Dec. 15, 1959 E. A. WESTOVER 2,917,153

LINE SPACE PROGRAMMING APPARATUS FOR AN ELECTRIC TYPEWRITER

Filed Oct. 19, 1956 4 Sheets-Sheet 1

Fig. 1.

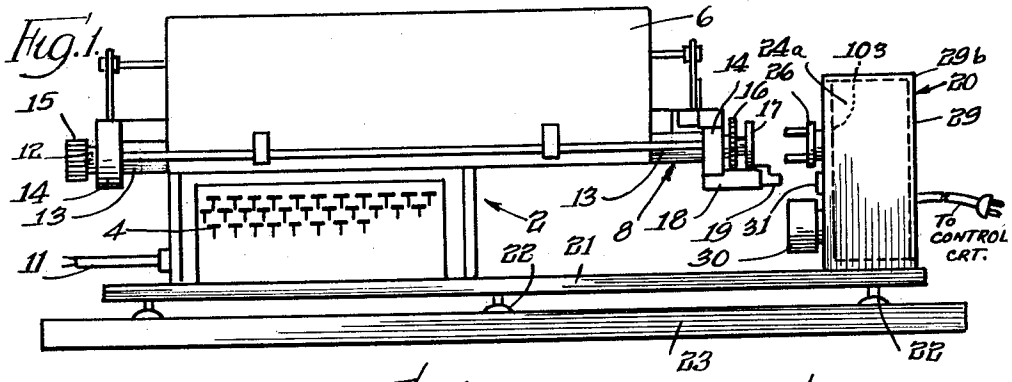


Fig. 4.

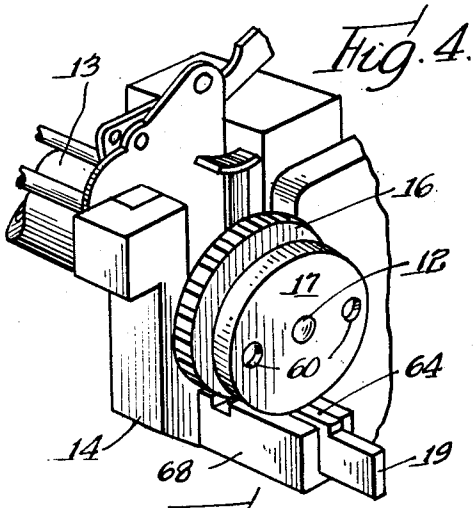


Fig. 5.

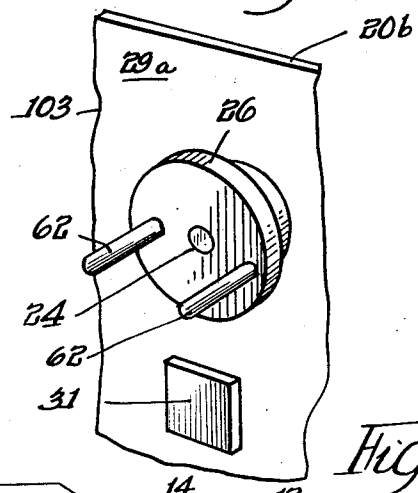


Fig. 6.

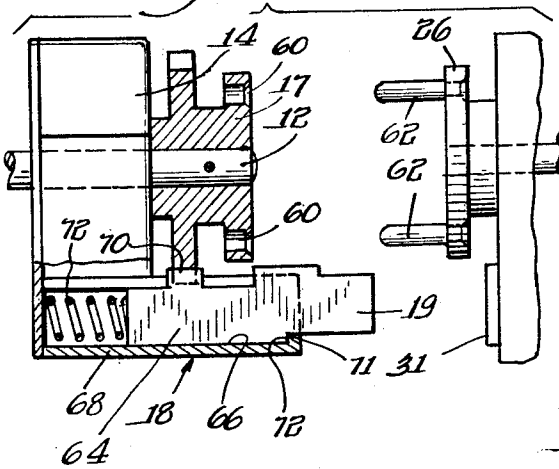
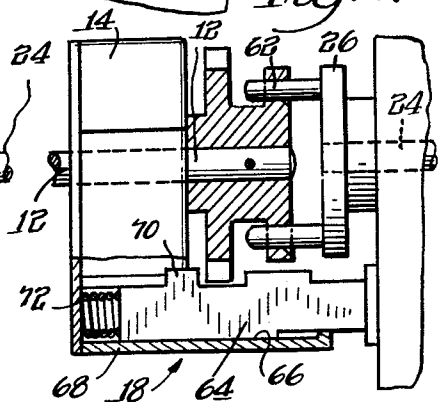


Fig. 7.



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LINE SPACE PROGRAMMING APPARATUS FOR AN ELECTRIC TYPEWRITER

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Fig. 3.

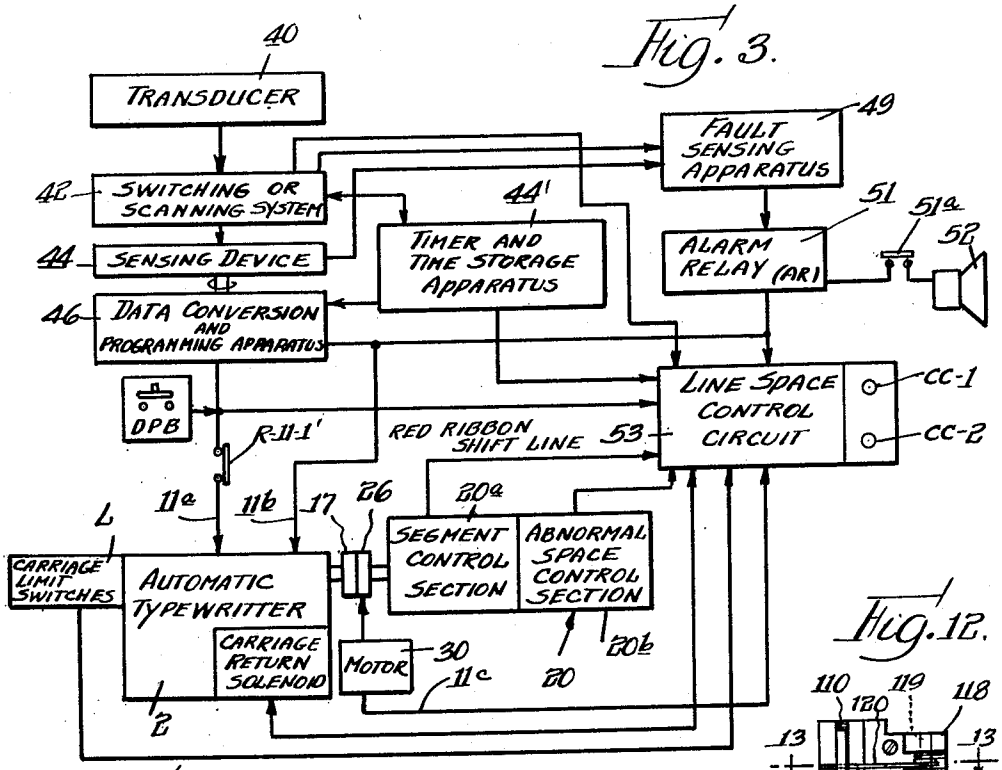


Fig. 12.

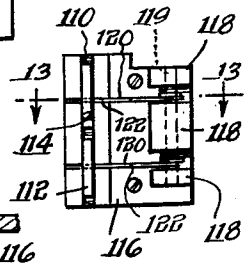


Fig. 2.

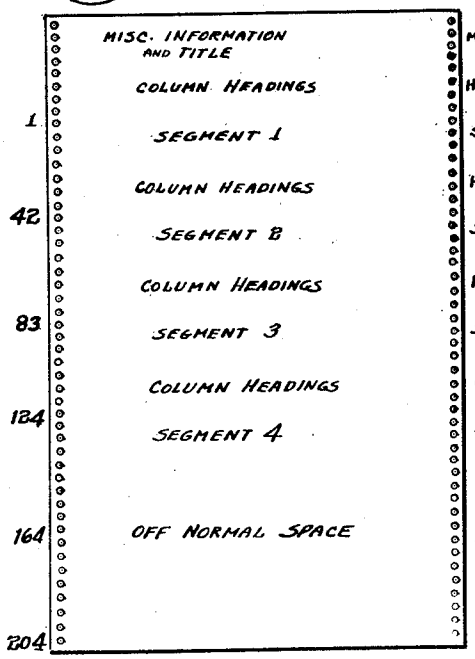


Fig. 13

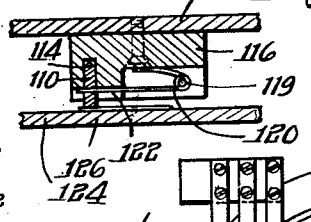
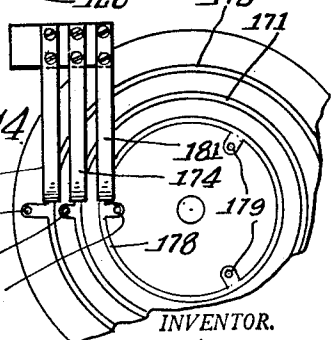


Fig. 14



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LINE SPACE PROGRAMMING APPARATUS FOR AN ELECTRIC TYPEWRITER

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Fig. 10.

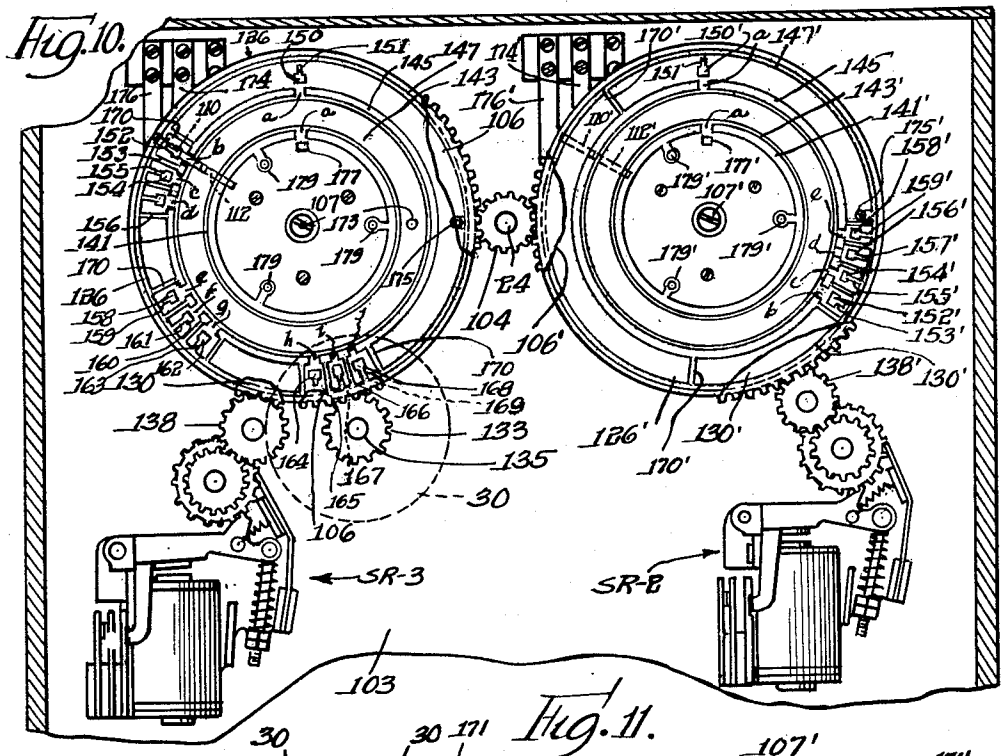
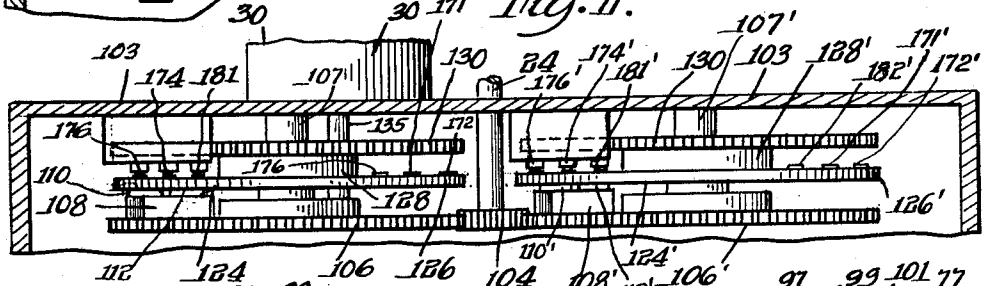


Fig. 11.



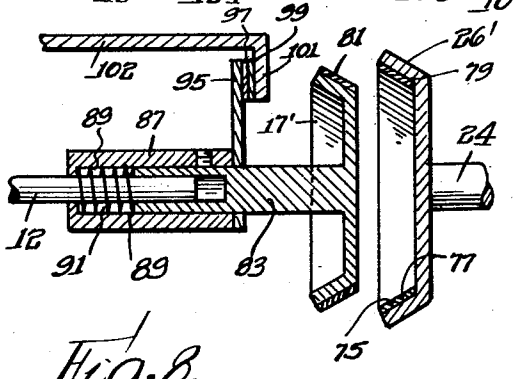


Fig. 8.

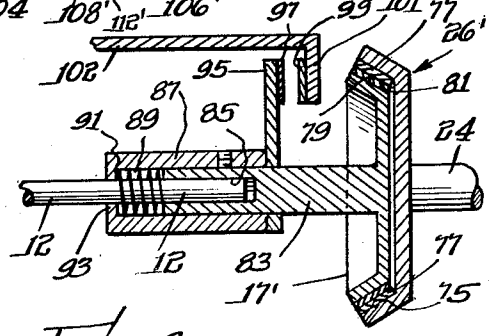


Fig. 9.

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LINE SPACE PROGRAMMING APPARATUS FOR AN ELECTRIC TYPEWRITER

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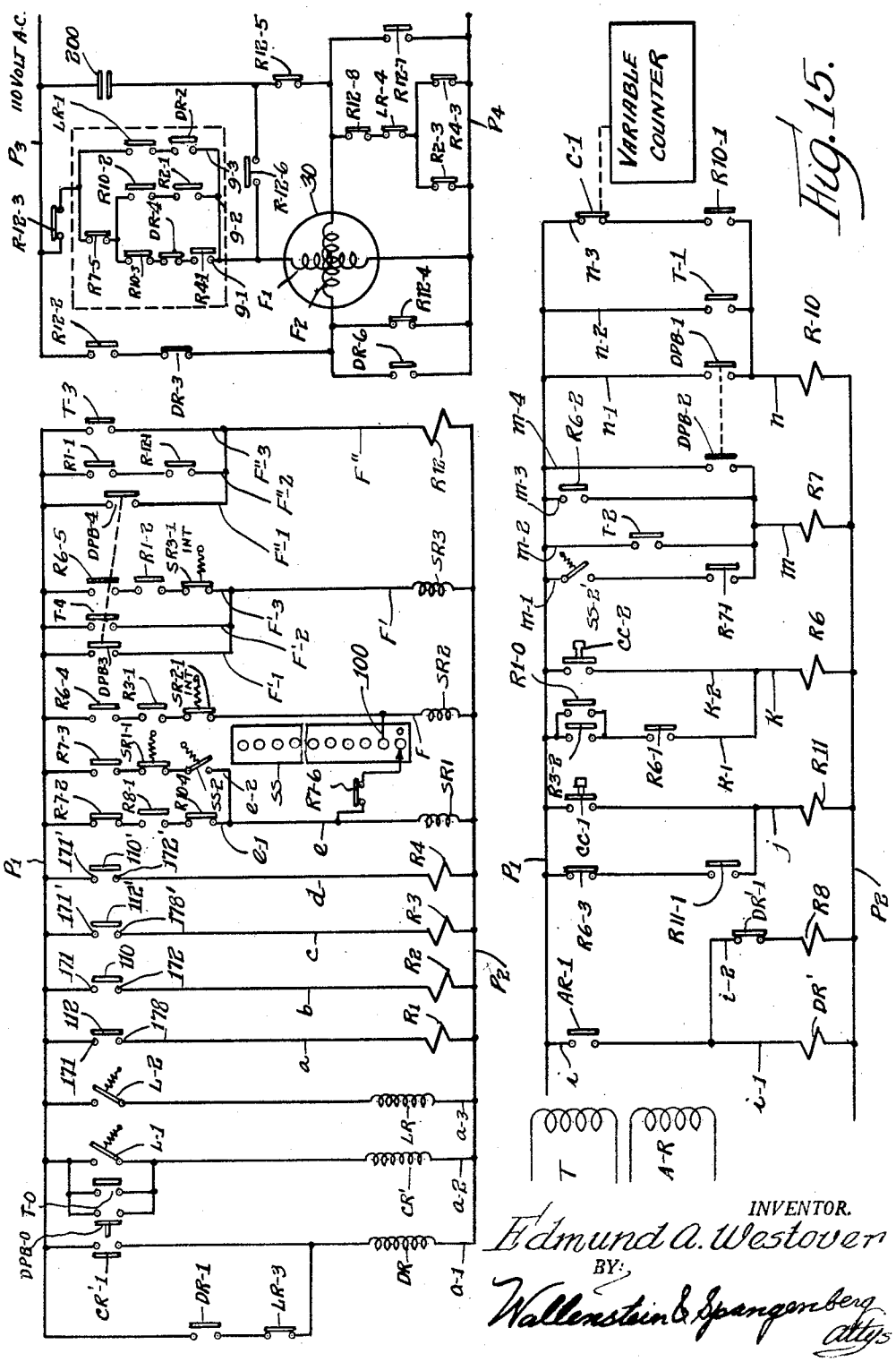

FIG. 15.

United States Patent Office 2,917,153 Patented Dec. 15, 1959

2,917,153

LINE SPACE PROGRAMMING APPARATUS FOR AN ELECTRIC TYPEWRITER

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Application October 19, 1956, Serial No. 616,993

11 Claims. (Cl. 197—133)

This invention relates primarily to automatic data recording systems, particularly to such systems utilizing an automatic electric typewriter to record the values of process and other variables.

In United States Patent No. 2,701,748, granted February 8, 1955, to Ralph Arthur Anderson, an automatic process logging system is disclosed utilizing an electric typewriter where the typewriter prints data on a large number of variables in vertical columns in two longitudinally spaced segments of the log sheet. In a normal recording cycle, variable data is sequentially typed in a line of the first segment of the log sheet following which the log sheet is line indexed so that data on other variables are typed in the corresponding line of the second segment of the log sheet. Within each segment each vertical column contains data covering, for example, a 24-hour period for a particular variable scanned regularly, such as hourly. Between these hourly recording cycles, the log sheet is automatically indexed to receive printing in a third area of the log of data only on abnormal variables scanned between the regular recording cycles. Such data may represent data on variables which are abnormal or which have returned to normal. At the beginning of the next regular recording cycle, the log sheet is automatically indexed to receive printing in the next available line of the first segment of the log sheet, whereupon the aforementioned recording cycle is repeated. In this or any other type of recording system where the log sheet is indexed to receive printing in widely spaced areas of the log sheet, some means must be provided for setting up a given line spacing program, preferably one in which the program can be changed easily. The conventional electric typewriter is inherently set for automatic single or double line spacing, but not an irregular program or one where a large number of lines are skipped. Furthermore, the recording system described requires that the log sheet be regularly returned to a position to receive printing in a line below the last printed line automatically. This type of line spacing program is not a conventional one and, therefore, requires special control apparatus for the typewriter.

It is one of the objects of the present invention to provide improved line spacing control apparatus for electric typewriters or the like, which is less complex, less expensive and more reliable than line spacing control apparatuses previously utilized to control the aforementioned automatic typewriter. An ancillary object of the present invention is to provide such line spacing control apparatus which includes mechanical means moved with the log sheet during line spacing and cooperating electrical apparatus controlled by the mechanical means, which in turn controls the log sheet driving means so that a feed back loop is provided whose controlling functions are responsive to the actual position of the log sheet rather than to some other means independent of such position.

A more specific object of the present invention is to

provide a data recording system utilizing an electric typewriter as a recording element in the system, which requires an unconventional line spacing program, but which may utilize a conventional type electric typewriter modified to only a minor extent so that conventional, mass produced and, hence, relatively inexpensive, relative to custom-made, typewriters may be utilized.

An ancillary object of the present invention is to provide a system such as just described, which utilizes the type of line space control apparatus described in the previous paragraphs.

In accordance with the present invention, the automatic electric typewriter utilized is preferably a type having a traversable carriage carrying a feed roll fixed to a shaft, which is rotated to effect line spacing of the log sheet. One such typewriter is being presently sold under the name of "Flex-O-Writer" manufactured by the Commercial Controls Corporation. In utilizing this typewriter in the environment of the present invention, the usual ratchet and gear feed for the feed roll shaft is preferably disconnected, and a clutch member, to be described more fully hereafter, is fixed to one end of the feed roll shaft A means for locking the feed roll shaft in position is also provided, such means being, for example, carried by the feed roll shaft to lock the same in position. Preferably mounted on the same base as the typewriter is a frame or housing supporting mechanism for controlling the turning of the feed roll shaft. Since this mechanism is supported externally of the typewriter, the typewriter carriage does not have to carry the weight of this mechanism which substantially reduces the wear and increases the reliability and longevity of the electric typewriter over the situation where such apparatus is supported upon the typewriter carriage. This line spacing control mechanism may include one or more pairs of control wheels or the like, mounted in confronting relation and the wheels of each pair being turnable independently of the other. One of the wheels of each of the pairs of wheels is coupled to a common shaft which carries a clutch member on the end thereof, which is adapted to interengage with the aforementioned clutch member carried on the end of the feed roll shaft when the typewriter carriages reaches one of its limits of travel. At other times, these clutch members are disengaged whereupon the typewriter is uncoupled from the line space control mechanism. The other wheel of each pair of wheels may be coupled for operation by a solenoid for modifying the line spacing program each recording cycle, such as to advance the line spacing program one line to enable recording in successive lines of each of the aforementioned segments of the log sheet.

The confronting wheels of each pair of wheels carry cooperating switching elements which operate at predetermined relative angular positions of the wheels. When recording in a line of the log sheet is completed, the carriage of the typewriter is moved to its limit which results in engagement of said clutch members whereupon a blind line spacing operation begins upon energization of an electric motor or the like, preferably secured to the frame or housing which supports the line space control mechanism above mentioned and which motor is preferably permanently coupled to said common shaft. Then, when the programming wheel connected to the common shaft reaches an angular position which indicates that the feed roll is positioned in the next proper line in which typing is to be received, the switching means above mentioned is operated to terminate operation of the electric motor. This cycle is repeated for forward line spacing following completion of recording in the line of the log sheet involved. When the next hourly or other regular recording cycle is to begin, one of the aforementioned solenoids in

the line spacing control mechanism is actuated to precess the wheel of one of the wheel pairs which is not connected to the aforementioned common clutch shaft to advance the line spacing program a given number of lines. Also, the electric motor is then energized to initiate another blind line spacing operation which is terminated by operation of switching means carried by said programming wheels.

As previously mentioned, locking means is provided for normally holding the feed roll shaft in position. This locking means is released when the clutch members interengage so that the feed roll may be readily turned by the line spacing control mechanism above described. This locking means may be responsive to the longitudinal force applied to the feed roll shaft when the clutch members engage, or it may be responsive to the movement of a slideable arm which engages the frame or housing of the line spacing control mechanism, or some other equivalent means.

With the clutch arrangement above described, conventional type electric typewriters may be quickly and easily and inexpensively converted for use with the line spacing programming system above described. Furthermore, the line spacing program may be changed by the simple expedient of modifying or changing the programming wheels in the line spacing control mechanism.

Other objects, advantages and features of the invention will become apparent upon making reference to the specification to follow, the claims and the drawings wherein:

Fig. 1 is a front elevational view of an electric typewriter and the associated line spacing control mechanism of the invention;

Fig. 2 shows the arrangement of the log sheet which may be utilized with the data recording system of the invention;

Fig. 3 is a block diagram of the components making up a complete automatic data recording system utilizing the slightly modified typewriter and associated line spacing control mechanism;

Fig. 4 is an enlarged fragmentary perspective view of the right-hand end of the typewriter carriage showing the feed roll clutch member and the associated feed roll shaft locking means;

Fig. 5 is an enlarged fragmentary perspective view of the clutch member on the line spacing control mechanism which engages with the clutch member of the feed roll shaft;

Fig. 6 is a fragmentary front elevational view, partly in section, showing the clutch member and locking means of Figs. 4 and 5 in disengaged position;

Fig. 7 is a view corresponding to Fig. 6 but showing the clutch members in engaged position;

Fig. 8 is a sectional view through a modified form of clutch construction and feed roll shaft locking means with the clutch members apart;

Fig. 9 is a view of the mechanism of Fig. 8 with the clutch members fully engaged;

Fig. 10 is a side elevational view of the line space control mechanism which drives the clutch member in Fig. 5;

Fig. 11 is a plan view of the mechanism in Fig. 10;

Fig. 12 is a view of one of the brush plate holding assemblies carried by one of the gear wheels in Fig. 11;

Fig. 13 is a transverse section through the assembly of Fig. 12, taken along line 13—13;

Fig. 14 is a rear view of one of the printed circuit programming wheels shown in Fig. 9; and

Fig. 15 is a schematic diagram of the control circuit in which the switching means of the line spacing control mechanism is located, which control circuit controls operation of the electric motor which drives the feed roll shaft through the clutch mechanism of the invention.

Refer now more particularly to Fig. 1 which illustrates an automatic electric typewriter **2**, modified in accordance with the invention. The typewriter **2** may be any well known type of automatic typewriter as, for example, the aforementioned "Flex-O-Writer" typewriter. As is conventional in these typewriters, a keyboard **4** is provided for manual typing to permit an operator to add notations or headings to the logging sheet **6**, which may be of the type shown in Fig. 2, supported on the carriage of the typewriter generally indicated by reference numeral **8**. The carriage illustrated has a substantial length and is of the type found on typewriters used for bookkeeping and accounting purposes. Process variable information obtained in the form of electrical signals are fed to the typewriter for printing through a cable **11** which may include 5 conductors representing a 5-channel code, and other control lines, such as a red ribbon shift control line. The five conductors in the cable **11** may be energized in different code combinations which represent letters of the alphabet, numbers, punctuation marks, horizontal spacing and carriage return directions. Accordingly, the typewriter includes suitable code-receiving and translating mechanism for actuating the keys of the typewriter automatically in response to the signals received by the typewriter. In the usual form of automatic electric typewriter, line spacing and carriage return is effected by pulsing what is known as a carriage return solenoid, which spaces the record sheet one line per pulse and returns the carriage to a start position. The carriage return solenoid usually operates a gear and ratchet mechanism coupled to the feed roll shaft **12**. In the present invention, the feed roll shaft is preferably disconnected from the gear and ratchet mechanism so that the feed roll shaft may be controlled externally of the carriage return solenoid. Also, if the typewriter is not already provided with limit switches, such switches may be readily secured to the base of the typewriter and operated by arms carried by the typewriter carriage so that the switch is closed or open as the carriage reaches any one of its two limits of travel. It will be assumed that these limit switches are contained within the commercial form of typewriter used in the exemplary system to be described.

As is usual in conventional electric typewriters, the feed roll shaft **12** to which the feed roll **13** is connected projects beyond the ends of the carriage frame **14** to receive hand knobs, such as hand knob **15**, for manually turning the feed roll. In the embodiment illustrated in the drawings, the right-hand knob has been removed, and, in place thereof, a locking wheel **16** and a clutch member **17** is mounted thereon. Cooperating with the locking wheel is an assembly generally indicated by the reference numberal **18** which, in a manner to be more fully described hereafter, normally makes engagement with the locking wheel **16** to hold the feed roll shaft in a given position. Extending from the assembly **18** is a depressable arm **19** which, when pushed in, releases the locking means which holds the feed roll shaft. The construction and operation of the clutch member **17** and of the locking wheel **16** and cooperating assembly **18** will be described in more detail hereafter.

In accordance with the invention, line space control mechanism **20** forming a compact housed assembly is mounted upon the same base **21** upon which the electric typewriter **2** is directly mounted. The base **21** is supported upon shock mounts **22** which in turn are secured to a main base support **23**. The assembly **20** includes gearing and other apparatus to be described, which is connected to a shaft **24** (see Figs. 5, 6 and 7) having a clutch member **26** fixed to the end thereof, positioned to make engagement with the clutch member **17** fixed to the end of the feed roll shaft of the electric typewriter when the carriage thereof has been returned to a position to receive printing at the beginning of a line on the log sheets **6**. Clutch member **26**, its shaft **24** and the aforementioned gearing, etc. are supported within and from a housing **29**, on the outside of which is also mounted a reversable electric motor **30**. The motor **30** is coupled to the clutch member shaft **24** and is con-

trolled by a control circuit which controls the energization and direction of movement of the motor **30**. This control circuit, which is shown in Fig. 15, will be described in detail hereafter. Suffice it to say at this point, this control circuit includes switching means operated by the line space control mechanism **20**.

Following completion of a line in the log sheet **6**, one of the aforementioned limit switches of the typewriter **2** is actuated and initiates a carriage return operation. When the carriage reaches its fully right-hand position, clutch members **17** and **26** make engagement whereupon, in a manner to be explained, the motor **30** is energized starting a blind line spacing operation. The depressible arm **19**, when the carriage is returned to its reference or start position, engages a pad **31** on the housing **29**, and is pushed in to unlock the feed roll shaft **12** to permit line spacing. When the log sheet has been indexed to the proper line, the mechanism **20** actuates the aforementioned switching means which de-energizes the motor **30** to stop the line spacing operation. Following completion of another line of the log sheet, the aforementioned line spacing operation repeats. One exemplary line spacing program for which the present invention is particularly suitable will now be described. The construction of the line spacing control mechanism **20** and the control circuit which controls the motor **30** and other details of construction of the system shown in Fig. 1 will be described in detail.

Reference should now be made to Fig. 2 showing a view of the log sheet **6**. This sheet has four identically sized segments or sections **S–1**, **S–2**, **S–3**, and **S–4** for receiving regular, such as hourly, data information in vertical columns, all hourly data information for each variable being grouped together in the same vertical column of the same segment. Heading spaces **H–1**, **H–2**, **H–3**, and **H–4** are provided above each segment in which the variables are identified. A main heading space **MH** is provided at the top of the sheet for information common to all variables. Below the last segment is a space **ONS** in which data on off-normal variables scanned is automatically printed subsequent to the hourly recording in the segments **S–1** through **S–4**. The data information to be typed in the first segment **S–1** may comprise data on fifty variables arranged in respective vertical columns. Where regular data recording is carried out hourly, segment **S–1** would have at least twenty-four lines. Sometimes it is desired to record data on all variables between the regular hourly periods upon actuation of a manual read-out switch or the like and so additional lines are provided for this purpose in each segment.

The first column in segment **S–1** contains a number representing the time during which the variables in that segment were scanned and succeeding vertical columns in the first segment contain numbers representing the actual values of the variables scanned, the identification of the variable and the units of the data being obtained in the corresponding column in the heading space **H–1**. When the number of variables scanned is greater than the number of available vertical columns in segment **S–1**, there will also be similar data in the next lower segment **S–2** of the log sheet. When the first line of segment **S–1** is filled with data, the logging sheet is automatically indexed to bring the corresponding line of the second segment **S–2** in position to receive printing of data on other variables scanned during a scanning cycle. In the example illustrated, corresponding lines in the first and second segments are spaced forty-one lines apart so that if the first line in segment **S–1** is considered to be line one, the first line in segment **S–2** would be line number forty-two of the log sheet. Upon completion of a line in segment **S–2** the log sheet is indexed to receive printing in the corresponding line of segment **S–3**. The first line of segment **S–2** is shown to be spaced forty-one lines from the first line in the second segment so that line one of segment **S–3** is line number eighty-three of the log sheet. The segment **S–3** accommodates data of variables which cannot be accommodated in segment two.

Following the completion of a line in segment **S–3**, the log sheet is again indexed to receive printing in the corresponding line of the fourth segment **S–4** if segment **S–3** cannot accommodate the remainder of the variables. The first line of segment **S–4** is shown as line number one hundred twenty-four of the log sheet. Following the completion of a scanning cycle at the beginning of a given hour (a scanning cycle may take five or six minutes for two hundred variables at fifty variables per segment), printing of variable data under normal conditions ceases until the beginning of the next hourly period. However, variables are continuously scanned between spaced regular hourly scanning cycles for monitoring of abnormal variables. When an abnormal variable is scanned, the logging system feeds data on the abnormal variables to the typewriter for printing in the off-normal space **ONS** located beneath the last segment **S–4** of the logging sheet. In the illustrated embodiment, the first line of the off-normal space **ONS** is the line number one hundred and sixty-four of the log sheet. Thirty-nine lines are provided in the off-normal space **ONS** for off-normal data. If desired, the apparatus may be designed also to record data on variables which have just returned to normal in the space **ONS**. Each group of data may comprise a number which represents the time at which the off-normal data was taken, a second number which represents an identification number for the variable, and a third number representing the value of the variable. Data on additional variables which become abnormal between successive regular hourly scanning cycles are printed in the same line of the off-normal space.

The log sheet is indexed from the left segment **S–4** to the next available complete line in the off-normal space **ONS**, even though the last line recorded in the space **ONS** had not been completely filled. Assuming that no off-normal data has been previously recorded in the off-normal space, it can be seen that the spacing required to index the log sheet from the last printed line of the last segment **S–4** to the first line in the off-normal space decreases by one for each basic recording cycle or period, which was assumed to be a one hour period. Further, this spacing increases by one line for each line containing recorded data in the off-normal space.

Just prior to the beginning of a regular hourly scanning cycle, the log sheet must be indexed from the off-normal space to the next available line of the first segment **S–1**.

It should be understood that the line spacing program above described may vary widely. For example, the number of segments may be varied, the number of lines in each segment may be varied, and the number of lines in the entire log sheet may be varied.

Before other details of the preferred embodiment of the invention are described, it would be helpful to first understand the overall organization of a data recording system in which the invention is utilized.

Refer now to Fig. 3 showing a block diagram of an entire automatic process logging system including the automatic typewriter of Fig. 1. The system includes transducers represented by the box **40**, there being one transducer element for each process variable on which information is desired. Each transducer produces a variable voltage, current, resistance, or phase angle, etc., output which is a function (preferably a linear function) of the value of the associated process variable. In the case where temperatures are measured, the transducer element associated with the temperature variable may be a thermo-couple or a temperature sensitive element. Where other process variables relating to pressure or flow are involved, suitable well known transducers for converting measurements to voltages or other electrical quantities which vary in a predetermined relationship to the values of the process variables may be provided. The

outputs of the various transducer elements are sequentially coupled by scanning switches 42 to a sensing device 44, which may be a null-balancing potentiometer. The switching system 42 may comprise a number of stepping switches driven by suitable timing apparatus 44'. This timing apparatus may include a synchronous motor and a number of cam-operated switch contacts which interrupt electrical circuits to provide properly timed pulses for operating stepping switches and other parts of the system.

The sensing device 44 may provide a mechanical output in the form of a shaft movement, the angular position of which is a measure of the magnitude of the signal voltage fed to the sensing device by the scanning system. Shaft movement is coupled to conversion apparatus represented by the block 46 which converts data from analogue to digital form and this information is stored in suitable relay or other storage means to permit sequential feeding of the digital data to the automatic typewriter in the form of suitable coded signals to operate the typewriter under control of suitable programming apparatus also represented by box 46. Programming apparatus for performing similar functions are well known and, in the present instance, may comprise banks of stepping switches which sequentially feed digital data on the variables as well as timing information from a digital time storage unit forming part of the timing apparatus 44', in the form of coded electrical signals, to the typewriter input. For example, at the initiation of the regular hourly recording interval, the programmer operates to feed coded information to the typewriter to effect sequential printing of four numbers representing the time at which the data was scanned. Following this, the programmer feeds variable data to the typewriter as each variable is scanned which is printed in segment No. 1. The programmer then ceases to feed information to the automatic typewriter until the logging sheet has been indexed to receive information in the next or second segment S–2. Then the programmer initially again feeds time data to the typewriter to record timing information in the first column of the second segment followed by variable data on the successive variables scanned which are recorded in the remainder of the line of the second segment. This procedure repeats itself until all variable data is printed within the segments S–1 through S–4.

Wherever a variable scanned is abnormal, apparatus is provided for controlling the color of the printing of data on that variable and for actuating an audible alarm. This apparatus includes suitable fault sensing appartus represented by the box 49 which compares an electrical output of the sensing device 44 with individual high and low set point potentiometers for each variable. Whenever the output of the sensing device indicates that the value of the scanned variable has exceeded certain predetermined safe limits, the fault sensing apparatus 49 energizes an alarm relay 51, also hereinafter referred to as relay AR, which performs numerous control functions. For one, a contact of this relay connects with the automatic typewriter through a conductor 11*b* of the cable 11 to energize the red ribbon shift solenoid of the typewriter to bring the red portion of the ribbon into position to receive the type. This occurs during printing in the segments S–1 through S–4 and the off-normal space. Contacts of the alarm relay are also arranged to sound an audible alarm 52 which is silenced by depression of an acknowledge push button 51*a* subsequent to the recording of the regular hourly scanned data in the segments S–1 through S–4. The alarm relay controls, through the programmer, the feeding of data to the automatic typewriter for printing in the off-normal space ONS previously referred to when abnormal variables are scanned. After a regular recording of data in the segments, the scanning switch 42 continues to scan the transducer outputs but the programmer fails to feed the scanned data to the automatic typewriter except when the alarm relay is energized to indicate the existence of an abnormal variable. The programmer then feeds information on this abnormal variable preferably only once to the automatic typewriter 2, until the variable has returned to normal. Apparatus for limiting the information fed to the typewriter in this manner is disclosed in co-pending application Serial No. 470,859, entitled "Automatic Process Logging System" filed November 24, 1954 by Ralph Arthur Anderson.

In a manner to be more fully explained hereinafter, the alarm relay also has contacts in a line space control circuit generally indicated by the box 53. The circuit 53 operates in conjunction with the line space control mechanism 20, previously referred to, to provide a feed back loop which controls the operation of the motor 30. Mechanism 20 comprises a segment control section 20*a* which controls indexing of the logging sheet to the various segments S–1 through S–4, and a second section 20*b* which controls spacing between the last printed line of the last segment S–4 and the off-normal space ONS.

In certain situations it may be preferable to drive the carriage feed roll by pulsing the carriage return solenoid. In such case the control circuit 53 would be connected to operate the solenoid rather than the electric motor.

Push buttons CC–1 and CC–2 are interposed in the line space control circuit to perform disabling and reset functions required to disable the system when the log sheet is changed and to reset the line space control mechanism 20 to initiate a new recording cycle at the beginning of a twenty-four hour period. A manual push button control DPB is also provided for on demand recording of all scanned variables within the log sheet segments S–1 through S–4 between the hourly periods. It is desirable to print such on demand or manual read-out data in the regular segments rather than in the off-normal space ONS, as the embodiment described in said Patent 2,701,748. Such on demand data, of course, is printed within the appropriate columns of log sheet segments.

Refer now more particularly to Figs. 4 through 7, which illustrate the construction of the clutch members 17 and 26 and of the feed roll shaft locking assembly 18. The clutch member 17 illustrated in the drawings is formed integrally with the locking wheel 16 which in turn is fixed to the projecting end of the feed roll shaft 12 in any suotable manner. Clutch member 17 has a pair of chamfered holes 60—60 which are designed to receive clutch pins 62—62 of the clutch members 26 which pins have rounded or tapered outer ends which aid in guiding the clutch pins into the chamfered holes 60—60.

The locking wheel has peripheral teeth, the angular spacing of which is such that advancement of the locking wheel one tooth will turn the feed roll a distance to line space the log sheet 6 one line space unit. The assembly 18 which cooperates with the locking wheel to lock and unlock the feed roll shaft comprises a slider 64, the outer end of which constitutes the aforementioned depressible arm. The slider is slidable in a channel 66 of a metal body member 68 which is welded or otherwise suitably secured to the carriage frame 14. Slider 64 has on its upper face a projection 70 which is normally urged by a compression spring 72 in the slot 66 to a position where it enters the slot between a pair of teeth in the locking wheel 16. The slider 64 has a shoulder 71 formed in the bottom edge thereof which shoulder engages a lip 72 formed on the bottom of the body member 68 to limit the outward movement of the slider 64, the slider in its limited position being in its locking position. As the typewriter carriage 8 is returned to its extreme right hand position, the end of the slider 64 is brought against the pad 31 on the housing 29 of the line spacing control mechanism 20. This forces the slider against the compression spring 72 which removes the projection 70 of the slider from between the teeth of the locking wheel, thereby freeing the feed roll shaft for rotation by the

clutch member 26. As shown in Fig. 7, when the carriage has reached its extreme right hand position, clutch pins 62—62 have fully entered the holes 60—60 in the clutch member 17. One of the typewriter limit switches is then also actuated which initiates the energization of the motor 30 which rotates the clutch member 26 to rotate the feed roll shaft to the proper position.

Fig. 8 shows a modified form of clutching and locking apparatus which may be substituted for clutch members 26 and 17, and for the locking wheel 16 and associated assembly 18. The modified clutch member 26' secured to the clutch shaft 24 comprises a circular metal member having a large tapered recess 75 in its outer face. This recess is lined with a suitable friction material 77 such as neoprene or the like. The modified clutch part 17' has an outer frusto-conical surface 79 which is covered with a layer 81 of friction material such as neoprene or the like. Clutch member 17' with its friction layer 81 is of complementary shape to the lined tapered recess of the clutch member 26'. Rotary motion is coupled between the clutch members when they are fully inter-engaged, as shown in Fig. 9.

The clutch member 17' is fixed to a shaft 83 which has a longitudinal bore 85 therein which is slidably mounted over the end of the feed roll shaft 12 of the typewriter. Secured around the shaft 83 is a collar 87 which extends beyond the inner end of the shaft 83 and thereby defines an annular space 89 which receives a compression spring 91 which at one end bears against a flange or lip 93 at the inner end of the collar 87 and at the other end against the inner end of the shaft 83 to urge the clutch member 17' outward. Secured to the collar 87 is an arm 95 covered on its outer face with a layer of braking material 97. Normally, the compression spring 91 urges the shaft 83 and the associated collar 87 into a position where the friction layer 97 engages the friction layer 99 of similar material fixed to the inner face of the down turn end 101 of an arm 102 mounted to the carriage frame 14. The area of contact between the friction layers 97 and 99 is sufficient to lock the feed roll shaft in position when the compression spring 91 urges the shaft 83 to its fully right-hand position. The feed roll shaft 12 is unlocked when the typewriter carriage is moved to its extreme right hand or start position where the clutch member 17' engages the tapered surface of the clutch member 26', as shown in Fig. 9. In this position, the shaft 83 has been pushed inwardly to further compress the spring 91 which separates the friction layers 97 and 99, thereby freeing the feed roll shaft 12 for rotation by the driving clutch member 26'.

The housing 29 in which the line spacing control mechanism is housed, is made of two sections 29*a* and 29*b* (Fig. 1), the latter telescoping around the outside of the former. The housing section 29*a* is fixed to the base 21 and includes a main vertical support wall 103 to which the motor 30 and the other mechanism now to be described are mounted. When the housing section 29*b* is removed from the section 29*a*, the top and right side of the housing section 29*a* is exposed to provide ready access to the mechanism therein for servicing, replacement of parts, etc.

Refer now more particularly to Figs. 10 through 14 which illustrate various views of the mechanism mounted in the housing 29.

As shown most clearly in Figs. 10 and 11, the clutch member shaft 24 has secured to the end thereof within the housing 29 a pinion gear 104 which meshes with gears 106—106'. The gears 106—106', respectively, are elements in wheel assemblies associated, respectively, with the segment control section 20*a* and the abnormal space control section 20*b* of the line spacing control mechanism. Each is rotatably mounted around a shaft 107 or 107'. Secured to the inner faces of the gears 106—106' are respective brush assemblies 108—108' shown most clearly in Figs. 12 and 13. Since both brush assemblies are identical, only one is shown in detail in the drawings. Suffice it to say, that each brush assembly includes an outermost brush plate, 110 or 110' and an innermost brush plate 112 or 112'. These brush plates are mounted in a slot 114 in a body of insulating material 116 having three closely spaced projections or ears 118—118—118 through which a mounting pin 119 extends. Spring members 120—120 are mounted around the mounting pin in the spaces between the above-mentioned ears, and the springs extend through transverse slits 122—122 which intersect the slot 114. The ends of the springs pass through respective openings in the brush plates 110—112 or 110'—112' and urge them outwardly or axially against the associated wheel 126 or 126'. The brush plates make sliding contact engagement with the outer face 124 or 124' of the wheels 126 or 126' which have printed circuit patterns, to be described in more detail hereafter, over which the brush plates ride. The wheels 126—126' are made of insulating material and are respectively secured as by screws to metal discs 128—128' which in turn are secured to gear wheels 130—130' which are fixed to the shafts 107—107'. Gear wheels 106—106' are thus respectively mounted for rotation relative to gear wheels 130—130'.

The gear wheel 106 meshes with a drive pinion 133 fixed to the shaft 135 of the motor 30. Thus, energization of the motor 30 will drive the gear wheel 106 which in turn will drive the pinion 104 which rotates the clutch member shaft 24 and also the other gear wheel 106'. Gear wheels 106—106' and pinion 104 are so dimensioned that rotation of gear wheel 106 or 106' one-tooth unit will rotate the clutch member shaft 24 a sufficient distance to turn the feed roll shaft one line space unit. In the example illustrated, it will be assumed that the gear wheels 106—106' have 240 teeth which means that it can accommodate a line spacing program for a log sheet having 240 available lines. The angular position of the brush plates carried by the gear wheels 106—106' correspond to the line of the log sheet positioned to receive typing.

Counterclockwise rotation of the gear wheel 106 by motor 30 rotates the clutch member shaft 24 in a direction which line spaces the log sheet in a forward direction. Obviously, rotation of the gear wheel 106 in the opposite direction will result in a return line spacing operation.

The other gear wheels 130—130' mesh with drive pinions 138—138', respectively, which are driven by ratchet opening solenoids SR–3 and SR–2. Each time the solenoids SR–3 and SR–2 are pulsed once, the drive pinions 138—138' are respectively rotated one tooth which in turn rotates the gear wheels 130—130' one-tooth in a counterclockwise direction as viewed in Fig. 10.

Refer now more particularly to Fig. 10 which shows the layout of the conductive areas on the outer faces of the printed circuit programming wheels 126—126'. As previously indicated, the conductive areas on the wheel 126 are designed to control line spacing in the segments S1–S4 of the log sheet containing the regular, such as hourly, recorded data.

Basically, the conductive areas are arranged in four concentric rings 141, 143, 145 and 147. The outermost brush plate 110 cooperates with the outermost three rings, 143, 145 and 147 whereas the other brush plate 112 cooperates with the two innermost rings, 141 and 143, the ring 143 being in common with the circuits associated with the two brush plates. Considering the wheel to be divided into 240 segments, one segment per tooth, the ring 145 is interrupted at a number of points corresponding to the various lines of the log sheet to which successive line spacing operations in a forward direction are to be obtained. In the example of Fig. 2, the log sheet is to be positioned to receive typing successively in lines 1, 42, 83 and 124. Accordingly, conductive ring 145 is interrupted in angular segments corresponding to these lines, which are indicated in Fig. 10 by gaps *a*, *b*, *e*

and *h*, respectively. Other gaps *c, d, f, g, i* and *j* are provided for alternate line spacing programs. To this end, the circuit is initially made up to include a number of conductive spots **150, 152, 154, 156, 158, 160, 162, 164, 166,** and **168,** each having respective tails **151, 153, 155, 157, 159, 161, 163, 165, 167** and **169** leading to the outermost conductive ring **147** which is a continuous ring. These spots are located in the same segments as the various aforementioned gaps in the conductive ring **145.** Electrical contact between the sections of the non-continuous conductive ring **145** and the outermost continuous ring **147** is obtained by a number of radially extending conductive lines **170,** which connect each section of the ring **145** with the continuous ring **147.**

The outermost brush plate **110** occupies a radial extent extending from the common ring **143** and the conductive spots **150–168.** Therefore, it can be seen that initially there will be electrical continuity between the common ring **143** and the outermost ring **147** for each angular position of the brush plate **110.** A particular line spacing program may be obtained by the simple expedient of filing away part of the various tails, **151–169,** at the segments corresponding to the lines where line spacing is desired. Thus, as illustrated in Fig. 10, tails **151, 153, 159** and **165** have been interrupted to break the continuity between the various associated conductive spots and the outermost continuous ring **147.** Thus, when the brush plate **110** reaches the aforementioned segment positions, electrical continuity between the rings **143** and **147** will be interrupted. The latter rings are respectively connected through the conductive coated linings of holes **173—175** to slip rings **171** and **172** printed on the inner face of the wheel **126.** Brushes **176** and **174** mounted to the wall **103** of the housing **29** ride on the slip rings **171** and **172.** Circuits to be described extending to the slip rings are operated when a discontinuity exists between the rings **143** and **147** which de-energizes the electric motor **30** to terminate a blind line spacing operation. Actually, the dis-continuity which exists between the rings **143** and **147** when the brush plate **110** reaches slot *a* is not effective in terminating a blind line spacing operation but rather maintains the motor de-energized in a manner to be explained.

Termination of a blind return line spacing operation is effected by means of a discontinuity appearing between the common ring **143** and the innermost conductive ring **141.** Innermost ring **141** has a discontinuity or gap *a* located at the same angular segment as the gap *a* in the ring **145,** and a conductive spot **177** is positioned opposite the gap *a* so that the brush plate **112** always has support at both ends thereof. The conductive spots **150, 152,** etc. perform a similar function for brush **110.** The inner brush plate **112** extends between the rings **141** and **143** and bridges these rings until the brush plate reaches the gap *a.* The inner ring **141** is electrically connected through a conductive coated lining of holes **179** to a slip ring **178** printed on the inner face of the wheel **126.** A stationary brush **181** rides on slip ring **178.** During rotation of the feed roll shaft in a direction for forward line spacing, the brush plates **110—112** are moved in a counter-clockwise direction relative to the printed circuit wheel **126,** so that the brush **110** is brought successively opposite the gaps *a, b, c, d,* etc. However, for phasing purposes, or when it is desired to have a return line spacing operation where the log sheet is positioned to receive printing in the first segment of the log sheet, the brush plates are rotated in a clockwise direction so that the outermost brush plate **110** will be moved opposite the gaps, *h, e, b* and *a* in the order mentioned. If the gaps *h, e* and *b* were then active to terminate a blind line spacing operation, a return line spacing operation would cease when the brush plate **110** is opposite gap *h.* During return line spacing, rings **143** and **147** are rendered inoperative to terminate a blind line spacing operation and instead, the innermost rings **141** and **143** are rendered active so that the line spacing is terminated when the inner brush plate **112** reaches the gap *a* in the inner ring **141.**

It should be noted that precessing or advancement of the line spacing program by one line each succeeding hourly recording cycle is obtained by the simple expedient of pulsing the solenoid SR–3 once which results in the advancement of the gear wheel **130** one tooth in a counterclockwise direction so that upon a return line spacing operation, the brush plate **112** will stop in a position one line ahead of the last line printed in the first segment of the log sheet.

The arrangement of the conductive areas on the printed circuit wheel **126'** associated with the abnormal space control section **20***b* of the control mechanism follows a similar pattern except that the conductive rings are interrupted in a different angular position corresponding to the position of the first line in the off normal space of the log sheet. For reasons to be explained, the wheel **126'** is actually designed to stop the log sheet one line ahead of the first line in the off normal space ONS.

Referring to Fig. 10, the two inner conductive rings **141'** and **143'** are provided for phasing purposes so that when desired the brush plates **110'** and **112'** may be returned to the position of the gap *a* in the innermost ring **141'.** The conductive ring **145'** is provided with a gap *b* in the angular segment corresponding to line **164.** The conductive spot **152'** associated therewith has a tail **153'** which has been filed away at one point to break the continuity between the spot and the outermost conductive ring **147'.** In a like manner, to enable flexibility in the line spacing program, other conductive spots **154', 156',** and **158'** are provided, tails **155', 157'** and **159'** extending to the outermost ring **147'.** Corresponding gaps *c, d* and *e* in the ring **145'** are provided for reasons which are apparent from the explanation above. The brush plates **110'** and **112'** have a position corresponding to the line in which the log sheet is positioned to receive typing, and, if line spacing is under control of the brush plate **110',** a blind line spacing operation will be terminated when a discontinuity exists between rings **143'** and **147'** when the log sheet is positioned to receive printing in line **164** of the log sheet. The phasing or return of the brush plates to a start position is obtained when a discontinuity exists between the innermost rings **141'** and **143'.** However, in the phasing operation, the printed circuit wheel **126'** is moved rather than the brush plates fixed to the gear wheel **106'.**

Electrical connection to the conductive rings **141', 143'** and **147'** are made in the same manner as in the case of the corresponding rings of wheel **126.** Thus slip rings **171', 172'** and **178'** are provided on the back of wheel **126'** which are connected to these rings through holes lined with conductive material such as holes **173', 175'** and **179'.** Brushes **176', 174'** and **181'** mounted upon the housing wall **103** make contact with the slip rings **171', 172'** and **178',** respectively.

As the line in the off normal space ONS of the log sheet is completed, or at the beginning of each hourly recording period, solenoid SR–2 is pulsed once to advance the printed circuit wheel **126** one tooth in a counterclockwise direction so that the condition of this discontinuity between the conductive rings **143'** and **147'** will occur when the log sheet is positioned one line ahead of the last printed line in the off normal space. The reason for this will become apparent as this description proceeds.

Refer now more particularly to Fig. 15 showing the control circuit in which the various aforementioned slip rings are located, which control circuit controls the energization and the direction of rotation of the electric motor **30,** among other things. Fig. 15 shows a schematic across-the-line diagram of the circuit. It will be described by first stating a function to be performed in the data recording system and then tracing the circuit

which performs the function. The contacts of the relays are identified by the same reference characters used for the associated relays plus a number identifying the particular set of contacts of these relays. Furthermore, the relay contacts are shown in their positions when the associated relays are de-energized.

In setting up the recording system for operation, the log sheet is first placed on the typewriter carriage to receive printing in the first line of the first segment of the log sheet. This requires manual turning of the feed roll knob **15** which may be accomplished by release of the locking means holding the feed roll shaft **12** in position. Since the typewriter may be operated manually, this may be accomplished by depressing the carriage return key commonly found on electric typewriters, which brings the carriage into start position where the clutch members **17** and **26** are engaged and the feed roll shaft locking means are disengaged. At the same time, control buttons CC–1 and CC–2 (see Figs. 3 and 15) are depressed for disabling operation of the system where feeding of data information to the typewriter is terminatted and motor **30** is held de-energized.

The contacts of the push button CC–1 are located in a branch *j* extending between power lines P1—P2. Depression of the push button energizes the relay R–11 in that branch which seals in through a holding circuit including holding contacts R11–1′ and normally close the contacts R6–3 connected between the upper terminal of the relay coil R11 and the power line P1. Energization of the relay R11 opens normally closed contacts R11–1′ of this relay (see Fig. 3) to open the input circuits to the typewriter.

Depression of the push button CC–2, among other things, initiates the pulsing of the solenoids SR3 and SR2 which move the gear wheels **130—130′** until the associated brush plates of wheel **106** are opposite the small gaps *a* in the conductive rings **145—145′** of the printed circuit wheels **126—126′**. As previously indicated, inner brush plate **112** of the wheel **126** controls the phasing of the wheels **126** and **106**. The slip rings **171** and **178** associated with rings **141** and **143** of the wheel **126** are connected in a branch *a* between lines P1 and P2, which branch includes a relay R1. When the inner brush plate **112** associated with the slip rings **171** and **178** is opposite the gap *a* in the conductive ring **141**, the circuit between the slip rings **171** and **178** is open, thereby de-energizing the relay R1.

Slip rings **171′** and **178′** of wheel **126′** are in a branch *c* between the lines P1 and P2, which branch includes the relay R3 which is de-energized when the wheels **106′** and **126′** are phased, that is when the brush plate **112′** of wheel **106′** is opposite the gap *a* in ring **141′** of wheel **126′**. Also, slip rings **171** and **172** of wheel **126** are in a branch circuit *b* in series with a relay R2, and slip rings **172′** and **171′** of wheel **126** are in a branch circuit *e* in series with a relay R4. The relays R1 and R3 have contacts in branch circuits F and F′ between the lines P1 and P2, which branches contain respectively, ratchet solenoids SR–2 and SR–3. Branch F includes in series with the solenoid SR–2 interrupter contacts SR–2–1, normally open contacts R3–1 and normally open contacts R6–4. The branch F′ includes in series with the solenoid SR3 interrupter contacts SR3–1, normally open contacts R1–2 and normally open contacts R6–5. The relay R6 which controls the contacts R6–4 and R6–5 is in a branch *k* between the power lines P1 and P2 which branch includes a sub-branch K–2 having the push button switch CC–2 and a parallel sub-branch K–1 normally open holding contacts R6–1 and normally open contacts R3–2 in parallel with normally open contacts R1–0. Thus, when the push button switch CC–2 is momentarily depressed, the relay R6 seals in through sub-branch K–1 upon the closing of contacts R6–1 as long as either relay R1 or relay R3 is energized, which is the case as long as the associated wheels **106—126** and **106′—126′** are not phased. When both are phased, then sub-branch K–1 is opened and relay R6 becomes de-energized.

Upon energization of the relay R6, contacts R6–4 in branch *f* close to establish energization of the index solenoid SR–2 and the contacts R6–5 in branch F′ close to establish energization of the index solenoid SR–3 whereupon the interrupter switches SR2–1 and SR3–1 continue to open and close to pulse the associated solenoids until the above-mentioned phasing operations are complete, whereupon the relay contacts R3–1 and R1–2 in the branches F and F′ open upon de-energization of relays R1 and R3 to terminate pulsing of the solenoids. Energization of relay R6 also results in the closing of normally open contacts R6–2 in the sub-branch *m*–3 of branch *m*. Contacts R6–2 are in series with the relay coil R7 which becomes energized as relay R6 becomes energized. The relay R7 seals in through a holding sub-branch *m*–1 which includes normally open holding contacts R7–1 and homing contacts SS–2′ of an abnormal count stepping switch SS, which contacts open when the switch SS is homed or in its **0** contact position. As will be explained, the depression of push button CC–2 initiates the homing of this stepping switch. This switch counts and memorizes the number of off-normal variable groups within the active line in the off-normal space ONS of the log sheet. Of course, other types of counting devices may be utilized. In the example illustrated, it is assumed that each line in the off-normal space of the log sheet will hold as many data groups as there are contacts on the stepping switch SS. One of the contacts, contact **0**, of this switch is a homing contact to which the wiper of the switch is advanced upon initiation of each regular, such as hourly, scanning cycle. The advancement of the wiper of the switch SS is controlled by solenoid SR–1 in branch *e* which, when pulsed once, advances the wiper of the stepping switch SS one contact position utilizing suitable well known ratchet and gear mechanism, not shown.

Energization of the relay R7 closes normally open contacts R7–3 in sub-branch *e*–2 and establishes an energized path for the stepping switch solenoid SR–1 through interrupter contacts SR1–1 and homing contacts SS–2 of the count switch SS which open when the latter switch is positioned to its home contact **0**. Therefore, when relay R7 is energized solenoid SR1 is continuously pulsed until the stepping switch SS is homed, which opens the homing contacts SS–2, thereby terminating pulsing of the solenoid SR1. When the stepping switch SS is in its home position, its other homing contacts SS–2′ in sub-branch *m*–1 open to break the holding circuit of relay R7 which de-energizes the same.

The energization of the relay R7 resulting from the initial depression of the reset push button CC–2 also opens the normally closed relay contacts R7–5 in series with parallel sub-branches *g*–1 and *g*–2 in a circuit controlling the energization of the motor **30**. This disables motor **30** and, hence, rotation of the feed roll shaft by means other than the manual control knob **15** on the typewriter carriage.

When all of the aforementioned phasing and homing operations are complete, relays R6 and R7 are de-energized and the recording system is then free to operate in the normal manner.

Following completion of recording of a complete line of data in the first segment S–1 of the log sheet, the carriage of the typewriter is in its extreme left hand position, whereupon a typewriter carriage limit switch L–1 closes. This switch is in a branch *a*–2 between the lines P–1 and P–2 which branch includes the relay CR′. Connected in parallel with switch L–1 is a timing switch T–0 which closes momentarily at the beginning of each regular recording interval, and also a normally open switch DPB–0 which is closed either directly or through a relay when the on demand pushbutton DPB (Fig. 3) is depressed. As previously indicated, the pushbutton DPB is operated when recording of all variables in the segments S–1

through S–4 of the log sheet is desired between the regular recording intervals. Relay CR′ has contacts (not shown) which close when the relay energizes to energize the input line of electric typewriter which operates the carriage return relay of the typewriter. Thus, upon closing of limit switch L–1 or the other contacts T–0 or DPB–0, the carriage of the typwriter is automatically returned to its fully right-hand or start position where the clutch members **26** and **17** are fully engaged to initiate a line spacing operation.

It is necessary that motor **30** be energized to initiate a blind line spacing operation only when the clutch members are in engagement. This is accomplished through the use of a relay DR in a branch *a*–**1** between the lines P1—P2. In circuit with the relay DR are the normally open contacts CR′–**1** of the relay CR′. A holding branch is provided for the relay DR which includes normally closed contacts LR–**3** and normally open holding contacts DR–**1**. Thus, momentary energization of the relay CR′ will energize the relay DR which locks in through the aforementioned holding branch. Contacts of the relay DR to be described prevent energization of the motor **30** under certain circumstances until the relay DR is subsequently de-energized. This de-energization is brought about by a relay LR in a branch *a*–**3** between the lines P1—P2. This branch includes a typewriter carriage to limit switch L–**2** which closes when the carriage reaches its fully right-hand position, that is, when the clutch members **26** and **17** are fully engaged. Then, as the relay LR is energized, its normally closed contacts LR–**3** in the holding branch of the relay DR open, which de-energizes the relay DR. Note that the relay CR′ is then de-energized because the limit switch L–**1** in the energization circuit thereof is closed only when the carriage is in the fully left-hand position.

The energization circuit for the motor **30** will be now described.

The electric motor **30** is preferably a two-phase induction motor having a pair of windings F1 and F2 which are coupled through relay contacts to power lines P3 and P4, which may be a 110 volt A.C. power system as distinguished from a lower voltage A.C. or D.C. voltage connected to power lines P1—P2 controlling the various relays in the system. In a manner to be described, the direction of rotation of the motor **30** is obtained by switching a phasing capacitor **200** from one field circuit to another. Termination of the line spacing operation is effective by dynamic breaking in the field coil circuit of the motor. That is, one of the field windings F2 is shorted out of the circuit when it is desired to suddenly stop the motor to terminate a line spacing operation.

The direction of rotation of the motor is controlled by a reverse rotation relay R12 in a branch circuit F″ between the lines P1—P2. This branch circuit includes a number of parallel connected sub-branches, a sub-branch F″–**3** having normally open timing contacts T–**3** which momentarily close just prior to the beginning of a regular recording interval, an alternative branch F″–**2** comprising normally open holding contacts R12–**1** in series with normally open contacts R1–**1** and a third series with normally open contacts R1–**1** and a third sub-branch F″–**1** including normally open contacts DPB–**4** which are momentarily closed when on demand push-button DPB is closed. Thus, when either the timing contacts T–**3** or the contacts DPB–**4** are closed, the energization circuit is completed for relay R12 which seals in through the sub-branch containing normally open contacts R1–**1** and the then closed holding contacts R12–**1**. Note that the contacts R1–**1** are closed except when the brush plates of the wheel **126** are homed.

Energization of relay R12 establishes an energization circuit for field coil F1 of motor **30** after the carriage has been returned to its exertme right hand position. The circuit extends from line P3 through the phasing capacity **200**, the then closed normally open contacts R12–**6** and the field coil F1 leading to the other power line P4. Energization of the other field coil F2 is effected through a circuit extending from power line P3 through the then closed normally open contacts R12–**2**, normally closed contacts DR–**3** which are open when the carriage is being returned to its extreme right hand position, field coil F2, and the then closed normally open contacts R12–**7** leading to the power line P4. This causes rotation of the motor **30** in what will be referred to a a reverse direction for obtaining a return line spacing operation. That is, it rotates the gear wheels **106—106′** in a clockwise direction which rotates the feed roll shaft in a counterclockwise direction viewed from the right-hand side thereof which would back the log sheet up to a point where it would receive printing in a portion above the last printed line thereof. The return line spacing operation ceases when the brush plate **112** reaches the small gap *a* of conductive ring **141**, which results in the de-energization of relay R1. Then, the contacts R1–**1** in sub-branch *f*″–**2** open to break the holding circuit to the relay R12 which de-energizes the same. In the circuit just traced, it will be apparent that this will de-energize the motor **30**. The de-energization of relay R12 operates other contacts thereof, which prepares the energization circuit of the motor **30** for forward rotation.

One of the latter circuits extends from power line P3, through the phasing capacitor **200**, through the then closed normally closed set of contacts R12–**5**, field coil F2 and the then closed normally closed contacts R12–**4**. A set of normally open contacts DR–**6** in parallel with the contacts R12–**4** come into play during motor breaking in a manner to be hereinafter explained. Phasing condenser **200** is thus transferred from a circuit including the field coil F1 to a circuit including the field coil F2 to prepare the motor for operation in the normal forward direction thereof. The new circuit for field coil F1 may be traced from power line P3 through the then closed normally closed contacts R12–**3**, through one of a number of parallel sub-branches, namely, the sub-branches *g*–**1**, *g*–**2** and *g*–**3**. During reverse rotation operation of the motor **30**, these circuits are inactive because of the opening of the contacts R12–**3** when relay R12 is energized. The sub-branch *g*–**3** includes normally opened contacts LR–**1** of the relay LR, previously described, which relay is energized when the carriage is returned to its extreme right-hand position. In series with the latter contacts in the sub-branch *g*–**3**, is a set of normally open contacts DR–**2** of the relay DR which is energized in the interval when the carriage is being moved towards its extreme right-hand position. Relay DR is preferably a slow release relay so that at the instant the carriage reaches its extreme right-hand position, closing of the limit switch L–**2** will close the contacts LR–**1** and complete momentarily the energization circuit to the field coil F1 through the still closed normally opened contacts DR–**2** even though relay DR has become de-energized with the opening of contacts LR–**3** in the holding circuit thereof. The slow release characteristics of the relay DR are adjusted so that contacts DR–**2** open after an interval required to energize the motor **30** for a sufficient time interval to step or advance the gear wheel **106** carrying the brush plates only one tooth in a counterclockwise direction. Once the motor has moved the brush plates away from one of the gaps, the energization thereof is continued through sub-branches *g*–**1** or *g*–**2** until the brush plates reach the next gap in the printed circuit wheel involved.

Normally closed contacts R7–**5** leading to the sub-branches *g*–**1** and *g*–**2** are open during the initial setting up of the recording equipment when pushbutton CC–**2** is depressed or during the hourly resetting of the count switch SS to prevent a forward line spacing operation. The sub-branch *g*–**2** is operative to control the termination of a blind line spacing operation in the segments S–**2** through S–**4** of the log sheet and to maintain the

motor de-energized when the log sheet is positioned to receive typing in the first segment S–1 of the log sheet; whereas the sub-branch *g*–1 controls the termination of a blind line spacing operation in the off-normal space of the log sheet. The sub-branch *g*–2 includes normally open transfer contacts R10–2 which are closed during the recording in the segments S–1 through S–4. Relay R10 in branch circuit *n* is energized during the line spacing program in segments S1–S4. Also included in this sub-branch are a set of normally open contacts R2–1 which close whenever the relay R2 is energized, which occurs when the log sheet is positioned to receive printing in lines other than the lines included in the desired line spacing program. That is, whenever the brush plate 110 is in an angular position between gaps *a* and *h* and displaced from gaps *b* and *e* a forward blind line spacing operation is initiated by the return of the carriage to its extreme right-hand position which results in the energization of the sub-branch *g*–3 for a sufficient time to move the brush plate 110 away from an active gap whereupon relay R2 becomes energized to close the contacts R2–1 to energize the motor through branch *g*–2. The motor 30 becomes de-energized, when the brush plate 110 reaches the next active gap, such as *b*, *e* or *h* which results in the de-energization of the relay R2 and the opening of the contacts R2–1 in the sub-branch *g*–2. Following completion of a line in each of the regular log sheet segments S–1 through S–3, sub-branch *g*–2 operates in the same manner to control line spacing. However, following completion of the last line in the last segment S–4 of the log sheet and a carriage return operation, in a manner to be described, contacts R10–2 in the sub-branch *g*–2 open whereupon the sub-branch *g*–2 is de-energized and the sub-branch *g*–1 becomes operative to control forward line spacing of the log sheet as the normally closed contacts R10–3 close.

When the last variable has been scanned and recorded in the last segment of the log sheet, that is, segment S–4 in the example being described, normally closed contacts C–1 in a sub-branch *n*–3 in series with relay R10 is momentarily opened to de-energize the relay R10. The relay R10 was previously energized on the closing of the timing contacts T–1 in a sub-branch *n*–2, which close momentarily at the beginning of each regular, such as hourly, recording interval. The relay R10 then sealed in through its holding contacts R10–1 in sub-branch *n*–3. Contacts C–1 may be controlled from a suitable variable counter which actuates a relay (not shown) controlling the contacts C–1 when the last variable in the last regular segment of the log sheet has been printed. The variable counter may be a stepping switch in the scanning system 42 shown in box form in Fig. 3. The latter stepping switch system 42 obviously has one contact associated with each variable and when the stepping switch contacts leave the last contact of that system, the relay can be energized in a suitable manner to momentarily open the normally closed contacts C–1.

The de-energization of the relay R10 transfers control over energization of the motor 30 to the sub-branch *g*–1 which includes the normally closed contacts R10–3, normally closed contacts DR–4 and normally open contacts R4–1 of relay R4 in the branch *d*. Upon completion of the last line in the segment S–4 of the log sheet, a carriage return operation is initiated and control over line spacing is transferred to sub-branch *g*–3. The relay R4 in branch circuit *d* is energized until the log sheet is positioned to receive printing in the line ahead of the next completely free line in the off normal space ONS, and thus contacts R4–1 in branch *g*–1 are therefore closed when control over forward line spacing is initially transferred to sub-branch *g*–1. However, sub-branch *g*–1 does not become energized until contacts DR–4 therein are closed, and these contacts are opened during a carriage return operation. When contacts DR–4 reclose, a blind line spacing operation is initiated which is terminated when the brush plate 110′ is moved opposite the gap *b*. This de-energizes the relay R4, opens contacts R4–1 in sub-branch *g*–1 and thereby de-energizes the motor 30.

The manner in which the log sheet is advanced in the first available line in the off normal space ONS of the log sheet will now be described.

When the fault sensing apparatus 49 senses an abnormal variable, the alarm relay AR is energized which closes normally open alarm relay contacts AR–1 in branch *i* (Fig. 12). The alarm relay contacts AR–1 are in series with two alternate branches *i*–1 and *i*–2. A slow acting relay DR′ in branch *i*–1 has normally closed slow acting contacts DR′–1 in sub-branch *i*–2 which are in series with a relay R–8. The relay R–8 energizes until the normally closed slow acting relay contacts DR′–1 open. The last-mentioned relay has normally open contacts R8–1 in sub-branch *e*–1 which sub-branch also includes normally closed contacts R7–2 of the then de-energized relay R–7 and normally closed contacts R10–4 of the then de-energized relay R–10. An energization circuit is therefore established to the stepping switch solenoid SR–1 which steps the switch SS one position to indicate or count the existence of one abnormal variable whose data is to be printed in the off-normal log sheet space ONS. Since the movable contact of the stepping switch SS had been previously homed to its zero position, the aforementioned stepping of the switch one position brings the movable contact of the stepping switch into engagement with its No. 1 stationary contact, to which is connected a lead 100 joining a terminal of the index solenoid. Energizing voltage is thereby fed to the index solenoid through an energization circuit including power line P–1, normally closed contacts R7–2 in sub-branch *e*–1, the then closed contacts R8–1, the then closed normally closed contacts R10–4, the then closed normally closed contacts R7–6, the No. 1 contacts of the stepping switch, lead 100 and index solenoid SR–2 connected to power line P–2.

The slow acting relay DR′ is connected so that its normally closed contacts DR′–1 seal in after a delay which is sufficient to enable the stepping switch SS to be stepped one position and the index solenoid SR–2 be actuated as above described. Then, as the contacts DR′–1 open in sub-branch *i*–2, relay R8 becomes de-energized which opens contacts R8–1 in sub-branch *e*–1 to terminate or complete the pulsing of the stepping switch index solenoid. As the index solenoid is pulsed once, the gear 124′ moves clockwise one tooth which in turn moves the connected printed circuit wheel 126′ one angular unit. Then, brush plate 112′ is displaced one angular unit in a clockwise direction from the gap *b* in the conductive ring 145′ which results in the energization of relay R4 and the closing of contacts R4–1 in sub-branch *g*–1. The motor 30 is thus energized to move the gear 106′ and the feed roll shaft through pinion gear 104 and the clutch members 26 and 17. As soon as the gear 106′ has been moved one angular unit, the brush plate 110′ reaches the gap *b* again and a single line spacing operation has been completed. The log sheet is now positioned in the first available line of the off normal space ONS. The recording of the abnormal data scanned between regular, such as hourly, recording intervals then proceeds. If sufficient abnormal data is present to fill the then active line in the off normal space ONS, the limit switch L–1 is tripped to initiate a carriage return operation in the manner above explained.

The data on the first abnormal variable scanned is of course fed to the typewriter and the same is typed in the first line of the off normal space ONS. Each time an abnormal variable is scanned, the alarm relay AR is energized which initiates pulsing of the solenoid SR–1 in the manner above-described to advance the wiper of the stepping switch SS one contact position. These stepping switches are customarily designed so that the wiper

moves from the last so-called contact to the first contact in the forward direction of movement of the wiper by utilizing a semi-circular contact arrangement together with a double-ended wiper so that following the scanning of the last abnormal variable which can be accommodated by a line in the log sheet, the wiper of stepping switch SS will be in its zero or home position. If, prior to the next hourly recording interval, still another abnormal variable is scanned, relay AR will become energized, and, as a spacing pulse is fed to the typewriter input (such a pulse may be provided by the programming apparatus **46** prior to the printing of any data group), the carriage is advanced one space to the left which will bring the carriage to its extreme left-hand position which results in the closing off limit switch L–**1** with the consequent momentary energization of the relay CR′ following which the relay DR is energized and locked in through its holding branch circuit. Also, upon the last energization of the alarm relay, the wiper of the stepping switch SS is stepped to its #1 position which, in the manner above-explained pulses the solenoid SR**2** once to advance the printed circuit wheel **126′** one angular unit in a counter-clockwise direction. Brush plate **110′** is again moved one angular unit away from the gap *b* so that relay R**4** is energized resulting the closing of the contacts R**4**–**1** in the sub-branch *g*–**1**. However, this branch is not energized to start the motor **30** until the contacts DR–**4** reclose in the branch *g*–**1**. This occurs when the carriage reaches its extreme right hand position which closes when the limit switch L–**2** is closed to energize relay LR and consequently break the holding circuit of the relay DR. As subsequent lines are used up in the off normal space ONS between regularly hourly recording intervals, the aforementioned procedures repeats itself.

At the beginning of the next hourly recording interval, or when the operator desires to obtain data on all variable between the hourly recording intervals, either the timing contacts T–**1**, T–**2**, etc., or the on demand pushbutton contacts DPB–**1**, etc., momentarily close in the various circuits above-mentioned to initiate a number of operations. For one, relay R**7** is energized on the closing of contacts T**2** or DPB–**2** in sub-branches *m*–**2** and *m*–**4** to home the abnormal count switch SS in the manner above-explained. Also, solenoid SR–**3** which controls the position of the printed circuit wheel **126** is pulsed once upon the momentary closing of the contacts DPB–**3** or T–**4** in sub-branches F′–**1** and F′–**2** respectively, so that the return line spacing operation terminates when the log sheet is positioned to receive typing in the line below the last printed line in the first segment of the log sheet. Further, contacts DPB–**4** or contacts T–**3** in sub-branches F″–**1** or F″–**3** momentarily close to energize the reverse rotation relay R**12** which seals-in in the manner previously described to prepare the energization circuits of the motor **30** for reverse rotation. The closing of the timing contacts or the push-button contacts DPB energize the relay CR′ which in turn energizes relay DR which seals-in until the carriage is returned to its extreme right-hand position. Then, contacts DR–**3** in the energization circuit of the motor **30** close to initiate a return line spacing operation which ends when the brush plate **110** reaches the gap *a* in the conductive ring **145**, at which point the log sheet is positioned to receive printing in the line below the last printed line in the first segment of the log sheet. To accomplish this, sub-branch *g*–**2** must be active and this is accomplished by the energization of relay R**10** on the momentary closing of the contacts DPB–**1** or T–**1** in the sub-branches *m*–**1** or *m*–**2**.

In the various line spacing operations above-described, it is apparent that inertia effects of the motor when the motor is de-energized must be eliminated so that the feed roll shaft will precisely position to the correct line. This is obtained by dynamic braking of the motor **30** by means of a shunting circuit for the field coil F–**2**. During the forward line spacing operations, this circuit extends from one field coil terminal through the normally closed contacts R**12**–**4**, power line P**4**, one of the parallel sub-branches, including respectively the normally closed contacts R**2**–**3** which are closed when the brush plate **110** is opposite one of the active gaps *a*, *b*, *e*, or *h*, of the conductive ring **145**, or the normally closed contacts R**4**–**3** which close when the brush plate **110′** is opposite the active gap *b* of the conductive ring **145′**, the normally closed contacts LR–**4** which open when the carriage is in its extreme right-hand position, and the normally closed contacts R**12**–**8** leading to the other terminal of the field coil F**2**. The contacts LR–**4** should be of the type which open only momentarily upon energization of the relay LR or else the braking circuit will not be effective when the contacts R**2**–**3** or R**4**–**3** close upon the completion of a line spacing operation. Upon such completion the carriage would still be in its extreme right-hand position which, unless the contacts L**4**–**4** are of the momentarily operating type, will keep the braking circuit open since the relay LR remains energized until the carriage is moved from its extreme right-hand position. Thus, when the carriage is returned to its extreme right-hand position to initiate or to begin a line spacing operation, contacts LR–**4** momentarily open to brake the dynamic locking of the motor **30** whereupon the consequent movement of the gear wheels carrying the brush plates are moved away from one of the active gaps opening contacts R**2**–**3** or R**4**–**3** which maintains the braking circuit open following subsequent closure of the contacts LR–**4**.

The dynamic braking circuit during the return line spacing operation operates in a similar manner. When the reverse rotation relay R**12** is initially energized, a carriage return operation is started. The braking circuit should be maintained until this carriage return operation is completed. To maintain the braking circuit until the carriage is returned to its extreme right-hand position, contacts DR–**6** in parallel with contacts R**12**–**4** are provided so that upon opening of contacts R**12**–**4** the braking circuit is maintained by contacts DR–**6**, which close during the energization of the relay DR, until a carriage return operation is completed. The braking circuit during the carriage return operation includes the then closed contacts DR–**6**, field coil F**2** and the normally opened but then closed contacts R**12**–**7**. When the carriage return operation ends, contacts DR–**6** open to open the braking circuit. The braking circuit becomes effective again when the return line spacing operation is complete, whereupon the reverse rotation relay R**12** becomes de-energized establishing the braking circuit upon the closing of the contacts R**12**–**4** and R**12**–**8** and one of the sets of contacts R**2**–**3** or R**4**–**3**.

It should be understood that the present invention is not to be limited by the specific circuitry above described which was utilized in order to disclose a preferred embodiment of the invention. Many modifications may be made thereof without deviating from the invention.

I claim as my invention:

1. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively recorded in spaced areas of the log sheet, line spacing programming means which control the movement of said feed means to advance said log sheet to enable successive recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and having relatively movable programming means therein, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said shaft, a cooperating clutch member connected to said feed means,

said clutch members coming together to make driving engagement with one another when the typewriter carriage has reached one of the limits of its path of travel for coupling together said one programming means and said feed means, motion-imparting means connected in driving relation to said clutch shaft of said line spacing programming means, control means connected to said motion-imparting means for controlling the operation thereof, and means following completion of the recording of data in a line of said log sheet for actuating said carriage return means, said control means being responsive to the bringing together of said clutch members for initiating the movement of said motion-imparting means to advance said feed means, said relatively movable programming means forming part of said control means and including means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing in the appropriate line in said log sheet.

2. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively recorded in spaced areas of the log sheet, line spacing programming means which control the movement of said feed means to advance said log sheet to enable successive recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and having relatively movable programming means therein, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said shaft, a cooperating clutch member connected to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has been returned to a position to begin a new line of data for coupling together said one programming means and said feed means, motion-imparting means connected in driving relation to said clutch shaft, control means connected to said motion-imparting means for controlling the operation thereof, and means following completion of the recording of data in a line of said log sheet for actuating said carriage return means, said control means being responsive to the bringing together of said clutch members for initiating the movement of said motion-imparting means to advance said feed means, said relatively movable programming means forming part of said control means and including means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing in the appropriate line in said log sheet.

3. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively recorded in spaced areas of the log sheet, line spacing programming means which control the movement of said feed means to advance said log sheet to enable successive recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and having relatively movable programming means therein, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said shaft, a cooperating clutch member connected to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has reached one of the limits of its path of travel, for coupling together said one programming means and said feed means, electric motion-imparting means connected in driving relation to said clutch shaft of said line spacing programming means, control circuit means connected to said motion-imparting means for controlling the operation thereof, and means following completion of the recording of data in a line of said log sheet for actuating said carriage return means, said control circuit means being responsive to the bringing together of said clutch members for initiating the movement of said motion-imparting means to advance said feed means, said relatively movable programming means forming part of said control circuit means and including switching means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing on the appropriate line in said log sheet.

4. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively and repeatedly recorded in a first and a second spaced area of the log sheet, line spacing programming means which controls the turning of said feed means to advance said log sheet to enable successive and periodic recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and including a housing having relatively movable programming means therein, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member accessible from outside of said housing and connected to said clutch shaft, a cooperating clutch member connected to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has been returned to a position to begin a new line of data, for coupling together said one programming means and said feed means, electric motion-imparting means connected in driving relation to said clutch shaft, said motion-imparting means comprising a reversible electric motor secured to said housing, control circuit means connected to said motion-imparting means for controlling the operation and direction of movement thereof, and means following completion of the recording of data in a line of the first area of said log sheet for actuating said carriage return means to effect a carriage return operation, said control circuit means being responsive to the bringing together of said clutch members for initiating the forward movement of said motion-imparting means to turn said feed means, said relatively movable programming means being operatively connected with said control circuit means and including switching means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing in the appropriate line in said second area of said log sheet, said control circuit means including means for actuating said carriage return means and for moving the carriage to bring said clutch members following completion of the recording of data in a line in the second area of the log sheet and for initiating reverse movement of said motion-imparting means after said clutch members have come together to return the log sheet to a position to receive data in said first area thereof, said relatively movable programming means including switching means for terminating the movement of said motion-imparting means when the log sheet has been positioned to receive printing in the appropriate line in said first area of said log sheet.

5. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively and repeatedly recorded in a first and a second spaced area of the log sheet, line spacing programming means which controls the turning of said feed means to advance said log sheet to enable successive and

periodic recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and including relatively movable programming means, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said clutch shaft, a cooperating clutch member connected to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has reached one of the limits of its path of travel, for coupling together said one programming means and said feed means electric motion-imparting means in driving relation to said clutch shaft, said motion-imparting means comprising a reversible electric motor secured to said housing, control circuit means conected to said motion-imparting means for controlling the operation and direction of movement thereof, and means following completion of the recording of data in a line of the first area of said log sheet for actuating said carriage return means to effect a carriage return operation, said control circuit means being responsive to the bringing together of said clutch members for initiating the forward movement of said motion-imparting means to turn said feed means, said relatively movable programming means being operatively connected with said control circuit means and including switching means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing in the appropriate line in said second area of said log sheet, said control circuit means including means for actuating said carriage return means and for moving the carriage to bring said clutch members together following completion of the recording of data in a line in the second area of the log sheet and for initiating reverse movement of said motion-imparting means after said clutch members have come together to return the log sheet to a position to receive data in said first area thereof, said relatively movable programming means including switching means for terminating the movement of said motion-imparting means when the log sheet has been positioned to receive printing in the appropriate line in said first area of said log sheet.

6. In an automatic data recording system, an automatic electric typewriter having a traversable carriage and carriage return means for automatically returning the carriage to begin a new line, feed means on said carriage for supporting a log sheet on which data is to be successively and repeatedly recorded in a first and a second spaced area of the log sheet, line spacing programming means which controls the turning of said feed means to advance said log sheet to enable successive and periodic recording of data in said spaced areas of the log sheet, said line spacing programming means being mounted externally of said carriage and including relatively movable programming means, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said clutch shaft, a cooperating clutch member connected to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has reached one of the limits of its path of travel, for coupling together said one programming means and said feed means, electric motion-imparting means connected in driving relation to said clutch shaft, circuit means connected to said motion-imparting means for controlling the operation and direction of movement thereof, and means following completion of the recording of data in a line of the first area of said log sheet for actuating said carriage return means to effect a carriage return operation, said control circuit means being responsive to the bringing together of said clutch members for initiating the forward movement of said motion-imparting means to turn said feed means, said relatively movable programming means being operatively connected with said control circuit means and including switching means for terminating the movement of said motion-imparting means when the log sheet has been indexed to receive printing in the appropriate line in said second area of said log sheet, said control circuit means including means for actuating said carriage return means and for moving the carriage to bring said clutch members together following completion of the recording of data in a line in the second area of the log sheet and for initiating movement of said motion-imparting means after said clutch members have come together to return the log sheet to a position to receive data in said first area thereof, said relatively movable programming means including switching means for terminating the movement of said motion-imparting means when the log sheet has been positioned to receive printing in the appropriate line in said first area of said log sheet.

7. In combination with an automatic electric typewriter having a traversing carriage on which is supported rotatable feed means for supporting a log sheet on which information is to be typed, line spacing programming mechanism for controlling the rotation of said feed means to provide a given line spacing program, said line spacing programming mechanism being mounted to one side of said typewriter, a common base for supporting both said typewriter and said line spacing programming mechanism, said line spacing programming mechanism including a frame supporting relatively movable programming means, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said clutch shaft, a cooperating clutch member on said carriage and coupled to said feed means, said clutch members coming together to make driving engagement with one another when the typewriter carriage has reached one of the limits of its path of travel, for coupling together said one programming means and said feed means, releasable locking means for normally locking said feed means against rotation, means for unlocking said locking means to free the feed means for rotation when the clutch members come together, motion-imparting means mounted upon said frame and connected to said clutch shaft, control circuit means connected to said motion-imparting means for controlling operation thereof, and means for moving said carriage to said limit where said clutch members make driving engagement with one another following completion of a recording operation in a line of said log sheet, said control circuit means including means for initiating movement of said motion-imparting means immediately following the coming together of said clutch members to turn both said feed means and said one programming means, said relatively movable programming means having respective control means which come together during different predetermined relative angular positions thereof to provide a line spacing program, said control circuit means including means responsive to the coming together of said control means for terminating operation of said motion-imparting means.

8. In combination with an automatic electric typewriter having a traversing carriage on which is supported rotatable feed means for supporting a log sheet on which information is to be typed, line spacing programming mechanism for controlling the rotation of said feed means to provide a given line spacing program, said line spacing programming mechanism being mounted to one side of said typewriter, said line spacing programming mechanism including relatively movable programming means, a clutch shaft coupled to one of said programming means so that the clutch shaft and said one programming means move together, a clutch member connected to said clutch shaft, a cooperating clutch member on said carriage and coupled to said feed means, said clutch members coming together to make driving engagement with one an-

other when the typewriter carriage has reached one of the limits of its path of travel, for coupling together said one programming means and said feed means, releasable locking means for normally locking said feed means against rotation, means for unlocking said locking means to free the feed means for rotation when the clutch members come together, motion-imparting means connected to one of said feed means and clutch shaft, control circuit means connected to said motion-imparting means for controlling the operation thereof, and means for moving said carriage to said limit where said clutch members make driving engagement with one another following completion of a recording operation in a line of said log sheet, said control circuit means including means for initiating movement of said motion-imparting means immediately following the coming together of said clutch members to advance both said feed means and said one programming means, said relatively movable programming means having respective control means which come together during different predetermined relative angular positions thereof to provide a line spacing program, said control circuit means including means responsive to the coming together of said control means for terminating operation of said motion-imparting means.

9. In combination with an electric typewriter having a traversing carriage and sheet feeding means carried by said carriage for supporting a record sheet for line spacing, locking means for normally locking said sheet feeding means against movement in either feeding direction, first clutch means, mounted on said carriage and coupled to said sheet feeding means, for coupling motive power thereto, control means for driving said clutch means to provide a line spacing program which moves the record sheet to receive repeatedly information in first and second spaced areas thereof, said control means comprising: relatively movable programming means, second clutch means mounted externally of said carriage and positioned to make driving engagement with said first clutch means when said traversing carriage is at one limit of traverse thereof, one of said programming means being connected for movement with said second clutch means during engagement of said first and second clutch means, so that it is moved with said sheet feeding means, means responsive to the engagement of said first and second clutch means for unlocking said locking means to free said sheet feeding means for movement in either feeding direction, means including a reverse drive electric motor supported externally of said carriage for driving said second clutch means during its engagement with said first clutch means, to initiate line spacing operations, means including said relatively movable programming means for terminating line spacing operations at a number of different relative positions of said relatively movable programming means, and means dependent upon the position of said one programming means for automatically operating said reverse drive motor in one direction when the second sheet is to be advanced from a position where it is to receive printing in said second area and for automatically operating said reverse drive motor in the opposite direction when the record sheet is to be advanced from a position where it receives printing in said second area to a position where it is to receive printing in said first area.

10. In combination with an electric typewriter having a traversing carriage and sheet feeding means carried by said carriage for supporting a record sheet for line spacing, first clutch means mounted on said carriage and coupled to said sheet feeding means for coupling motive power thereto, control means for driving said clutch means to provide a line spacing program which moves the record sheet to receive information in first and second spaced areas thereof, said control means comprising: relatively movable programming means both supported externally of said carriage, second clutch means mounted externally of said carriage and positioned to make driving engagement with said first clutch means when said traversing carriage is at one limit of traverse thereof, one of said programming means being connected for movement with said second clutch means during engagement of said first and second clutch means so that it is moved with said sheet feeding means, means including an electric motor supported externally of said carriage for driving said second clutch means during its engagement with said first clutch means, to initiate line spacing operations, and means including said relatively movable programming means for terminating line spacing operations at a number of different relative positions of said relatively movable

11. In combination with an electric typewriter having a traversing carriage and sheet feeding means carried by said carriage for supporting a record sheet for line spacing, locking means for normally locking said sheet feeding means against movement in either feeding direction, first clutch means mounted on said carriage and coupled to said sheet feeding means for coupling motive power thereto, control means for driving said clutch means to provide a line spacing program which moves the record sheet to receive repeatedly information in first and second spaced areas thereof, said control means comprising: relatively movable programming means both supported externally of said carriage, second clutch means mounted externally of said carriage and positioned to make driving engagement with said first clutch means when said traversing carriage is at one limit of traverse thereof, one of said programming means being connected for movement with said second clutch means, so that it is moved with said sheet feeding means, means responsive to the engagement of said first and second clutch means for unlocking said locking means to free said sheet feeding means for movement in either feeding direction, means including a reverse drive electric motor supported externally of said carriage for driving said second clutch means during its engagement with said first clutch means, to initiate line spacing operations, means including said relatively movable programming means for terminating line spacing operations at a number of different relative positions of said relatively movable programming means, and means dependent upon the position of said one programming means for automatically operating said reverse drive motor in one direction when the second sheet is to be advanced from a position where it receives printing in said first area to a position where it is to receive printing in said second area and for automatically operating said reverse drive motor in the opposite direction when the record sheet is to be advanced from a position where it receives printing in said second area to a position where it is to receive printing in said first area.

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