permit the plungers to be depressed by a positioning device **36** to be described. These plungers **34** are arranged in radial alinement with the stop pins **22** respectively of any wheel **10** opposite which the selector ring **31** has been stopped temporarily for selection and are close enough to said pins, so that upon depressing a plunger **34** through the action of the positioning device **36**, the depressed plunger will in turn depress the corresponding stop pin **22** and thereby stop the wheel **10** carrying said stop pin in selected position.

The selector ring **31** is moved step by step into successive selecting positions opposite the stop pin guides **21** by any suitable drive means, in response to character and space function pulses or signals sent from a suitable transmitter, as will be more fully described. The specific drive means shown for purposes of illustration, comprises a conveyor **40** (Fig. 5) having a chain **41** passing over sprocket wheels **42** and **43**. The sprocket wheel **42** is driven from a drive **44** through a reversing gear unit **45** operable into either one of two positions to drive the conveyor in either direction and controlled in a manner to be described. The connection from the output of the reversing gear unit **45** to the sprocket wheel **42** is through a Geneva mechanism **46** to assure a predetermined movement of the selector ring **31** for every character or space function pulse or signal received. In response to each character or face function pulse, the drive pin carrying disk **47** to the Geneva mechanism **46** is triggered to rotate one revolution and no more through the usual one revolution clutch device of the well known type, and this causes the conveyor **40** to be moved one step through a predetermined distance to bring the selector ring **31** opposite the next stop pin guide **21** in selecting position with respect thereto.

The plungers **34** on the selector ring **31** are selectively depressed through the positioning bar device **36** comprising a series of bars **51** corresponding in number to the number of characters on each printing wheel **10**, i. e. 48 for the 48 characters in the specific example described, and extending parallel to the shaft **12** of the wheels **10** in an arcuate row around the selector ring **31** and concentric therewith. These bars **51** are positioned radially opposite the plungers **34** respectively carried by the selector ring **31**, so that upon operation of any one bar in a radially inward direction, a corresponding plunger **34** upon said selector ring is depressed. For so operating the positioning bars **51** selectively, each of said bars is connected at its ends to the plungers of two solenoids **52**, which in turn are controlled from the character and spaced function signals, as will be more fully described.

The character pulses are sent out by the transmitter, the pulses being all the same for the different characters, but being transmitted by separate leads corresponding to the different characters, so that in the specific form of the invention illustrated, there would be forty-eight pairs of leads. Each pair of leads would control the energization of a corresponding pair of solenoids **52** connected to a positioning bar **51**, which will select the character on a wheel **10** corresponding to the character signalled through said leads. These pulses may be made to act directly on the corresponding solenoids **52** after the necessary amplification, or may be made to control the operation of a relay switch in the circuit of the solenoids.

After selection of the character on a wheel **10** has been made in the manner described, and the wheel has been brought to a stop by the depression of the stop pin **22** corresponding to this character into wheel blocking position, a printing device **53** (Figs. 4 and 6) moving along the printing line of action A comes into play to imprint the selected character on this line of action onto the record sheet **16**. The record sheet **16** is a fan-fold paper sheet held in an input tray stand **54** (Fig. 1) in front of the printing machine and moved step by step by means of a suitable indexing sprocket mechanism **54***a* (Figs. 1, 4, 6 and 10) across the printing line of action A, the record sheet having side indexing perforations **55** for the purpose. After being printed, the record sheet **16** is returned to a second tray stand **56** above the input tray stand **54**. The record sheet **16** may consist of a multiplicity of layers interleaved with carbon tissues to permit the production of a number of carbon copies.

The printing device **53** comprises a spring-pressed plunger **57** (Figs. 4 and 6) in a housing **58** carried on a carriage **59** with wheels **60** permitting movement of the plunger step by step along supporting rails **61**. The

carriage 59 is driven step by step by an intermittent drive 62 similar to that for driving the selector ring 31.

The printing plunger 57 acts on one side of the course of the record sheet 16, while on the opposite side is located an inked ribbon 64 wound at its ends on two spools 65, one of which winds and the other unwinds, as in a conventional typewriter. After the printing of a line across the record sheet 16, the ribbon 64 is fed automatically a distance equivalent to a printed line to present a fresh section of the ribbon for the printing of the next line. A reversing mechanism 59a (Fig. 10) reverses the operation of the ribbon spools 65, when the ribbon has been unwound from one spool and wound on the other.

The plunger 57 when actuated in manner to be described, presses the record sheet 16 against the ribbon 64 and the ribbon against the selected character on the wheel 10, so that this character is imprinted on the record sheet. To operate the plunger 57 for this purpose, there is provided a plunger actuator bar 66 (Figs. 4 and 6) extending parallel to the shaft 12 of the wheels 10 and located opposite the projecting end of the plunger. The ends of this plunger actuator bar 66 are connected to the plungers of two solenoids 67, respectively, these being energized in response to character signals but being irresponsive to space function signals, as will be more fully described. When these solenoids 67 are energized upon receipt of the proper signals, the bar 66 is moved into engagement with the printing plunger 57 and this moves the plunger into position to print the selected character as described. These solenoids 67 may be energized directly by the information pulses after the necessary amplification or may be in a separate circuit and closed by a relay switch controlled by the pulses.

A synchronized delay is introduced between reception of a character signal and operation of the printing plunger 57 equivalent to a definite number of character and space function units, in order to allow a printing wheel 10 sufficient time to be positioned before printing of the selected character thereon takes place. In the specific form shown, the delay is made equivalent to 35 character and space function units and may be effected by a counting device or register of any type well known in the art. For the purpose of illustration, there is shown in basic form, a counting device 70 (Figs. 9 and 10) known as a magnetic shift register. This magnetic shift register 70 comprises a plurality of magnetically saturable cores 71, the number corresponding to the amount of delay required. In the specific form illustrated, for a delay equivalent to that necessary to receive 35 characters and space function signals, 35 of such cores are provided connected in series. The space function signals serve to provide the necessary spaces between words or between certain characters where required.

Although magnetic shift registers, per se, are well known, a suitable type is shown in its basic form in Fig. 9 and is described briefly herein:

A core made of magnetic material with a substantially rectangular hysteresis loop has two stable reproducible states, namely, a negative saturation state and a positive saturation state. Once magnetized to one of these states by an applied field strength pulse of positive or negative amplitude, the core will remain indefinitely in that state without application of external power. Use is made of these two states to store a pulse. The magnetic shift register 70 of the present invention is made up of a number of these magnetic cores 71, so interconnected that pulses can be stored and unidirectionally transferred from one core to another.

Fig. 9 shows a four core magnetic shift register for purpose of explanation and illustration, but it must be understood that the number of cores 71 depends on the amount of delay required (35 cores in the specific embodiment illustrated). Each core 71 has three windings: An input winding 72, an output winding 73 and an advance or shift winding 74, the input winding of the first core in the particular application of the present invention being adapted to receive input character and space function signals in wave voltage form of generally rectangular configuration. The advance winding 74 consists of advance A and advance B driver, these comprising receiver tube type pentodes normally cut off. When turned on, the advance A driver tube causes a magnetizing current to flow through the serially connected advance windings of the odd numbered cores 71. This current is in such direction as to drive these odd numbered cores to the negative saturation state. The advance B driver is similarly connected to the even numbered cores 71. The pulses sent through the advance windings A and B are in wave voltage form of rectangular configuration and are synchronized in time relation with the pulses fed into the input windings 72 of the first core 71, as for example by a synchronized pulse generator. These advance pulses follow the input pulses by a very slight delay running to a small fraction of a second.

In the description of the operation of the magnetic shift register that follows, it is assumed that all four cores 71 illustrated are in negative saturation state initially. At the time T1, the input driver 72 and the advance B drive are pulsed. The input driver 72 causes the first core 71 to change to positive saturation flux density. At the end of the input driver current pulse, the flux in the first core 71 changes to the positive saturation state. The second and fourth cores 71 remain in the negative saturation state. At time T2, the advance A driver is pulsed and the first core is returned to negative saturation flux density. The large charge in flux in going from positive to negative saturation state, produces a voltage at the output winding 73 of the first core 71 which forces current through the forward direction of the series rectifier in said output winding into the input winding 72 of the second core 71, magnetizing it to the positive saturation state. At time T3, the advance B driver current is turned on again, and the second core 71 is returned to the negative saturation state. The third core 71 is driven to positive saturation state by the large change in the flux in the second core 71. At time T4, the advance A driver current transfers in effect the input pulse from the third core 71 to the fourth core 71. In this manner, the input pulse initially read into the first core 71 has been transferred by the operation described to the fourth core 71 by successive applications of the advance A and advance B current pulses.

In the case where the magnetic shift register 70 has 35 cores 71 interconnected as described, the effect of the first information pulse into the first of the cores 71 is shifted successively through the 35 cores under the influence of the successive shift or advance pulses, so that the effect of an information pulse read into the register will be read out after a delay equivalent to the time required to receive 35 information pulses.

The information pulses corresponding to character signals are read out from the register 70 and serve to actuate the plunger actuator bar 66 through energization of its solenoids 67, into position to press the plunger 57 for printing. The information pulses corresponding to the space function signals are not discharged from the register 70, since no operation of the plunger actuator bar 66 takes place in response thereto. The information pulses corresponding to the space function signals may therefore be in potential opposite to the information pulses corresponding to the characters, or may simply consist in pauses, so as to have no effect on the register except to incorporate into the register a condition which will be evidenced by a lack of output pulse therefrom, when in the order of sequence, such pulses should be at the forward end of the sequence. The magnetic shift register 70 thereby serves not only as a device for delaying the action of an information signal but also as a memory device to render effective certain signals and

render ineffective certain signals, when the time for reading out such signals arrives.

The forty-eight pairs of leads transmitting the different character pulses from the transmitter, as described above, and the pair of leads transmitting the space function pulses from the transmitter are connected to the input winding **72** of the first core **71** of the delay register **70**, so that any time a pulse comes in from the transmitter through any one of the 49 pairs of leads, these are transmitted to the input winding **72** of the first core **71**, the form and relationship of the character and space function pulses being as described above.

In conjunction with the printing machine of the present invention, there is employed a second delay counter or register **70***a* (Fig. 10) located at the inlet side of the drive **62** for the printing plunger **57** for controlling the operation of this drive. This delay register **70***a* may be similar to the delay register **70**, except that the register **70***a* discharges both character and space function pulses after the requisite delay corresponding to that inherent in the delay register **70**, i. e. the delay of 35 character and space function units. The reason that the register **70***a* discharges every character pulse and space function pulse fed into it after the requisite delay, is that the plunger **57** which is controlled from the output of this register, moves step by step from wheel to wheel in synchronism with the selector ring **31** through the action of both types of pulses but with a lag which is maintained constant.

To operate the delay register **70***a* so that it discharges every information pulse fed into it, whether of the character or space function type, the input space function pulses fed into the register is of potential the same as that of the character signals. Therefore two signals are generated for every space function required, a positive pulse and a negative pulse, one corresponding in potential to that of the characters being sent to the delay register **70***a* and the other to the delay register **70**.

A third delay register **70***b* (Fig. 10) controlled from a line function signal for reversing the drive **62** to the printing plunger **57** and for operating the line feed **54***a* and a fold skip control **82** may be employed. When, for example, it is desired to start a new line of printing before the last line of printing of the previous line has reached the right-hand margin set for said selection, a line function signal is transmitted to the reversing gear unit **45** of the drive **44** for the selector ring **31**, causing said selector ring to reverse immediately back to its present left-hand margin. The line function signal is also transmitted to the reversing gear unit of the drive **62** for the printing plunger **57**, but since this printing plunger lags behind the selector ring **31** by an interval equivalent to 35 character and space function units, the effect of this line function signal upon the reversing gear unit of the drive **62** to the printing plunger **57** must be delayed to the extent of that interval, to permit the printing plunger to complete its printing of the characters already selected on the last line. For that purpose, the third delayed counter or register **70***b* is employed, the line function signal being fed into this register as an input information pulse. This register **70***b* may be similar to the register **70***a* and has lines **78** from the sources of the character signal and space function signal, which are normally opened but which are automatically closed through suitable switches and controls upon reception of a line function signal, to transmit subsequent character signal and space function signals to said register and to cause thereby the line function pulse initially fed into said register to be transmitted through successive cores in the register, until upon the receipt of the 35th input information signal, the line function pulse is discharged to reverse the printing plunger **57** towards the left. By that time, the printing plunger **57** will have completed its printing operations on the selections made on the last line and is ready to move to the left to the next line.

Upon discharge of the line function pulse from the delay register **70***b*, the lines **78** from the sources of the character signals and the space function signals are automatically opened through switches or other controls, and the network of the register set into condition to expunge the information pulses fed thereinto subsequent to the line function pulse, so that the next line function pulse will find the delay register cleared of all prior information pulses.

As another alternative, the lead lines **78** from the sources of information signals may be continuously closed during operation, but these signals may be converted into the same polarity as the shift pulses fed into the register **70***b*, so that they are not discharged from the register but hold their place in the sequence of stored pulses in the register, while the line function signal is of a polarity opposite from that of the shift pulses, so that only the shift pulses are discharged from the register after the delay inherent in the register.

The line advance of the paper record sheet **16** is made automatically through the indexing sprocket feed mechanism **54***a* (Figs. 4, 6 and 10). The feed of the ribbon **64** is synchronized with this paper line advance feed mechanism **54***a* to cause the ribbon to be fed a distance at least equal to that of a printing line, at the end of each line printing operation. Movement of the sprocket feed mechanism **54***a* is synchronized with the return of the printing plunger **57** to the left-hand margin for printing a new line. The return of the printing plunger **57** is an automatic function of a right-hand margin signal generated when the plunger reaches a preset right-hand margin. This return of the printing plunger **57** can be effected at any time before it reaches the preset right-hand margin by sending a line function pulse to the reversing gear unit of the drive **62** of the printing plunger **57** through the delay register **70***b* as already described.

There are two controls which intercept the line advance process in order to assure practical operations. These are a multiple line feed adjustment **81** (Fig. 10) for the paper line feed mechanism **54***a* and a fold skip control **82** coupled to this line feed mechanism. The purpose of the multiple line feed adjustment **81** is to provide single, double, or triple line feeding controlled by a dial indicator accessible to the operator. The fold skip control **82** functions to provide automatically adequate spacing in the place where the folds occur in the fan-fold paper sheet **16**. This fold skip control **82** prevents the printing of characters close to the bottom and top of the individual pages and may be operated automatically by sending a line function pulse at the proper time to effect the line skipping operation described. The output of the delay register **70***b* for that purpose, not only controls the reversal of the reversing gear unit of the drive **62** for the printing plunger **57**, as already described, but also controls the operation of the fold skip control **82** and the paper line feed mechanism **54***a* as regulated by the adjustment **81**.

The different switches, trips, adjustments and controls for effecting the line feed, ribbon feed and adjustments in these feeds may be of the type conventionally employed in typewriters.

As far as certain aspects of the invention are concerned, the use of a special line function signal for changing to a new line before selection to the preset right-hand margin is made, may be dispensed with and its function carried out by the use of space function signals which may be repeated to bring the selector ring **31** to its preset right-hand margin without character selection, whereupon the controls automatically operable when the selector ring reaches this margin take over to cause the next line shift.

When return of a selector ring **31** is indicated, either because the ring **31** reaches the preset right-hand margin

or because of the receipt of a line function signal, the selector ring **31** returns towards its left-hand margin for the next line selection. This return is effected through operation of the reversing gear unit **45** and through the Geneva mechanism **46**. If desired, the return of the selector ring **31** may be effected through continuous movement and therefore more quickly than during its forward selecting movement, by by-passing automatically the Geneva mechanism **46** when return of the selector ring **31** is indicated. This could be effected by an arrangement, which in synchronism with the reversal of the gear unit **45** connects the output of this unit directly to the drive sprocket **42** of the drive **44**.

During the return movement of the selector ring **31**, it is desirable to interrupt the transmission of input information pulses. To that end, an input stop signal is generated by a control device **85** (Fig. 10) as a function of the arrival of the selector ring **31** at its preset right-hand margin or the receipt of a line function signal. This input stop signal automatically sent to the information transmitter halts transmission of input character and space pulses for sufficient time to allow the selector ring **31** to return. During the return of the selector ring **31** and the resulting pause in the transmission of information signals, the feed operation of the printing plunger **57** and the printing operation of the plunger actuator bar **66** are interrupted by the absence of these signals. Upon completion of the shift of the selector ring **31** to the left-hand margin, an input start signal is automatically sent out by a control device **86** to the transmitter, whereupon the transmission of character and space function signals is resumed. This resumption in the transmission of information signals causes the selector ring **31** to resume selection of the next line, while the feed operation of the printing plunger **57** and the printing operation of the plunger actuator bar **66** are resumed to complete printing on the prior uncompleted line. When the printing plunger **57** reaches its preset right-hand margin corresponding to the preset right-hand margin of the selector ring **31** or reaches the limiting point determined by the transmission of a line function signal, the input stop signal device **85** generates an input stop signal which stops transmission of character and space function signals. At the same time, the reversing gear unit of the feed drive **62** for the printing plunger **57** is operated to reverse the printing plunger towards the left. During this return movement of the printing plunger **57**, the absence of incoming character and space function signals also interrupts the selector ring **31** in its selection of characters for the next line.

When the printing plunger **57** reaches its preset left-hand margin, an input stop signal is automatically sent out by the control device **86** to the information transmitter, causing resumption in the transmission of the character and space function signals from the information transmitter and thereby causing resumption in the operation of the selector ring **31** and the printing plunger **57**.

The interrupting operations described through the stop signal control device **85** and the start signal control **86** serve to maintain the predetermined lag offset equivalent to 35 character and space function units between the selector ring **31** and the printing plunger **57** during operations through successive printing lines.

The printing machine of the present invention has a margin and tabulating control device **90** (Fig. 10) by which the margin of the lines may be preset or by which the spacing of characters to form tabular listings can be controlled either locally or remotely. For local operations, a margin and tabulating control panel **91** is employed having knobs and indicators to permit manual setup of the margins of the line or of the spacings of tabular listings when such are desired. When a preset right-hand margin is reached, a local signal is generated and this causes the selector ring **31** to shift to the left-hand margin as described. This right-hand margin for line printing is set up manually on the panel **91** for the margin and tabulating control device **90**, to afford a maximum line corresponding in length to the distance occupied by all the printing wheels **10**, corresponding to the spacing of 70 characters in the specific example described.

Where tabular listings are desired, the left-hand boundary of each tabular column is set manually in the margin and tabulating control panel **91**. Transmission of character and space function pulses positions the characters relative to these left-hand column boundaries. Upon receipt of a tabulating signal, the tabulating control device **90**, acting upon the selector ring **31**, causes said selector ring to shift from the right-hand boundary of one tabular column to the left-hand margin of the next tabular column. Due to the interval required to effect this shift, the tabulating signal is also transmitted to the input stop control device **85** to hold up the transmission of input information during this interval. This stops the operation of the printing plunger **57**. After the required interval, an input start signal is supplied by the tabulating control device **90** to the input start control device **86** causing resumption in the transmission of the character and space signals. This causes the selector ring **31** to start its selecting operation on the next column and the printing plunger **57** to finish its printing operation on a previous column. When the printing plunger **57** reaches the right-hand boundary of the column it is operating on, a signal from the tabulating control device **90** causes the plunger **57** to shift to the left-hand boundary of the next column. During this shift, the transmission of character and space function signals is interrupted through the action of the input stop control device **85** and resumed through the input start control device **86**, as already described.

For remote control, some remote device may have information, perhaps manually inserted, as to the boundaries of each tabular column. Signals indicating the beginning and end of each column would be transmitted from the remote device to the tabulating control device **90**, thus controlling column spacing.

The printing machine, except the transmitter for the information signals, is enclosed in a casing **92** (Figs. 1, 2 and 3) having hinged covers **93** and **94** by which access to the lower and intermediate parts of the machine, such as the printing mechanism and wiring may be gained. Ready access to the upper part of the machine and particularly to the printing wheels **10** and the associated selector ring **31** and positioning bar device **36** may be gained through a transparent top cover **95** hinged at its back. Dials, knobs or indicators **96** for margin and tabulating adjustments and settings and for all other adjustments described and/or required are made accessible on the side of the casing **92**.

Although the operation of the printing machine is believed obvious from the foregoing description, it is herein summarized briefly:

At the beginning of operations, the selector ring **31** (Figs. 4, 5 and 6 and 10) and the printing plunger **57** are in position at the extreme left opposite the end printing wheel **10** and the wheels are all immobilized from the previous operation, while the shaft **12** is rotating continuously. After a character signal comes in from the transmitter, it causes immediate energization of the solenoids **52** of the positioning bar **51** corresponding to the particular character represented by that signal and movement of this bar radially inwardly in position to press inwardly the plunger **34** on the selector ring **31** corresponding to that character. This causes the stop pin **22** radially alined with the depressed plunger **34** and located on the stop pin guide **21** of the first wheel **10**, to be moved radially inwardly into the recess **17** of this wheel and in the path of its stop **18**. This inward movement of the selected stop pin **22** causes the release through the lock bar **25** of the stop pin **22** depressed from a

previous operation, thereby freeing the wheel **10** for rotation under the influence of the continuously rotating shaft **12**, until the stop **18** reaches the newly depressed stop pin **22**, whereupon the wheel stops. In this new position, the selected character will be on the line of action A of the printing plunger **57**.

While the first character signal is operating to effect selection of the first character on the first wheel **10** as described, the signal is also being transmitted to the drive of the selector ring **31** and after the selected stop pin **22** associated with the first wheel **10** has been depressed, the selector ring **31** under the influence of this first character signal moves the selector ring one step into position opposite the second wheel **10** which has been immobilized by a previous selecting operation.

The first character signal is also impressed on the delay registers **70** and **70***a* and stored therein, so that it has no effect on the drive of the printing plunger **57** or on the plunger actuator bar **66**. As a result, the printing plunger **57** remains in position opposite the first printing wheel **10**.

The operations in response to successive character signals are repeated without effect on the drive of the printing plunger **57** or on the plunger actuator bar **66**, the signals being stored in the delay registers **70** and **70***a* and simultaneously acting on the positioning bars **51** to effect selection of the characters on the wheels **10** successively and movement of the selector ring **31** from wheel to wheel. Not only are the character signals stored in the delay registers **70** and **70***a* but also the space function signals. These space function signals are transmitted to the drive **44** of the selector ring **31** to move the selector ring through corresponding steps but cause no selection in the corresponding wheels, since the spaces on the record sheet **16** opposite the latter wheels are retained unprinted to present the spaces required, as for example between words.

Upon receipt of the 35th character and space function signals, the first signal which was transmitted to the delay register **70** emerges from said register and if it corresponds to a character, it causes energization of the solenoids **67** of the plunger actuator bar **66** and moves the actuator bar in position to press the printing plunger **57** and thereby imprint on the record sheet **16** the character selected on the first wheel **10**. At the same time, the first signal transmitted to the delay register **70***a* emerges from this register and starts the drive **62** for the printing plunger **57** operating to cause it to move opposite the second wheel after the printing from the first wheel has been completed as described. This operation is continued through successive signals after the 35th signal, so that the selector ring **31** is ahead of the printing plunger **57** to an extent equivalent to 35 wheels, thereby giving the wheels ample time to accelerate or decelerate. As a result, the wheels **10** need not operate at high speed but can operate at comparatively low speed, while attaining printing speeds as high as 100 characters per second.

If, in the order of sequence, a space function signal should be emerging from the delay register **70**, this signal due to the memory characteristics of the register as described does not emerge, so that for the corresponding interval, no action takes place on the plunger actuator bar **66** and no printing takes place opposite the wheel **10** where a space is desired to be left on the record sheet **16**. However, the space function signals do emerge from the delay register **70***a* in proper sequence, so that the drive for the printing plunger **57** is actuated for a step movement, both from the character signals as well as the space function signals.

When the selector ring **31** reaches the preset right-hand margin of the record sheet **16**, the drive for the said ring is reversed and the selector ring returned towards the left. At the same time, an input stop signal is sent out from the stop signal control **85** to the transmitter interrupting further transmission of signals until the selector ring **31** reaches its left-hand margin. The absence of any signals immobilizes the printing plunger **57** and the plunger actuator bar **66**. When the selector ring **31** reaches the preset left-hand margin of the record sheet **16**, a signal from the input start control **86** resumes the transmission of information signals, whereupon the selector ring **31** starts selections for the next line, while the printing plunger **57** finishes imprinting characters selected for the previous line. When the printing plunger **57** reaches the preset right marginal position, it is returned towards the left with attendant interruptions and resumption of signals through the action of the stop and start controls **85** and **86**, so that the selection is stopped during the shifting of the printing plunger and resumed after shifting is completed. In this manner, the delay offset relationship between the selector ring **31** and the printing plunger **57** is maintained through successive line operations.

Upon receipt of a line function signal, the operation is similar to that described in connection with the shifting of the selector ring **31** and the printing plunger **57** upon reaching the preset right-hand margin of the record sheet **16**.

While the invention has been described with particular reference to a specific embodiment, it is to be understood that it is not to be limited thereto, but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed is:

1. A printer comprising a plurality of similar coaxial wheels, each bearing a series of characters, a shaft, means connecting said wheels for rotation with said shaft and operable to permit said wheels to be stopped independently of each other, selector means operable on said wheels in succession to stop said wheels in position to bring selected characters along a printing line, and printing means following the operation of said selector means and operable to imprint the selected characters in succession positioned along said line, and means for retarding the operation of said printing means in relation to the operation of said selector means, to interpose a phasic offset between the operation of the selector means and that of the printing means equivalent to a predetermined number of character bearing wheels.

2. A printer comprising a deck of similar coaxial wheels, each bearing on its periphery a series of characters, a drive shaft passing through the center of said wheels and adapted to be driven continuously, slip connections between said shaft and said wheels, causing said wheels to rotate with said shaft when said wheels are not impeded by selection and permitting said wheels to be stopped by selection independently of each other, while allowing the shaft to continue its rotation, a selector device movable along the deck of character bearing wheels by the reception of information signals and in synchronism with the reception of said signals, to bring said selector device opposite said wheels in succession, means operable by said selector device as said selector device moves opposite said wheels for stopping said wheels in succession and in position to bring selected characters on a printing line along the deck of wheels, a printing device responsive to the reception of information signals and following the operation of said selector device along said line to imprint the selector character in succession positioned along said line, and a delay register for receiving information signals and for lagging their transmission to the printing device by an extent equivalent to a predetermined number of wheels, whereby said printing device is phasically offset in its operation from said selector device by said predetermined number of wheels.

3. A printer comprising a series of similar coaxial wheels, each bearing on its periphery a plurality of characters, a drive shaft for said wheels adapted to be driven continuously, slip connections between said shaft and

said wheels causing said wheels to rotate with said shaft when said wheels are not impeded by selection and permitting said wheels to be stopped by selection independently of each other, while allowing the shaft to continue its rotation, a stop pin guide partially encircling each wheel and carrying a series of stop pins, each of said wheels having a stop adapted to move into engagement with a stop pin, when said stop pin has been actuated by selection and to cause thereby the wheel to stop in an angular position in which the character corresponding to the actuated pin lies on a predetermined line along the series of wheels, selector means movable from stop pin guide to stop pin guide in response to the reception of information signals, for actuating a selected stop pin in each guide according to the signal received for said guide, and a printing device following the operation of said selector means and operable to imprint the selected characters in succession positioned along said line.

4. A printer comprising a deck of similar coaxial wheels, each bearing on its periphery a series of characters, a drive shaft for said wheels adapted to be driven continuously, slip connections between said shaft and said wheels causing said wheels to rotate with said shaft when said wheels are not impeded by selection and permitting said wheels to be stopped by selection independently of each other, while allowing the shaft to continue its rotation, a stop pin guide partially encircling each wheel and carrying a series of stop pins guided for depressed movement radially inwardly towards the corresponding wheel, each of said wheels carrying a stop, said pins in depressed positions lying in the paths of rotation of the stops of the corresponding wheels, whereby said wheels are stopped by the depressed stop pins in angular positions in which the characters corresponding to the depressed pins lie on a predetermined line along the deck of wheels, a selector arm mounted for movement along the deck of wheels and adapted to encircle said stop pin guides successively as said selector arm is so moved, said selector arm carrying a series of plungers corresponding to the stop pins in each guide and adapted when depressed radially inwardly to depress the corresponding stop pins, plunger actuator bars extending substantially parallel along the deck of wheels and in an arcuate row around said selector arm opposite said plungers respectively, said plunger actuator bars being mounted to move into position when actuated to depress the corresponding plungers, means responsive to the reception of each character signal from a transmitter for moving said selector arm one step into selecting position from one stop pin guide to the next, and for actuating one of said plunger actuator bars corresponding to the character represented by the signal transmitted, whereby said wheels are stopped successively with the selected characters thereon positioned on said line, and a printing device operable along said line to imprint the selected characters positioned therealong.

5. A printer comprising a plurality of similar coaxial wheels, each bearing a series of characters, a shaft, means connecting said shaft for rotation with said shaft and operable to permit said wheels to be stopped independently of each other, a selector device, means for moving said selector device one step from position opposite one wheel to position opposite the next wheel as character signals are received in succession from a transmitter, means operable by said selector device as said selector device moves opposite said wheels for stopping the wheels in succession in response to said signals in angular positions to bring the characters corresponding to the signals into printing positions, a printing device, means responsive to the reception of character signals for moving said printing device one step from printing position with respect to the selected character on one wheel to printing position with respect to the selected character on the next wheel, and means for delaying transmission of character signals to said printing device to cause printing operations to lag behind selecting operations by a predetermined number of wheels.

6. A printer as described in claim 5, wherein there are provided means for returning the selector device to its starting position when the end of a line is indicated, means for interrupting the transmission of character signals to said selector device and to said printing device, while the selector device is returning to its starting position, means for resuming transmission of character signals after the selector device has reached starting position, means for returning the printing device to its starting position when the printing of all selected characters on a line has been completed, means for interrupting the transmission of character signals to said selector device and to said printing device while the printing device is returning to its starting position, and means for resuming transmission of character signals after the printing device has reached starting position.

7. A printer comprising a plurality of similar coaxial wheels, each bearing a series of characters, a shaft, means connecting said wheels for rotation with said shaft and operable to permit said wheels to be stopped independently of each other, a selector device, means for moving said selector device one step from position opposite one wheel to position opposite the next wheel as character and space function signals are received in succession from a transmitter, means operable by said selector device as said selector device moves opposite said wheels for stopping the wheels in succession in response to character signals in angular positions to bring the characters corresponding to the character signals into printing positions, a printing device, means responsive to the reception of character and space function signals for moving said printing device one step from one wheel to the next wheel, means for delaying transmission of character and space function signals to said printing device to cause said printing device to lag behind the selector device by a predetermined number of wheels, means responsive to the reception of a character signal for operating said printing device at any wheel to imprint the selected character from said wheel onto a record sheet, and a delay memory device for storing character and space function signals received from the transmitter and for transmitting the stored character signals in succession to the means for operating the printing device with a lag equivalent to said predetermined number of wheels, while rendering ineffective the space function signals on the means for operating the printing device.

8. A printer comprising a plurality of similar members arranged in a row and each bearing a series of characters, selector means, means responsive to input character signals received from a transmitter for moving said selector means along the row of character bearing members and for selecting characters from each of said members in succession, printing means, means responsive to input character signals from a transmitter for moving said printing means along the row of character bearing members and for operating said printing means to imprint on a record sheet the characters selected from each of said members in succession, means for delaying the transmission of character signals from the transmitter to the means for moving and operating the printing means, whereby said printing means lags in its movements and operations behind said selector means by a predetermined number of character bearing members, means operable when the selector means reaches a predetermined margin in a line for returning said selector means to its initial position to start a new line of selection, means operable while said selector means is returning to its initial position for interrupting transmission of character signals from the transmitter, means operable when the selector means reaches its initial position for resuming transmission of character signals from the transmitter, means operable when the printing means reaches said predeter-

mined margin for returning said printing means to its initial position for the start of a new line, means operable while said printing means is returning towards its initial position for interrupting the transmission of character signals from the transmitter, and means operable when the printing means reaches its initial position for resuming transmission of character signals from the transmitter.

9. A printer comprising a plurality of similar members arranged in a row and each bearing a series of characters, selector means, means responsive to input character signals for moving said selector means along the row of character bearing members and for selecting characters from each of said members in succession, printing means, means responsive to input character signals from a transmitter for moving said printing means along the row of character bearing members and for operating said printing means to imprint on a record sheet the characters selected from each of said members in succession, means for delaying the transmission of character signals from the transmitter, to the means for moving and operating the printing means, whereby said printing means lags in its movements and operations behind said selector means by a predetermined number of character bearing members, means responsive to an input line function signal received from the transmitter for returning said selector means to its initial position to start a new line of selection, means operable while said selector means is returning to its initial position for interrupting transmission of character signals from the transmitter, means operable when said selector means reaches its initial position for resuming transmission of character signals from the transmitter, means responsive to the input line function signal received from the transmitter, and operable after a delay equivalent to said predetermined number of character bearing members for returning said printing means to its initial position for the start of a new line, means operable while said printing means is returning towards its initial position for interrupting the transmission of character signals from the transmitter and means operable when the printing means reaches its initial position for resuming transmission of character signals from the transmitter.

10. A printer comprising a plurality of similar members arranged in a row and each bearing a series of characters, selector means, means responsive to input character signals for moving said selector means along the row of character bearing members and for selecting characters from each of said members in succession, printing means, means responsive to input character signals from a transmitter for moving said printing means along the row of character bearing members and for operating said printing means to imprint on a record sheet the characters selected from each of said members in succession, means for delaying the transmission of character signals from the transmitter to the means for moving and operating the printing means, whereby said printing means lags in its movements and operations behind said selector means by a predetermined number of character bearing members, means responsive to a tabulating signal from a transmitter for moving the selector means from the right hand margin of one column to the left hand margin of the next column, means operable while said selector means is shifting from one column to the next for interrupting transmission of character signals from the transmitter, means operable when said selector means reaches the next column for resuming transmission of character signals from the transmitter, means responsive to a tabulating signal from the transmitter and operable after a delay equivalent to said predetermined number of character bearing members for shifting said printing means from the right hand margin of one column to the left hand margin of the next column, means operable while said printing means is being so shifted for interrupting the transmission of character signals from the transmitter and means operable when the printing means reaches the next column for resuming transmission of character signals from the transmitter.

11. A printer comprising a plurality of similar members arranged in a row and each bearing a series of characters, selector means, means responsive to input character signals from a transmitter for moving said selector means along the row of character bearing members in succession, printing means, means responsive to input character signals from a transmitter for moving said printing means along the row of character bearing members and for operating said printing means to imprint on a record sheet the characters selected from each of said members in succession, means for delaying the transmission of character signals from the transmitter to the means for moving and operating the printing means, whereby said printing means lags in its movements and operations behind said selector means by a predetermined number of character bearing members, a tabulating control by which the left and right hand margins of each column on a record sheet can be preset, means operable when the selector means reaches the right-hand margin of a column set in said control for shifting the selector means from one column to the next, means operable when the selector means is so shifted for interrupting transmission of character signals from the transmitter, means operable when said selector means reaches the left-hand margin of the next column set in said control for resuming transmission of character signals from the transmitter, means operable when said printing means reaches the right-hand margin of a column preset in said control for shifting said printing means to the left-hand margin of the next column, means operable while said printing means is being so shifted for interrupting the transmission of character signals from the transmitter, and means operable when the printing means reaches the next column for resuming transmission of character signals from the transmitter.

References Cited in the file of this patent

UNITED STATES PATENTS

871,145	Richards	Nov. 19, 1907
1,976,599	Bryce	Oct. 9, 1934
2,047,505	Hausheer	July 14, 1936
2,080,649	Breitling	May 18, 1937
2,157,035	Torkelson	May 2, 1939
2,412,777	Kao	Dec. 17, 1946
2,566,944	Last	Sept. 4, 1951
2,692,551	Potter	Oct. 26, 1954
2,720,832	Luning	Oct. 18, 1955
2,726,601	Paris	Dec. 13, 1955
2,776,618	Hartley	Jan. 8, 1957
2,800,073	Block	July 23, 1957
2,805,620	Rosen	Sept. 10, 1957
2,811,102	Devol	Oct. 29, 1957