United States Patent

[11] 3,600,557

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[54] **DATA SCANNER**
59 Claims, 36 Drawing Figs.

[52] **U.S. Cl.** ..... **235/61.11E,** 250/219 D
[51] **Int. Cl.** **G06k 7/10,** G01n 21/30
[50] **Field of Search** ..... 235/61.115, 61.11; 250/219 R, 219 CR, 219 D, 219 FR

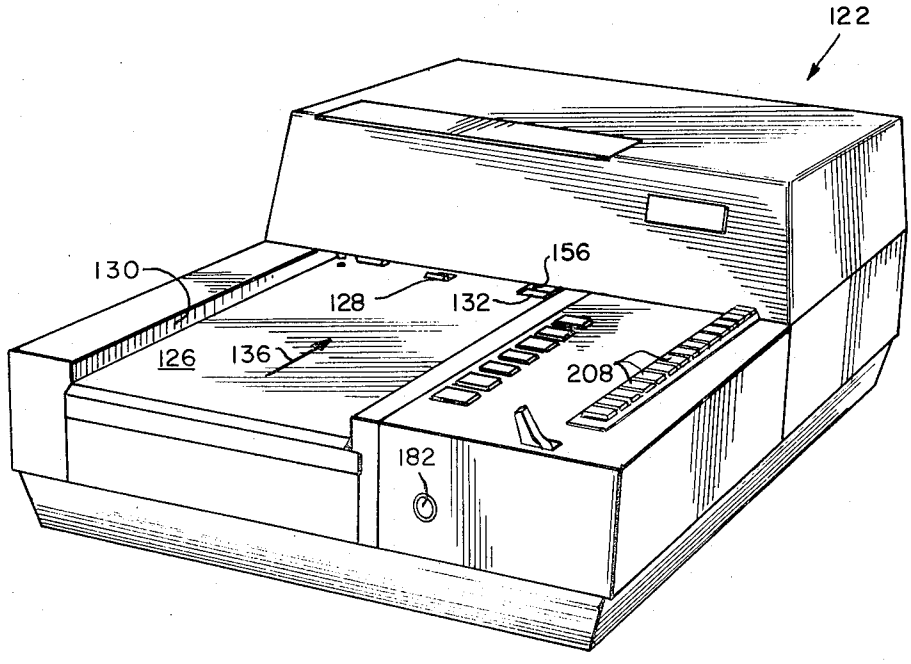
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Primary Examiner—Daryl W. Cook
Attorney—Hood, Gust, Irish, Lundy & Coffey

ABSTRACT: A system for scanning transversely extending lines of data printed graphically on a document, the system comprising a transversely movable scanning head, means for moving a document longitudinally relative to the scanning head and control means including optical means for finding a line of data to be scanned and stopping such relative movement. The control means may also include switch means for stopping the drive means providing the relative longitudinal movement and a plurality of switch actuator means longitudinally spaced apart to define a plurality of preselected relative positions for the scanning head and such a document. The scanning head carries light source means for projecting light at the data, a light-responsive semiconductor device and optical means for projecting light reflected from such a document toward said device, whereby the concentration of light on said device depends on the presence or absence as well as the width and spacing of graphical symbols in the line of data being scanned.



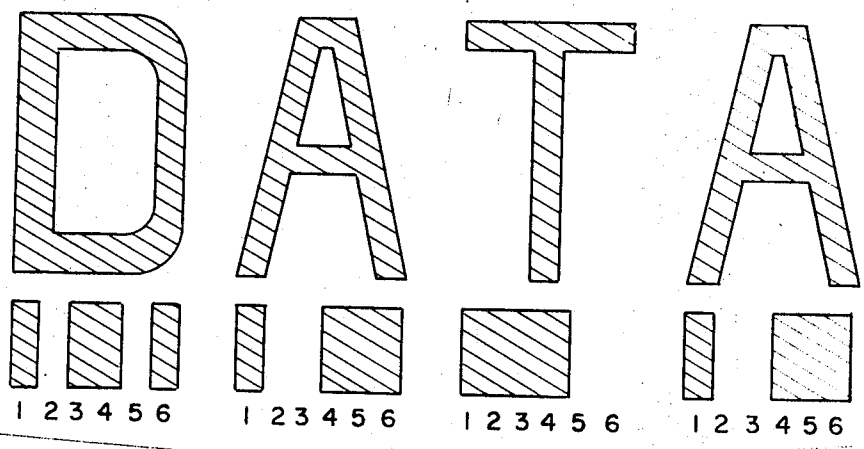


Fig. 1

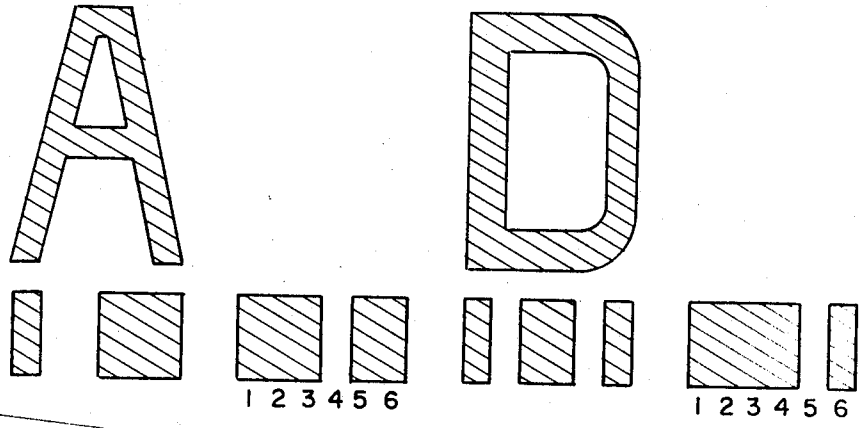


Fig. 2

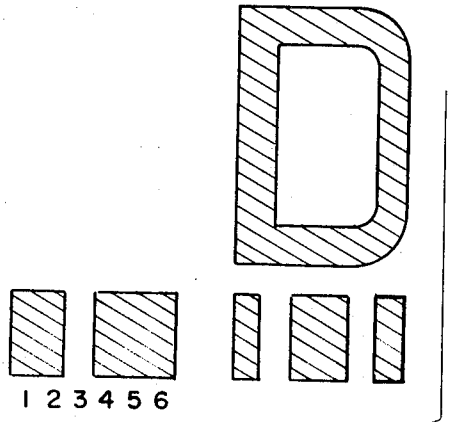


Fig. 3

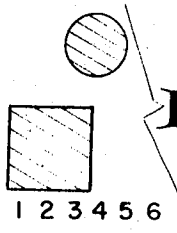


Fig. 4

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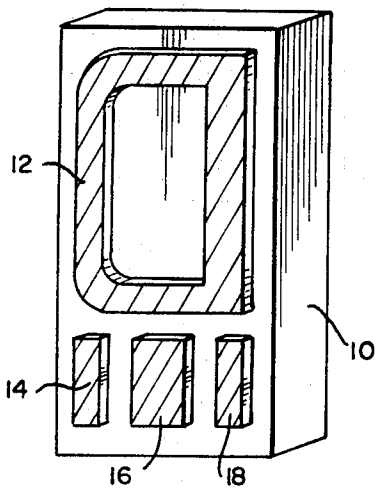


Fig. 5

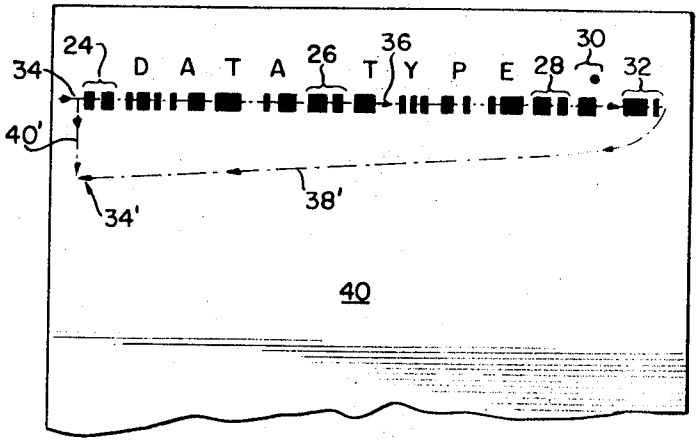


Fig. 7

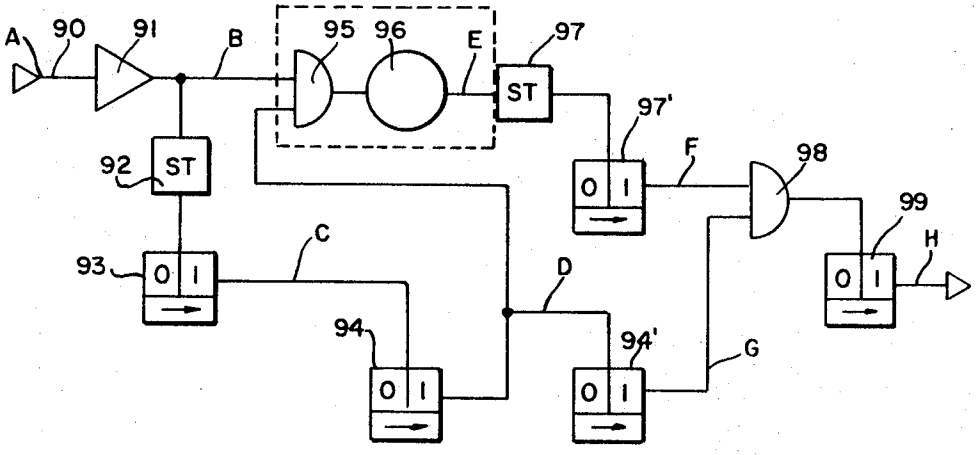


Fig. 8

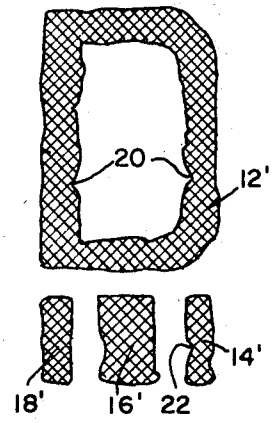


Fig. 6

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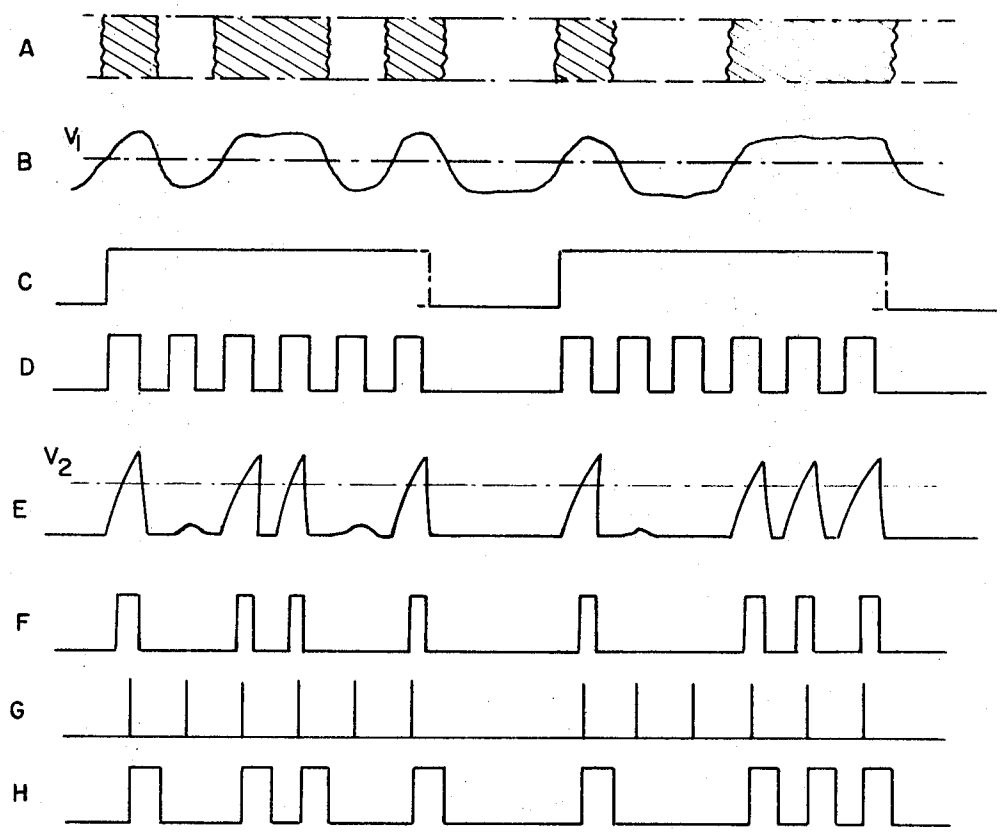


Fig. 9

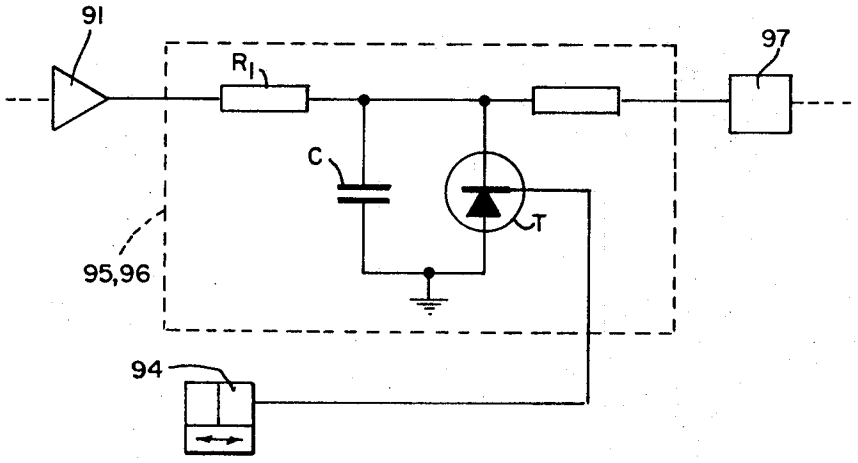


Fig. 11

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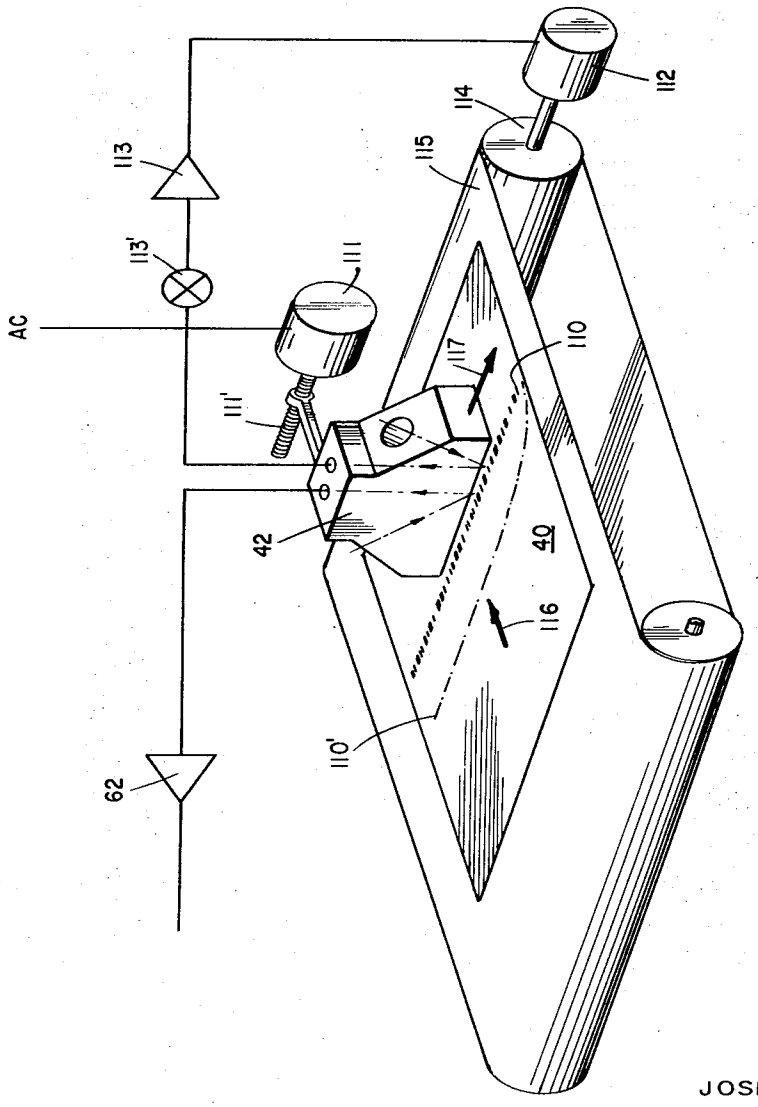
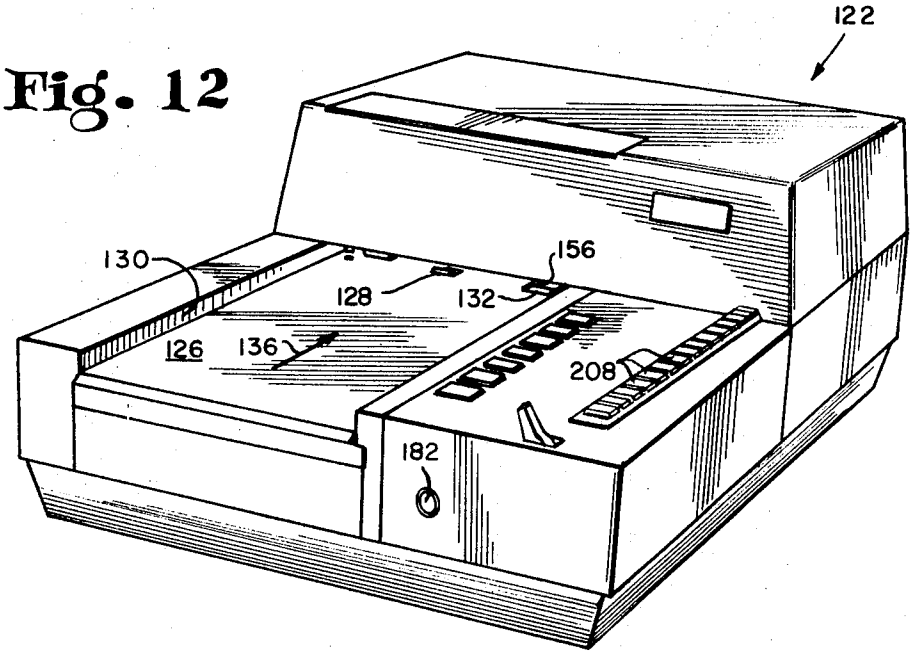


Fig. 10

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Fig. 12



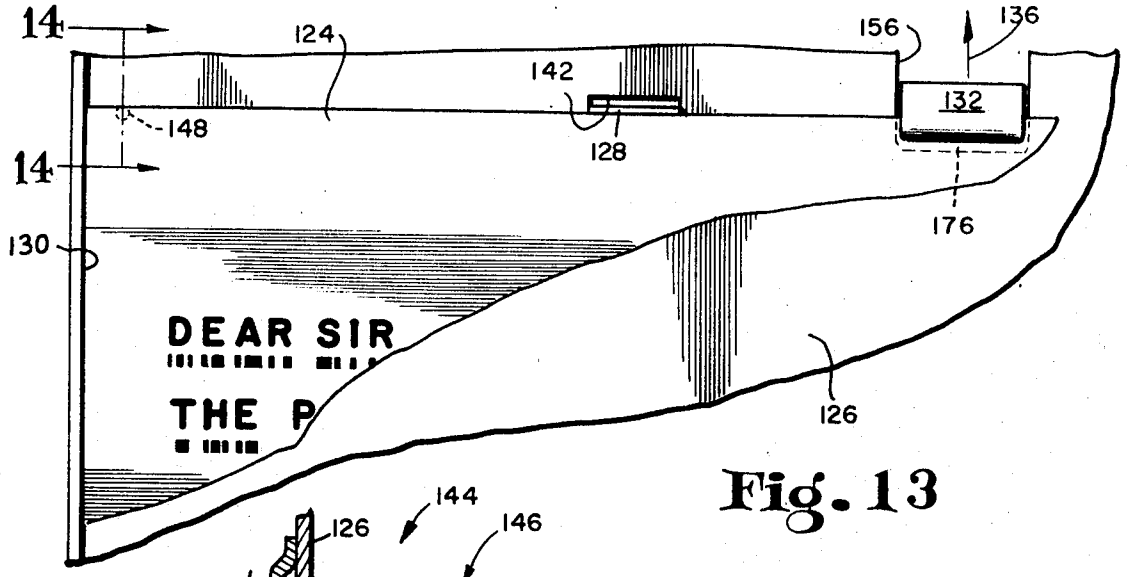


Fig. 13

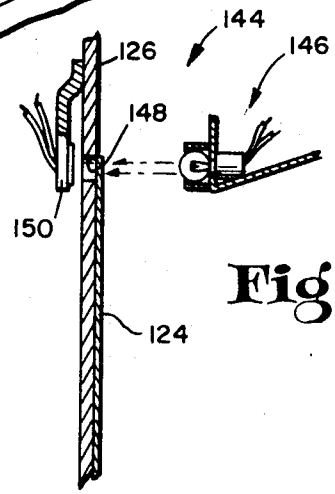


Fig. 14

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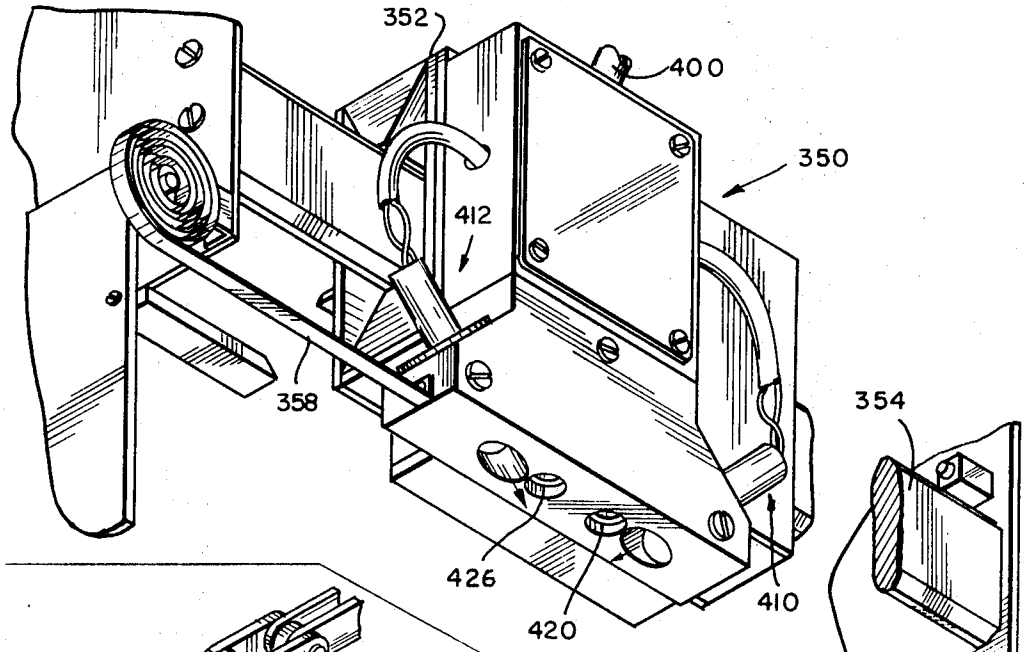


Fig. 15

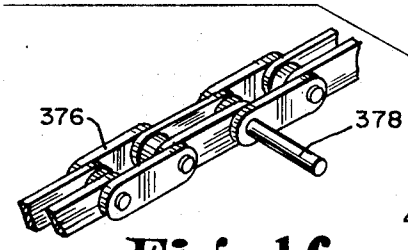


Fig. 16

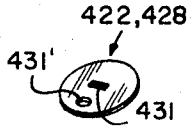


Fig. 20

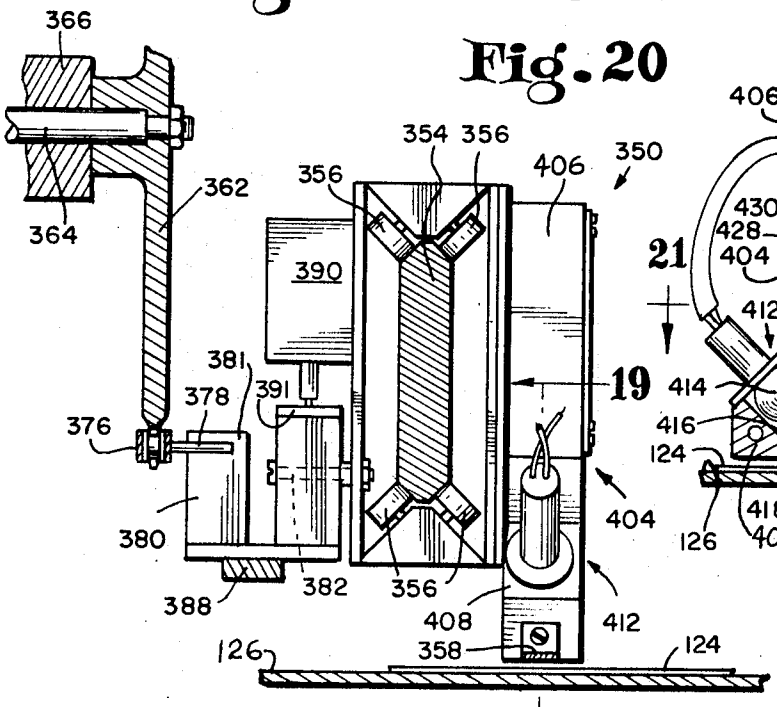


Fig. 17

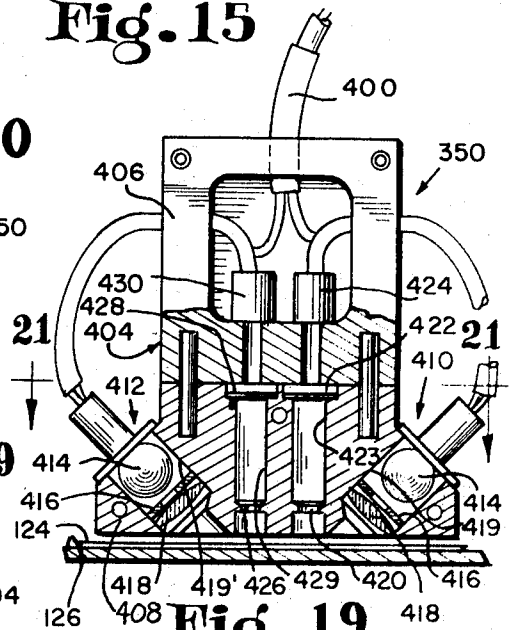


Fig. 19

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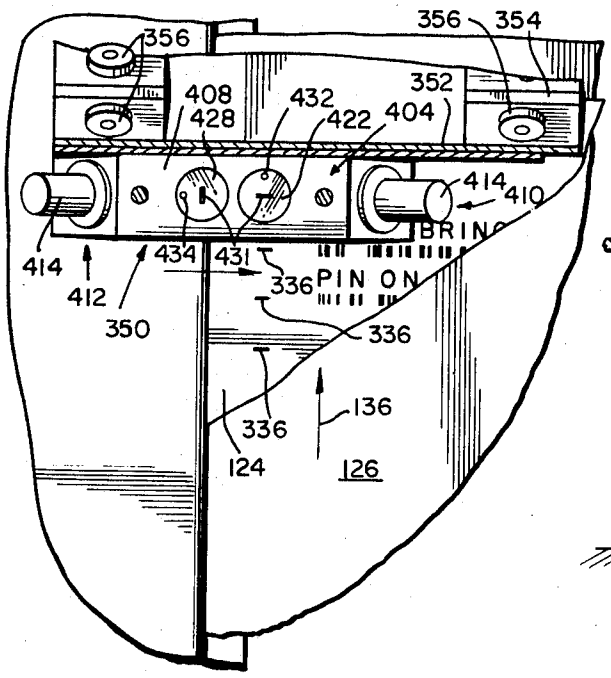


Fig. 21

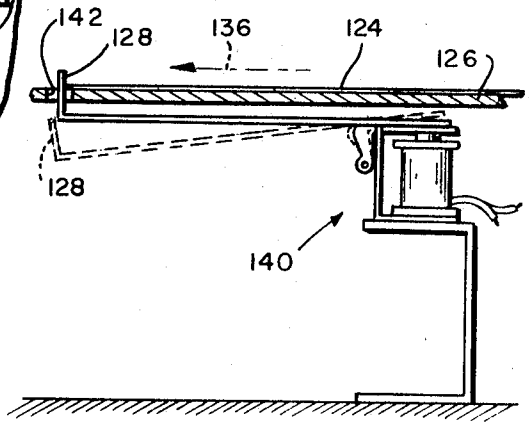


Fig. 22

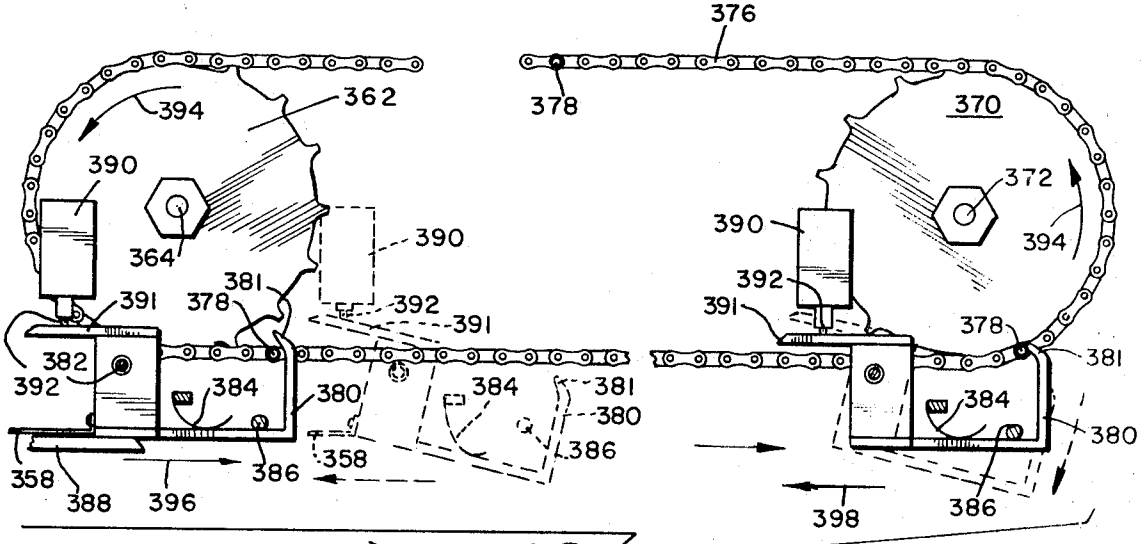
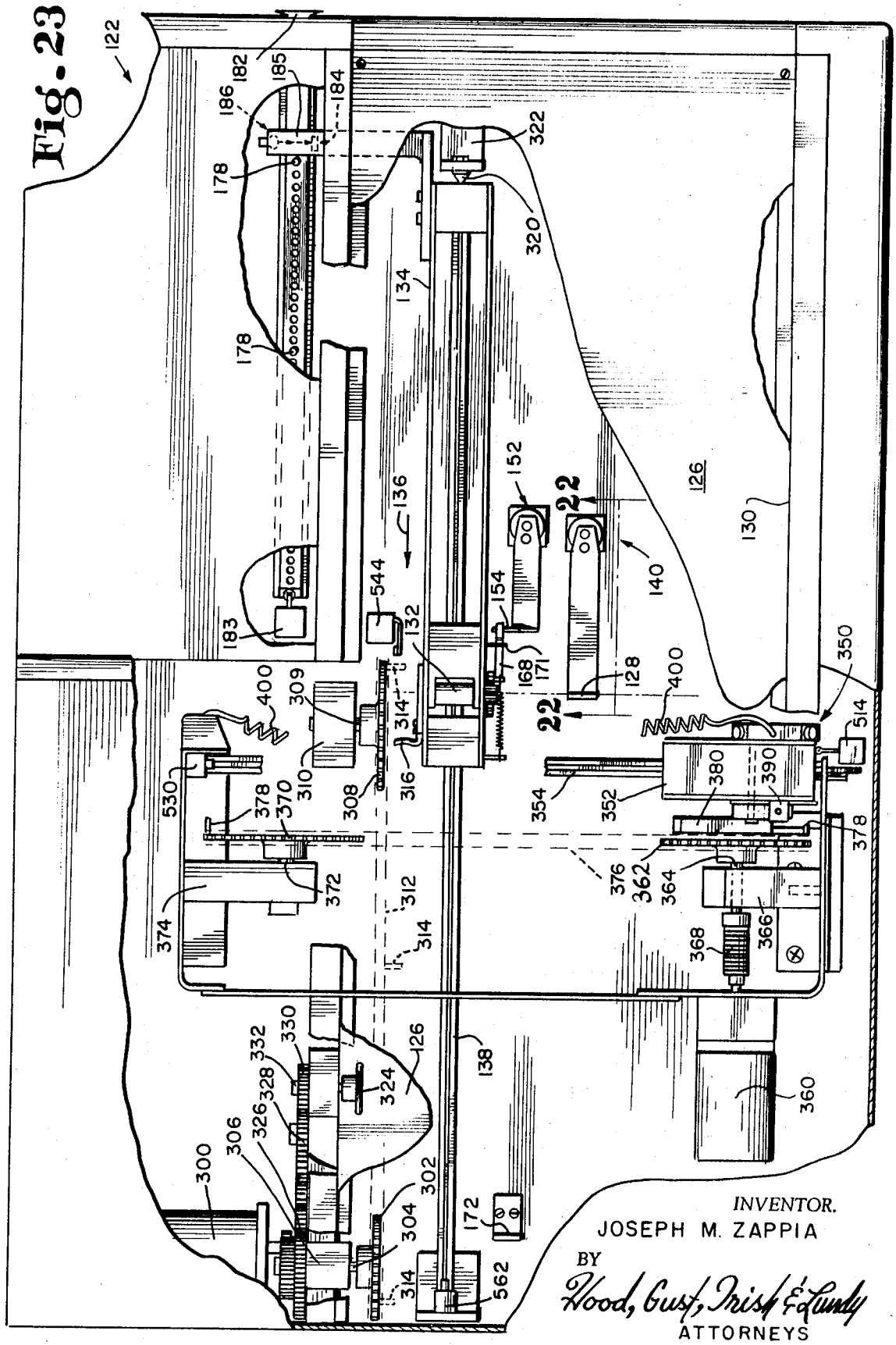


Fig. 18

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Fig. 23



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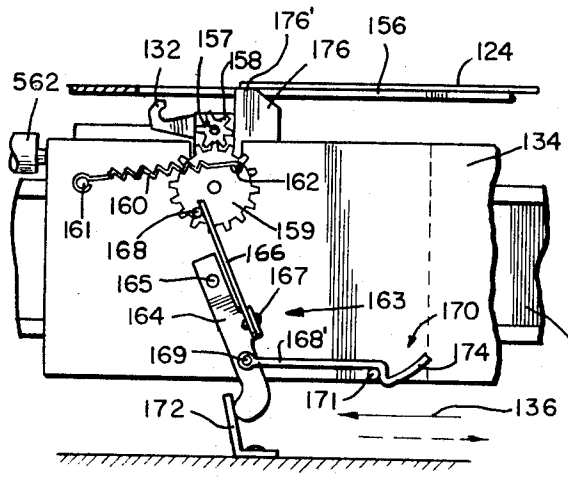


Fig. 24

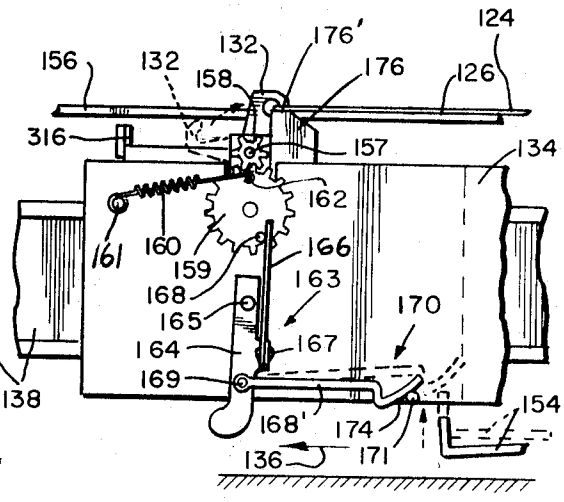


Fig. 25

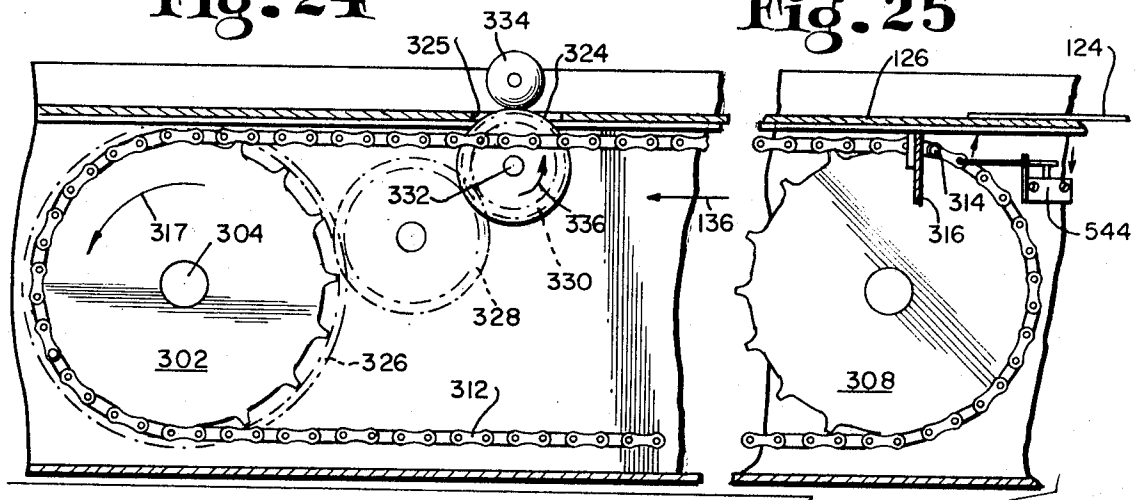


Fig. 26

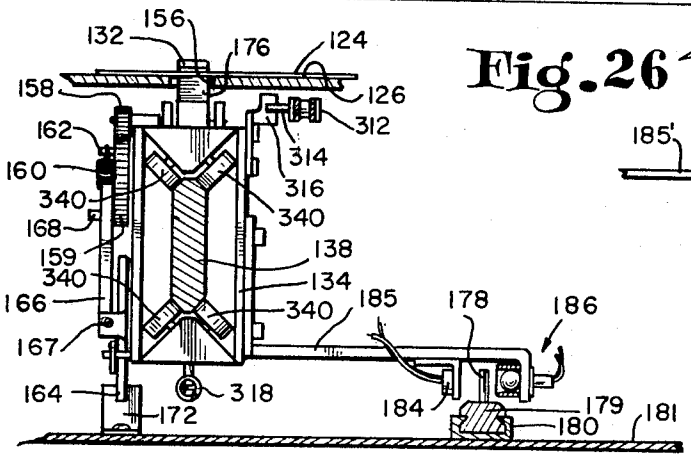


Fig. 27

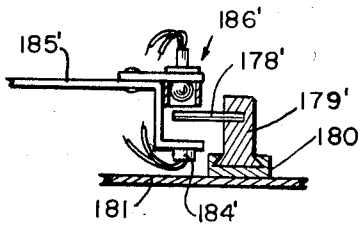


Fig. 28

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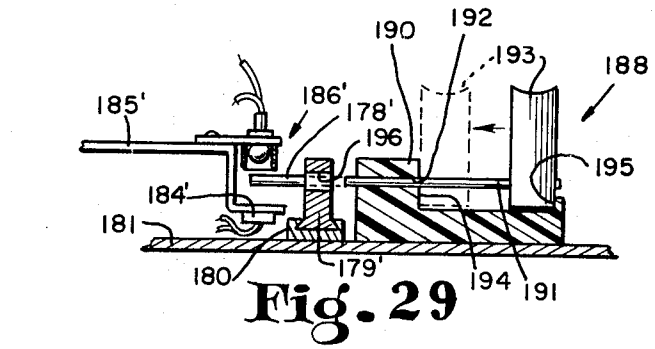


Fig. 29

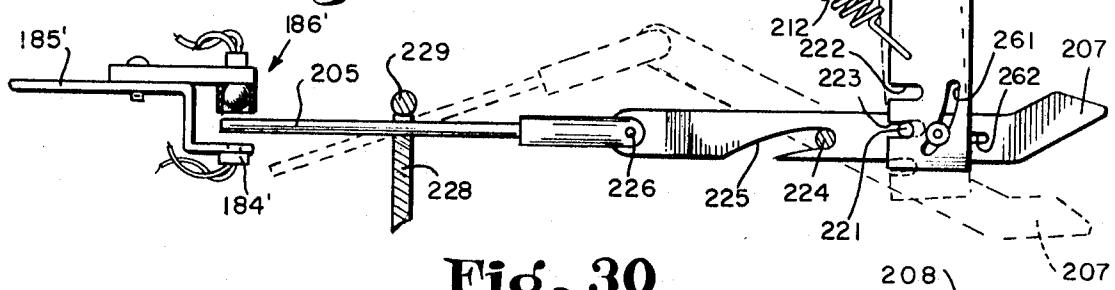


Fig. 30

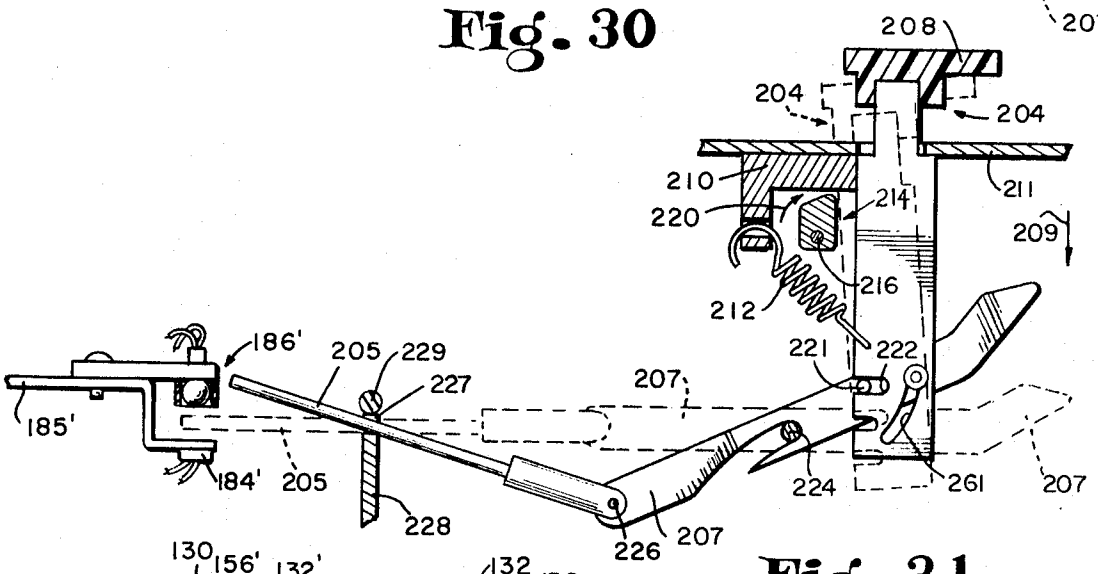


Fig. 31

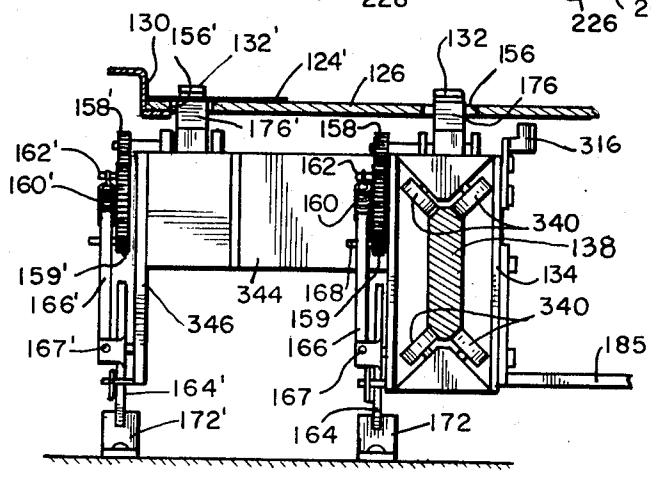


Fig. 34

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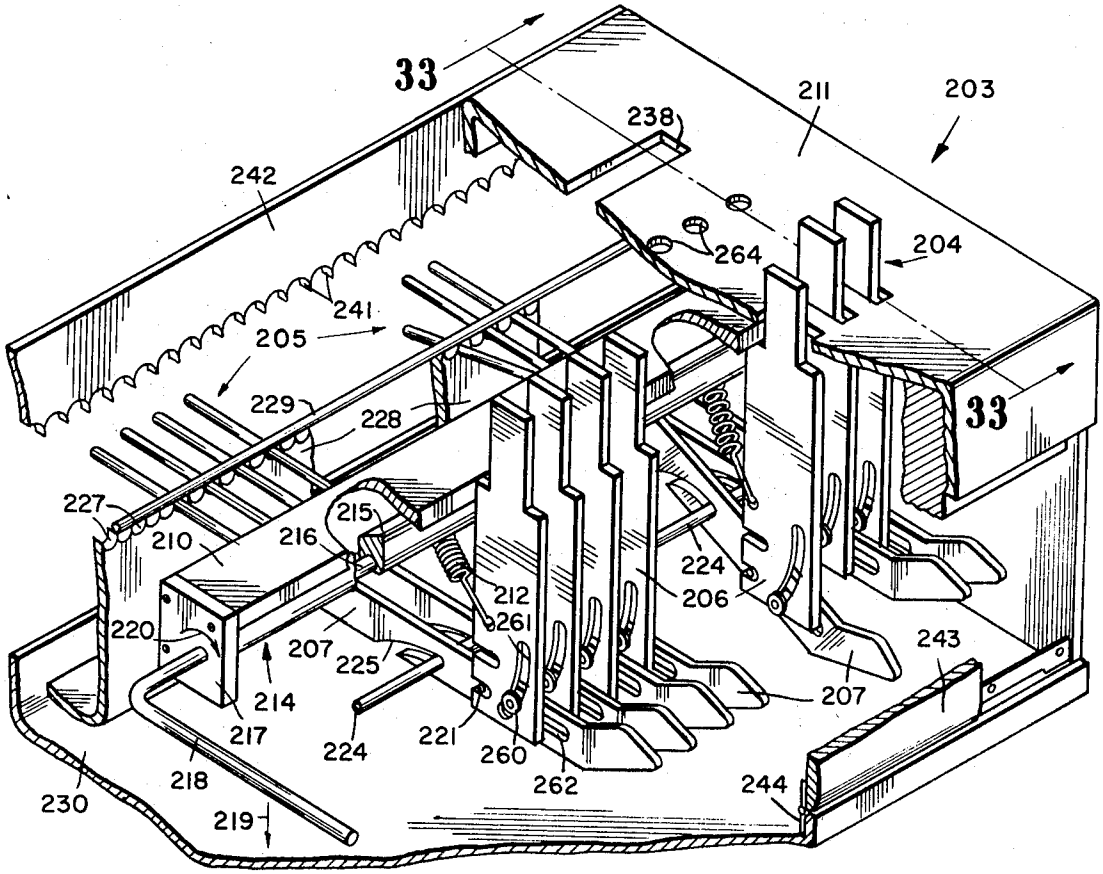


Fig. 32

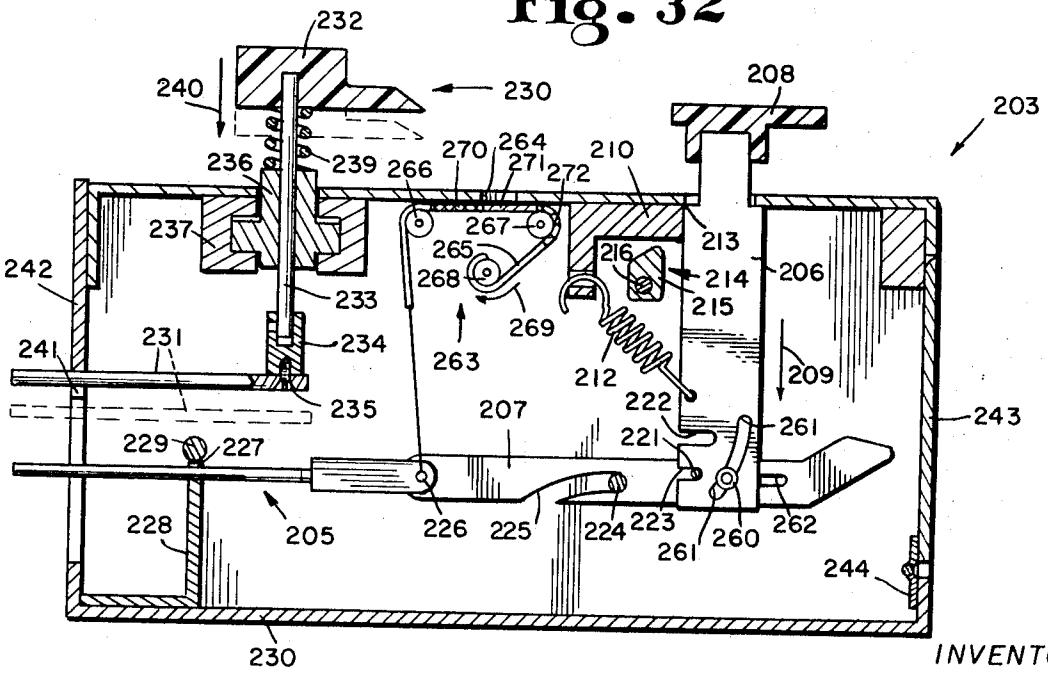


Fig. 33

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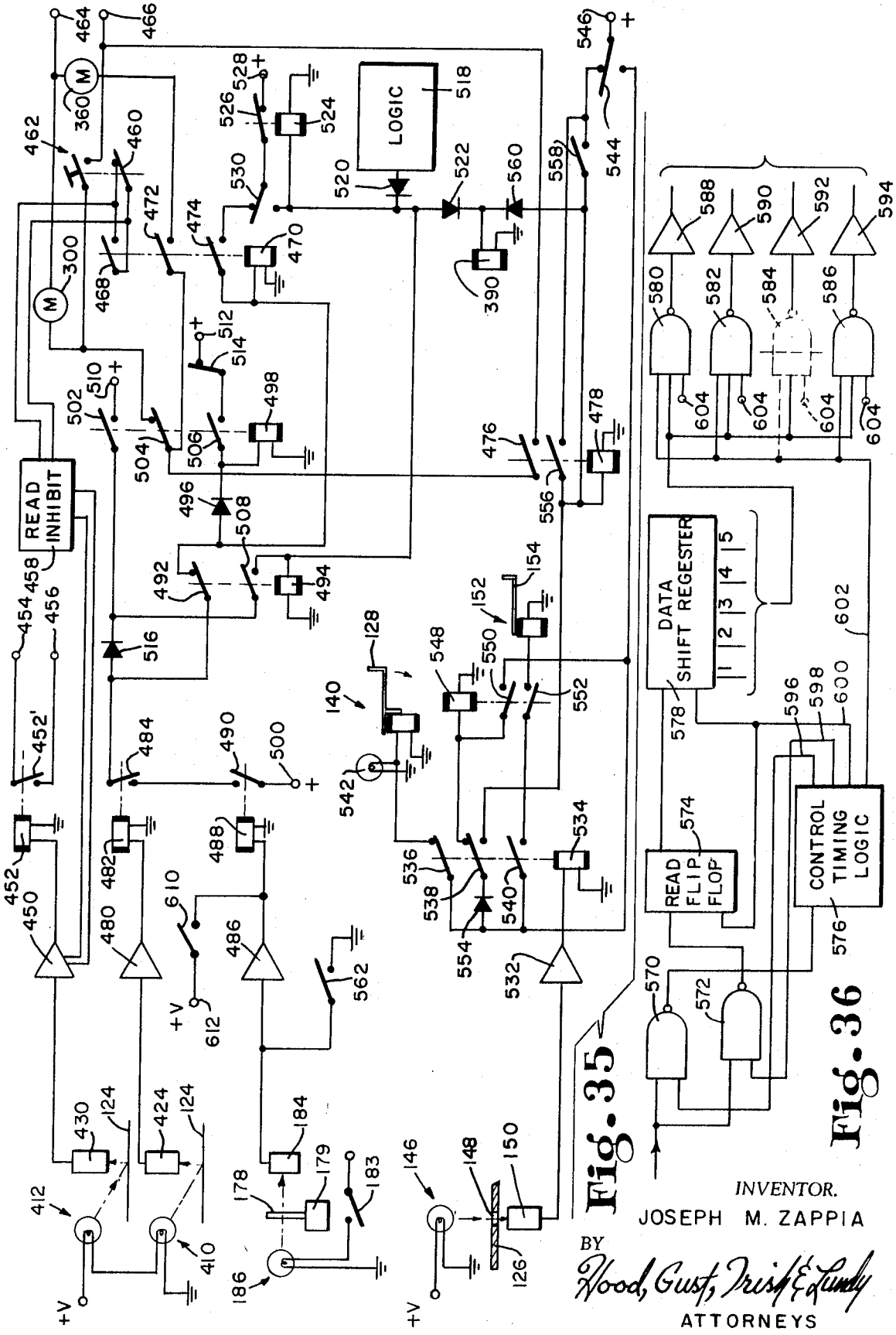


Fig. 35

Fig. 36

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DATA SCANNER

It is a primary object of my invention to provide a system for scanning data on a document, the system comprising a scanning head arranged for transverse movement relative to such a document, drive means for providing relative longitudinal movement between the scanning head and such a document, control means for the drive means, the control means including means for finding a transversely extending line of data to be scanned, the finding means including means for detecting the presence of a line of data on such a document and deenergizing the drive means to stop relative longitudinal movement between the scanning head and such a document, whereby the scanning head can scan such a line. In the disclosed system, the detecting and deenergizing means includes electro-optical means for detecting indicia printed on a document, the electro-optical means being longitudinally stationary relative to the scanning head. It will be seen, as this description progresses, that the preferred electro-optical means includes a light source arranged to project light at such a document, a light-actuated semiconductor device, and optical means for projecting the light reflected from such a document toward the semiconductor device. It will also be seen that the drive means is arranged to move such a document longitudinally past the scanning head, the drive means preferably including a carriage arranged for longitudinal reciprocation relative to the scanning head and clamp means carried by the carriage and arranged to clamp such a document for movement therewith.

It will be appreciated, therefore, that I have provided a system for reading graphically printed data disposed in transverse lines on a document, the system comprising a scanning head arranged for transverse movement relative to such a document, means for moving the scanning head along a line of data at a constant, predetermined rate of speed, light source means carried by the scanning head and arranged to project light at such a document, a light-responsive semiconductor device carried by the scanning head, optical means for projecting light reflected from such a document toward the semiconductor device, the optical means being carried by the scanning head, whereby the concentration of light on the semiconductor device depends on the presence or absence as well as the width and spacing of graphical symbols in the line of data being scanned, an output device, and circuit means for operatively connecting the semiconductor device to the output device.

My system for providing controlled relative longitudinal movement between the scanning head and the document, i.e., the above-mentioned control means for the drive means, preferably includes switch means for deenergizing the drive means to stop such relative longitudinal movement and a plurality of switch actuating means longitudinally spaced apart to define a plurality of preselected relative positions for the scanning head and such a document, each of the actuating means being arranged to actuate the first switch means. Preferably, in fact, the above-mentioned detecting and deenergizing means is disposed in series with the first switch means, whereby, when the first switch means is actuated by one of the actuating means and the detecting means simultaneously detects the presence of a line of data corresponding to the said one actuating means, the drive means will be deenergized.

My system is, therefore, means for reading graphically printed information disposed in transverse lines on a document, the system comprising a scanning or reading head arranged for transverse movement relative to such a document, means for moving the scanning head along a line of data at a constant, predetermined rate of speed, light source means carried by the scanning head and arranged to project light at such a document, a light-responsive semiconductor device carried by the scanning head, optical means for projecting light reflected from such a document toward the semiconductor device, whereby the concentration of light on the semiconductor device depends on the presence or absence as well as the width and spacing of graphical symbols in the line of data being scanned, an output device, and circuit means for operatively connecting the semiconductor device to the output device.

Machines which read letters, e.g., input devices for data processing systems or data transmission systems, have conventionally been developed along two different lines, represented on the one hand by a complicated reader which, at least theoretically, would be able to read even handwritten messages and, on the other hand, by readers arranged to read type of a particular design, i.e., type arranged so that each individual digit, letter or symbol differs as much as possible with any other symbol in the alphabet used, within the limits set by reasonably good readability. The first-mentioned solution, i.e., the apparatus for reading a written message, has proved to be extremely complicated, even for reading only printed digits and letters. It is an extremely hard task for such a machine to distinguish between, for example, a "2" and "Z," "5" and "S," "0" and "Q," "8" and "B" or "H" and either "X" or "K." This is particularly true if the type for the letters are worn or damaged or if the recording is otherwise impaired, in which case a reasonably reliable result can only be obtained with an extremely complex and, therefore, very expensive machine.

The other method of machine reading, namely modifying the type itself, for example, by dividing the type in several distinct vertical fields or by providing the type with additional or enlarged portions, makes it comparatively hard visually to read the type in a normal manner. In any event, such a type looks strange and unfamiliar to anybody who sees it for the first time and thus causes a reduction of reading speed and reading reliability. This is, of course, a distinct disadvantage, especially if the message recorded consists of digits, if the message is in an unfamiliar language, or if the message is coded. This situation is frequently encountered in important message transmitting systems, such as military communications systems or long-distance telecommunication systems.

My data scanner may be used to read data which is produced by an ordinary typewriter which is modified to provide, as well as conventional letters or symbols, a printed code representing the letters or symbols. Preferably, each type carrier will be modified so that there will be printed either below or above each letter or symbol marks which can be read by my scanning system. Preferably, as will be more fully explained hereinafter, the marks will have the shape of one or more rectangular fields. In fact, a conventional typewriter key may be easily modified to provide a machine-readable recording in accordance with the present invention. That is, there is sufficient space on the conventional type carrier of a typewriter, below the character on the type carrier, for providing a line of protruding marks, e.g., short vertical lines and/or rectangular fields of different width, which, for example, in a five or six place binary code system, gives a machine-readable representation. Thus, the basic binary recording consists of the presence or absence, respectively, of a vertical line in any of a number of predetermined positions. Adjacent lines may preferably join one another to a rectangular field, the width of which will be dependent on the number of lines.

It will be seen, as this description progresses, that I prefer that the machine-readable information correspond to the Baudot code. The manner in which this may be accomplished will be explained in greater detail hereinafter.

It is an object of my invention, therefore, to provide a system for scanning and reading data on a document, which system comprises a scanning head arranged for transverse movement relative to such a document, drive means for providing relative longitudinal movement between the scanning head and such a document, control means for the drive means, the control means including first switch means for deenergizing the drive means to stop such relative movement, and a plurality of switch actuating means longitudinally spaced apart to define a plurality of preselected relative posi-

tions for the scanning head and such a document, each of the actuating means being arranged to actuate the first switch means.

Another object of the present invention is to provide such a system in which the control means includes means for finding a transversely extending line of data to be scanned, the finding means including means for detecting the presence of a line of data on such a document and deenergizing the drive means to stop relative movement between the scanning head and such a document, whereby the scanning head can scan such a line. Preferably, as will be more fully explained hereinafter, the detecting and deenergizing means is disposed in series with the first switch means for deenergizing the drive means, whereby, when the first switch means is actuated by one of the said actuating means and the detecting means simultaneously detects the presence of a line of data corresponding to the said one actuating means, the drive means will be deenergized.

Another object of the present invention is to provide such a system in which the drive means is arranged to move the document longitudinally past the scanning head, the drive means including a carriage arranged for longitudinal reciprocation relative to the scanning head and clamp means on the carriage and arranged to clamp such a document for movement therewith. It will be seen, as this description progresses, that the clamp means includes a clamp member mounted on the carriage for movement between a document engaging position and a document releasing position, spring means for yieldably urging the clamp member to its document engaging position, latch means for holding the clamp member in its document releasing position in opposition to the spring means, the latch means being supported by the carriage, means for cocking the latch means, the cocking means being disposed adjacent one end of the travel of the carriage, and means for releasing the latch means, the releasing means being disposed adjacent the opposite end of the travel of the carriage. The cocking means may be an abutment disposed in the path of movement of the latch means and arranged to cock the latch means when the carriage reaches the said one end of its travel. The releasing means, in the illustrative embodiment, includes a solenoid-operated means effective, when energized, to release the latch means.

Another object of my invention is to provide such a system including means for detecting the presence of a document and energizing a solenoid when such a document is in position to be engaged by the clamping means, the solenoid being operatively connected to the clamping means.

A further object of my invention is to provide such a system including a solenoid-operated stop arranged to position such a document to be engaged by the clamping means, the solenoid-operated stop being movable, when actuated, to a position out of the path of movement of such a document.

Another object is to provide a frictional drive roller for engaging and moving a document longitudinally past the scanning head, the drive roller being positioned and arranged to continue to move a document longitudinally after the aforementioned clamp is moved to its document releasing position and the carriage on which the clamp is mounted is returned to its initial starting position. That is, the movable clamp arrangement is provided for moving the leading edge of a document to the point where it can be engaged and moved continually longitudinally past the scanning head by the friction drive roller.

Still another object of my invention is to provide a pin setting mechanism for use in combination with the line finding means discussed previously, thereby to scan selected lines of data on a document.

Other objects and features of the present invention will become apparent as this description progresses.

To the accomplishment of the above and related objects, the present invention may be embodied in the forms illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings and description are merely illustrative and that change may be made in the specific constructions illustrated and described so long as the scope of the appended claims is not violated.

In the drawings:

FIG. 1 schematically shows the word "DATA" recorded for visual as well as machine-reading in accordance with the concept of my invention;

FIG. 2 shows the letters "A" and "D" recorded with a visual and machine-readable representation, as well as the machine-readable representations of the machine functions "space" and "carriage return";

FIG. 3 shows a representation of the letter "D" preceded by a particular sign signifying "beginning of line" or "line feed";

FIG. 4 shows the visual and machine-readable representation of the sign "period (.)";

FIG. 5 shows a type carrier or a part thereof adapted to provide a visual as well as a machine-readable representation;

FIG. 6 shows how a recording made with the type carrier of FIG. 5 may appear on the record carrier, i.e., conventional paper;

FIG. 7 shows a line of data defined by visual as well as machine-readable characters;

FIG. 8 is a block diagram of a pulse shaping and recording circuit utilized in my data scanning system;

FIG. 9 is a pulse diagram of a number of representative signals utilized in and produced by a circuit, such as the circuit of FIG. 8;

FIG. 10 schematically illustrates, in a very simplified manner, a mechanical embodiment of my data scanning system;

FIG. 11 is a schematic showing, in detail, portions of the circuit of FIG. 8;

FIG. 12 is a perspective view of a working model of my data scanning system;

FIG. 13 is an enlarged, fragmentary view of the portion of the system on which a document is initially placed;

FIG. 14 is an enlarged, fragmentary sectional view taken from FIG. 13 generally along the line 14–14;

FIG. 15 is a fragmentary, perspective view, greatly enlarged, of the scanning or reading head of my system and the means on which the scanning head is mounted;

FIG. 16 is a fragmentary, perspective view of the chain which is used in the drive for the scanning head;

FIG. 17 is an enlarged, fragmentary sectional view of the scanning head and the means on which it is mounted;

FIG. 18 is a somewhat diagrammatical view of the driving system for the scanning head;

FIG. 19 is an enlarged, fragmentary sectional view taken from FIG. 17 generally along the line 19–19 and showing the arrangement of the optics in the scanning head;

FIG. 20 is a perspective view of one of the diaphragms used in the optics of the scanning head;

FIG. 21 is a fragmentary, plan view of the optics portion of the scanning head and showing the scanning head above a document;

FIG. 22 is a fragmentary, sectional view taken from FIG. 23 generally along the line 22–22 and showing the solenoid-operated stop used to position documents on the system;

FIG. 23 is an enlarged, fragmentary and partially cut-away plan view of the system of FIG. 12 and showing the relationship of the scanning head drive system with the document drive system;

FIG. 24 is a fragmentary, sectional view showing the document clamping means of the present invention latched in its document-releasing position;

FIG. 25 is a view similar to FIG. 24 except that the carriage on which the clamping means is mounted is at the opposite end of its travel and the clamping means is in its document-engaging position;

FIG. 26 is a fragmentary, sectional view, partially broken away, showing a friction driving system for the document as well as the chain drive for the carriage on which the clamping means is mounted;

FIG. 27 is a fragmentary, sectional view showing the carriage and the bar on which the carriage is movably supported and the switch-actuating means for stopping the carriage at selected points along its travel;

FIG. 28 is a fragmentary, sectional view showing switch-actuating means which is slightly different from that shown in FIG. 27;

FIG. 29 is a fragmentary, sectional view of still another type of switch-actuating means for stopping movement of the carriage, the system of FIG. 29 including means for manually selecting points at which the carriage will stop;

FIG. 30 is an enlarged fragmentary, sectional view of still another type of switch-actuating means for stopping the carriage at selected points;

FIG. 31 is a view, similar to FIG. 30, except showing the switch-actuating means in a different position;

FIG. 32 is a fragmentary, perspective view, partially sectioned and cutaway, showing a plurality of the switch-actuating means illustrated in FIGS. 30 and 31;

FIG. 33 is a sectional view taken from FIG. 32 generally along the line 33–33;

FIG. 34 is a fragmentary, sectional view showing double clamps for engaging a document;

FIG. 35 is a schematic of an illustrative control circuit for my system; and

FIG. 36 is a block diagram of the logic associated with the scanning head.

In FIG. 1 the word "DATA" is shown, such as it may appear recorded with visual as well as machine-readable symbols. The recording may be a graphic recording on any suitable record carrier such as a sheet of paper, card or tape of paper or other suitable materials. The type may, of course, be of any suitable shape.

Below each typed letter is a representation in a machine-readable code, which representation, however, could have been made above the letter if required in some particular machine. The machine-readable information is preferably in a line parallel with the visually readable graphic symbols. For several reasons it will be convenient to leave a space between the two types of information so that their outlines do not run into one another. One reason for this is that, without such a space, the visual reading may be difficult. Also, there is a risk that the reading machine might pick up the wrong information from parts of the letters.

Each of the symbols may be represented by a machine-readable 6-bit code represented by a presence or absence in the respective positions 1—6 of a registration. In the illustrative example, the positions are numbered from left to right. In FIG. 1 the machine-readable representation of the letter "D" is made up in the following way:

There is one registration in the position "1," no registration in the position "2," one registration in the position "3," one registration in the position "4," no registration in the position "5" and one registration in the position "6." In the following description, and for illustrative purposes only, the machine-readable code for each letter is designated by a 6-bit binary number where a binary "1" represents the presence of a printed mark and the binary " 0" represents the absence of a printed mark. The designation "*x*" in any position represents either a binary "1" or a binary "0" and the sign "/" is used to separate two code groups from one another. The code for the letter "D" is thus "1 0 1 1 0 1" and the code for the entire word "DATA" in FIG. 1 is "1 0 1 1 0 1/1 0 0 1 1 1/1 1 1 1 0 0/1 0 0 1 1 1."

For reasons which will be apparent from this description of the data scanning system, all groups in the chosen code are of the type "1*xxxxx*." Nonpermissible codes are thus the codes "0*xxxxx*," "00*xxxx*," "000*xxx*," "0000*xx*," "00000*x*" and "000000."From this it should be apparent that, in the illustrative example, only the code positions 2—6 carry variable information. If the reading and evaluation apparatus does not have a memory function, the alphabet then may only comprise at most 25 different symbols for this representation. In many cases, the receiving and/or the evaluating apparatus is provided with a memory thus making it possible to use a particular symbol to switch between different subsets of the alphabet. This possibility is, for example, made use of in telex apparatus where the switch between "lower case" and "upper case" is transmitted as a particular machine-controlling letter implying a switch between two different subsets of the alphabet, e.g. the subsets "lower case" and "upper case." As is well known, an alphabet with limited variance for each letter, such as, for example, a 5-bit code for each letter, may be used for transmitting an alphabet of any variance provided that the transmitting and receiving equipment is organized accordingly. It should therefore be realized that, even with a 5-bit code, the system of my invention is not limited to a 25-symbol alphabet.

In fact, my data scanning system is ideally suited for use with the Baudot code, i.e., five data bits plus start and stop bits, conventionally used in teletype and telegraph equipment.

The illustrated 6-bit code representation for each letter is therefore to be considered a matter of convenience which, for usual type size, paper quality, manufacturing accuracy for the type-carrier and the separating capacity of the reader, may be considered practical. This choice is, therefore, not a primary characteristic of the invention.

It is obvious that, apart from very simple information transmitting systems, machine governing functions or machine orders have to be transmitted as well as the letters of the alphabet which are to be printed. Thus, my data scanning unit must read and recognize certain codes representing machine functions. FIG. 2 shows an example of one code. Between the code for the letter "A" is thus a code for "space" which may be represented in binary as "111011." After the letter "D" the function "carriage return" may be represented in a similar manner by the binary representation "111101." This code "111101" thus terminates each line on the record carrier.

FIG. 3 shows a code example which may represent the beginning of a line. The code "110111" which precedes the letter "D" may be interpreted in different ways, depending on which kind of typewriter or printing device is actually used. In a system where the "line feed" takes place automatically after carriage return, the code "110111" may be interpreted as signifying the beginning of a line. If the carriage return takes place without a line feed, the symbol group "110111" may represent the machine order or function "line feed." In this case, the preceding letter "D" on the same line, having the code representation "101101" is not the information which is to be read after the "line feed," but rather an information in a corresponding place on the next line. This will, however, be more fully explained in connection with FIG. 10.

FIG. 4 illustrates that not only letters, but also signs, e.g., periods, commas, etc., may and should have a machine-readable representation. In the example shown the sign "period (.)" is represented by the code group "111000."

FIG. 5 illustrates a part of a type carrier **10** which, in the embodiment shown, is intended to print the upper case letter "D" and which is provided with means for producing a machine-readable representation of the letter as well. The type carrier **10** is, therefore, in the usual manner provided with a raised portion **12** in the shape of a mirror image of the letter "D." Under this portion **12** is a line comprising three rectangular protruding portions **14**, **16** and **18**. The portion **14** corresponds to the desired registration in position "6," the portion **16** corresponds to the registration in the positions "4" and "3" while the portion **18** corresponds to the desired registration in the position "1." The space between portions **14** and **16**, and the space between portions **16** and **18** correspond to the desired absence of registration in positions "5" and "2" respectively. The type carrier **10** may be of any conventional type, depending on which kind of typewriter is modified. Further, the carrier **10** is intended to represent a piece of a type ribbon or a type wheel or even a piece of a printing machine type.

FIG. 6 shows how the character "D" and its coded representation might appear on the record carrier when printed with a type carrier, for example, according to FIG. 5 via an intermediate ribbon or ink sheet or the like. The character is built up of the shape **12'**, forming the letter "D," and the three registrations **14'**, **16'** and **18'** corresponding to

the binary code representation chosen for the letter "D." As will be seen, the borderline of the character 12' may have imperfections 20 and the borderline of the code representation 14'—18' may have imperfections 22. These imperfections which are normally present in a recording make the machine reading of data rather difficult as will be further described hereinafter.

FIG. 7 shows, in an exaggerated scale, the text "data type" recorded to be machine read. The letter "D" in the word "-DATA" is preceded by a registration 24, signifying "start of line" or "line feed" as described in connection with FIG. 3. Between the words "DATA" and "TYPE" is a code group 26 signifying "space." The last letter "E" in the word "TYPE" is followed by a code group 28 also signifying space and the sign period (.). The line ends with the sign 32 signifying carriage return with or without line feed depending on the system chosen. The lines 36, 38' and 40' as well as the points 34 and 34' refer to the reading head movement for reading the coded characters as will be further described hereinafter. The registration is made on a data carrier or document 40 which may be of any suitable kind and which, in its simplest form, may be an ordinary typewriter sheet.

FIG. 8 is a block diagram of an electronic reading and discriminating circuit for evaluating the output from a photoelectric reader of my data scanning system. The circuit has an input 90 feeding a conventional amplifier 91. The amplifier 91, as well as the elements of the rest of the circuit, may have transistors as amplifying elements, the transistors being fed from source voltages of conventional levels. The output from the amplifier 91 is fed to the input of an amplitude sensitive pulse shaper 92. The shaper 92 may be a Schmidt-trigger or similar device of the type which has one output voltage, e.g., a low voltage, when the input is below a predetermined threshold value, and a different output voltage, e.g., a higher voltage, when the input is above the threshold value. The transition between the two different output states has to be fast in order to provide output signals with steep flanks from a slowly varying input signal. The reason for the use of such an amplitude sensitive pulse shaper will be described in more detail hereinafter.

The output from the Schmidt-trigger 92 is connected to the input of a monostable multivibrator or "one-shot" pulse generator 93 having two different output states, which will be designated "0" and "1" respectively. In the absence of an input signal the monostable multivibrator 93 will be in its rest state or zero state at which it produces an output signal "0." Upon the arrival to its input of a signal having sufficient steepness and amplitude, the monostable multivibrator changes its internal state and produces an output signal "1" during a time interval which is determined by an internal time constant. Conventionally, a resistor-capacitor network determines the time constant. As will be explained later, the time constant of the multivibrator 93 is comparatively long in terms of the pulse repetition frequency of the input signal to the amplifier 91.

The output signal from the multivibrator 93 is supplied as input signal to an astable multivibrator or gated multivibrator 94. As long as the multivibrator 94 is supplied with a "high" input signal, i.e., an input signal of value "1," it switches between the "0" and "1" state and produces an output signal which varies accordingly. The pulse repetition frequency as well as the pulse length of its output signal is determined by parameters of the multivibrator 94, usually by resistor-capacitor combinations. In the illustrative embodiment, the multivibrator 94 is arranged to produce six pulses during the time interval when the output from the multivibrator 93 produces an output of the value "1," and the multivibrator 94 will not produce anything but a "0" output signal during the pulse interval between consecutive output pulses from the multivibrator 93.

The output from the multivibrator 94 is fed to one input terminal of an AND gate 95, the second input of which is taken from the output of the amplifier 91. The output from the AND gate 95 will thus be a chopped signal with alternate periods in the "0" state and the logical product of the "1" state from the multivibrator 94 with the output from the amplifier 91 respectively. This output signal may be integrated in a resistor-capacitor-integrator or low-pass filter 96 having a time constant approximately of the same order as the pulse length of the output pulses from the multivibrator 94. This filters out any transients of higher frequency which may be caused by a number of different noise sources in the mechanical and optical system connected to the electronic reading and evaluating circuit, by imperfections in the document being read, or by an external noise source. The output signal from the integrator 96 will thus essentially be a saw tooth signal, the relevant portions of which will be of two kinds, namely a signal of comparatively high peak amplitude corresponding to a high output from the amplifier 91 and a signal of comparatively lower amplitude corresponding to a low output from the amplifier 91. Any possible transient signals of high amplitude, but of very short duration, which may be present in the output signal from the amplifier 91, will be filtered out by the integrator 96.

The output signal from the integrator 96 is fed to the input terminal of a pulse shaper and discriminator 97, which may be a Schmidt-trigger of essentially the same type as the Schmidt-trigger 92. The threshold level at which the output from the Schmidt-trigger 97 switches from the "0" to the "1" state or from the "1" to the "0" state respectively is preferably selected to give a reliable output pulse while, at the same time, suppressing or not reacting to, the low amplitude pulses between the significant saw tooth pulses.

The output pulses from the pulse shaper and discriminator 97 may be fed directly to the input of an AND gate 98, or the pulses may first be given equal pulse length by means of an intermediate monostable multivibrator 97'. The use of the intermediate monostable multivibrator 97' adds more complexity to the circuitry, but, it also contributes to the reliability of the readout in case the pulse width at the chosen discriminating level of the substantially saw tooth-shaped pulses from the integrator 96 varies significantly.

In the illustrative circuit, the other input to the AND gate 98 is taken from the output of a monostable multivibrator 94' having a comparatively short pulse time. The input to the monostable multivibrator 94' is derived from the output of the multivibrator 94. The multivibrator 94' is preferably further provided with an input delay to prevent it from being triggered by the fall of the output signal from the multivibrator 94 to produce an output pulse of short duration and of the state "1" at the instant of time when the output from the Schmidt-trigger 97 (or the multivibrator 97') is most probably in the state "1" if the chopped output signal from the AND gate 95 is in the state "1." In other words, the time of occurrence of the output signal from the multivibrator 94 or from the multivibrator 94' is chosen so that a reliable sampling pulse is fed to the input of the AND gate 98 whenever an output pulse from the Schmidt-trigger 97 or the multivibrator 97' may be expected.

In the illustrative embodiment, the output from the AND gate is connected to the input of a further monostable multivibrator 99 of approximately the same type and having the same time-determining parameters as the monostable multivibrator 93. The output from the monostable multivibrator 99 constitutes the information carrying output signal from the circuit and may be used to operate auxiliary output devices, such as an electric typewriter, an input device to a computer or a terminal device for receiving or transmitting information in an information transmitting system of any kind.

The operation of the circuit of FIG. 8 will now be further described with reference to FIG. 9, which shows various pulse and signal shapes typical for the operation of the circuit in connection with a photoelectric reader. The letters A, B, C, D, E, F, G and H in FIGS. 8 and 9 indicate the points at which a voltage level is sampled (FIG. 8) and the voltage curve at the respective points (FIG. 9).

Thus, the shaded generally rectangular fields designated A in FIG. 9 may represent a portion of a record carrier passing under a photoelectric reading head. It will be noticed that this is how the machine-readable portion designated XA in FIG. 1 under the letters "DA" in the word "DATA" would appear to the photoelectric reader. For this reason the light and dark spaces have not been numbered accordingly.

Since it is inevitable that a pencil of reading light, as will be explained hereinafter, will have a definite, but small cross section, and because of delay and limited band width of the photoelectric reader and the amplifier **91**, the output signal from the amplifier cannot be expected even to approach the pulse shape of a proper square wave. The best which may be obtained is an output voltage or current from the amplifier **91** having a pulse shape similar to the curve B in FIG. 9. Noise and disturbances have been left out of curve B, but it will be understood that this signal hardly may be expected to be noise free, and that one object of my invention is to provide an electronic reading and evaluating circuit which will compensate for noise and similar disturbances which may have a rather large amplitude but be of short duration.

The combination of the Schmidt-trigger **92** and the multivibrator **93** generates a comparatively long pulse, i.e., a pulse of sufficient duration to cover the time span when the code positions of an entire character pass under the reading or scanning head of the photoelectric reader. More specifically, the multivibrator **93** has to provide a deblocking signal to the multivibrator **94** to allow this multivibrator **94** to generate exactly six pulses of predetermined pulse width and pulse interval, which pulses are used as clock signals for the entire circuit.

The output signal from the monostable multivibrator **93** is represented by the curve C of FIG. 9. It is assumed that the Schmidt-trigger **92** generates an output signal as soon as the output voltage B from the amplifier **91** has reached a predetermined value, indicated by the dotted line designated V_1 in the curve B. The leading edge of the curve C is concurrent with this time instant, since any delay will be very small.

The trailing edge of the output signal from the monostable multivibrator **93** may fall anywhere between the time instant when the sixth pulse in the pulse train D has been initiated and the time instant when a seventh pulse would have been initiated. A suitable and safe design would be to have the pulse of the curve D fall at the trailing edge of the sixth pulse in each pulse group of the pulse train D. Thus if the pulse width of the pulses in the pulse train D arbitrarily is assigned the value 1 T (one unit of time) the pulse width of the pulse C will be 11 T (11 units of time). It will be understood that, in this case, one unit of time will be equal to half the nominal duration of a single light or dark space under the reading head as shown in the curve A.

The clock pulses from the multivibrator **94** are fed to one input of the AND gate **95**, the other input of which is fed from the output of the amplifier **91**. The output from the AND gate **95**, in its turn, is supplied to the input of the integrator **96**.

In this connection it has to be pointed out, that the AND gate and integrator shown in FIG. 8 are to be interpreted as functions. Thus, the output from the amplifier **91** may preferably be fed via a resistor R_1 to a capacitor C as shown in FIG. 11. In parallel with the capacitor C is a transistor T, the base electrode of which is fed from the output of the multivibrator **94**. The polarity of the output and the biasing of the transistor T is chosen to have the transistor conduct and short circuit the capacitor C in the intervals between the (positive) pulses of the pulse train D. The circuit of FIG. 11 will perform in the manner shown by the AND gate **95** and integrator **96** in the block diagram of FIG. 8, and will produce an output waveform E in FIG. 9 from the input waveform B, which essentially is a saw tooth curve, the leading edge of which is determined by the product R_1C and the trailing edge of which is determined by the product R_{ec} of the transistor T with the capacitor C.

The time constant of the R_1C combination may be of the order 1 T, where T is the arbitrary unit of time mentioned before and based on the pulse width of the pulses in the pulse train D.

The requirements on the summing or chopping and integrating circuit is to filter out noise and transients and at the same time to translate the waveform B, i.e., the output from the amplifier **91** into a pulse train with well defined pulses of maximum time-voltage integral at the instant of the actual signal, while at the same time discriminating between signal and absence of signal.

The Schmidt-trigger **97**, which follows the AND gate integrator **95**, **96** may be adapted to switch at the amplitude V_2 of the pulse train E to produce an output shown by the curve F of FIG. 9. This signal, the pulses of which may be of different width and generally shorter than 1 T, may be used directly as one input to the AND gate **98**, but, as mentioned previously, some advantages may be obtained by using the intermediate multivibrator **97'**, which may make all pulses of equal length of approximately the length 1 T. This increases the reliability of the circuit.

Leaving the function of the monostable multivibrator **97'** and the AND gate **98** for a moment, it will be seen that the output from the multivibrator **94** is connected to the input of the multivibrator **94'**, whose function it is to provide a sampling or strobing pulse for the AND gate **98**. Although the maximum amplitude of the pulse train E is concurrent with the fall or trailing edge of the pulses in the pulse train D, the optimum sampling instant, as far as reliability is concerned, is somewhat earlier in time, irrespective of whether the pulses F are taken out directly from the output of the Schmidt-trigger **97** or are reshaped by the monostable multivibrator **97'**. For this reason, the triggering of the monostable strobing or sampling multivibrator **94'** is delayed with respect to the leading edge of the pulse train D to take place at the time 0, 7—0, 8 T from the leading edge. This is at the probable maximum or on the median of the surface of the information carrying pulses in the pulse train F. The monostable multivibrator **94'** could, however, be used to make this median concurrent with the trailing edges of the pulses in the pulse train D, and thus make the delay element, or even the multivibrator **94'** itself superfluous. How this could be accomplished is, however, more a matter of design and will not be explained further here.

The pulse length of the output pulses from the multivibrator **94'** or from, for example, a differentiating and clipping circuit between the output of the multivibrator **94** and the AND gate **98** is preferably of the order 0, 1 T.

Thus, the output from the AND gate **98** will also be pulses of similar short duration, but occurring only at time instances when corresponding pulses are present in the F pulse train.

The output pulses from the AND gate **98** finally trigger the monostable multivibrator **99**, the pulse length of which may also be of the order 1 T. The output pulses from the multivibrator **99** are the output pulses of the circuit and correspond to the information read by the photoelectric reader. It will be realized that this pulse train H in Fig. 9 will contain information pulses of predetermined pulse length, determined by the parameters of the multivibrator **99**, the leading edges of which are spaced from each other by multiples of a predetermined time interval, determined by parameters of the multivibrator **94**.

The output pulses H may be temporarily stored in a register (not shown) preferably by being read serially into a shift register and the output or outputs may be connected to any suitable output/equipment, such as a displaying, recording or transmitting device.

FIG. **10** shows the more important parts of reader or data scanning system according to my invention. The reading head, indicated at **42**, is travelling during the read movement at a constant, predetermined speed along the selected line **110** on the record **40**. The driving means for the reading head **42** may be a synchronous motor **111** which is energized from a suitable AC source. The motor **111** may drive a lead screw **111'** to

which the reading head 42 may be drivingly coupled for movement in the direction of the arrow 117. As will be appreciated, means (not shown) must be provided for releasing the reading head 42 from the lead screw 111' so that it can be returned in a direction opposite to arrow 117 to its home position. For instance, solenoid-operated means for threadedly engaging the screw 111' may be mounted on the head 42 and arranged, when energized, drivingly to couple the head and motor 111.

The document or record feed may be accomplished by a servomotor 112 controlled by a servoamplifier 113, the input of which is connected to a photocell (not shown) in a recess of the reading head 42. This photocell serves as line finder, keeping the reading head 42 travelling along the line 110 irrespective of any skew of the line with respect to the normal line of travel of the reading head. The details of a line finding means will be more fully discussed hereinafter.

When the reading head 42 has reached the end of the line 110, which may be determined either by a limit switch (not shown) or by a circuit connected to the output signal of the multivibrator 99 and responsive to the code signifying "carriage return" and/or "line feed," as previously explained, a signal is generated. This signal is used to block or inhibit the output from the reading circuit and also to disconnect the head 42 and motor 111. Then, the reading head 42 will return in the direction opposite to the arrow 117 to its home position. When the reading head 42 has returned to this home position, or during the return travel of the reading head, an incremental signal is fed through conventional means 113' to the input of the servoamplifier 113, causing the output from the amplifier to drive the servomotor 112 to turn the illustrated roller 114 which supports an endless belt 115 on which the record carrier 40 is arranged. Thus, the belt 115 moves in the direction of the arrow 116 until a new line 110' comes under the reading head 42.

The relative longitudinal or feeding movement between the record carrier 40 and the reading head 42 may, for example, take place in either of the two modes shown in FIG. 7. That is, the relative movement may be as indicated at 38' or as indicated at 40'.

The record carrier 40 may be provided with sprocket holes (not shown) along the edges, in which case the feed mechanism may be simplified and take the form of a step mechanism for the line feed, provided that the sprocket holes have a definite location relationship relative to the lines. That is, an integral number of sprocket holes must be provided for an integral number of lines. A suitable and preferred feed drive means will be discussed hereinafter.

The most important or critical requirement on the reading apparatus, however, is that the transverse travelling speed of the reading head 42, i.e., in the direction of the arrow 117 in FIG. 10, bears a definite, predetermined relationship to the pulse repetition frequency of the multivibrator 94 of FIG. 8, thereby to enable the electronic reading and evaluating circuit to give an accurate translation of the information read into a pulse train H. Normally this may be secured by adjusting the pulse repetition frequency of the multivibrator 94 manually, but it is also possible to use the speed of the motor 111 to generate a control signal, which may be used automatically to adjust the pulse repetition determining parameter or parameters of the multivibrator 94. This is, however, a matter of design and should be obvious to one skilled in the art.

Referring now to FIG. 12, it will be seen that I have illustrated a practical embodiment, indicated generally by the reference numeral 122, of my data scanning system. A document, such as indicated at 124 in FIG. 13, is placed on the bed 126 portion of the system 122 to be against a stop 128 and a left-hand (FIG. 13), longitudinally and vertically extending wall 130 bounding the bed portion 126. When the document 124 is against the stop 128, it is in a position to be engaged by a clamp 132 which is arranged to hold the document on a carriage 134 (best seen in FIG. 23) which moves the document in the direction of the arrow 136.

The carriage 134 is mounted for longitudinal reciprocation on a longitudinally extending guide bar 138, the cross section of which is best seen in FIG. 27.

Specifically, the carriage 134 moves the document 124 in steps, determined by the distance between lines of data printed on the document, in the direction of the arrow 136. That is, the carriage 134 advances the document 124 in a step-by-step manner in the direction of the arrow 136, stopping the document at a plurality of selected positions so that a transversely moving scanning head of the system can scan transversely extending lines of data on the document. Preferably, each line of data on a document 124 will extend perpendicularly to the direction of movement of the carriage 134.

The stop 128 is operatively connected to a solenoid 140 as illustrated in FIG. 22, the solenoid being arranged so that, once the stop 128 has served its function of stopping the document 124 in a position to be engaged by the clamp 132, the stop can be moved to its illustrated broken-line position (FIG. 22) to be out of the path of movement of the document. As illustrated, the stop 128 may extend upwardly through an opening 142 in the bed 126.

I prefer to energize the solenoid 140 by means of an electro-optical device, such as illustrated in FIG. 14 and indicated generally by the reference numeral 144. The electro-optical device 144 comprises a light source 146 arranged to project light through an opening 148 in the bed 126 at a light-responsive device 150. The device 150 may be any conventional light-responsive device such as, for instance, a light-actuated silicon controlled rectifier or a light-actuated diode. When the document 124 is in its proper position on the bed 126, i.e., against the stop 128 and the wall 130 as illustrated in FIG. 13, the document will block the light projected through the opening 148 to cause the device 150 electrically to change state. As will be more fully discussed hereinafter, when the device 150 so electrically changes state, the solenoid 140 is operated to lower the stop 128.

Further, the output of the electro-optical device 144 is used to actuate the clamp 132. Specifically, as will be discussed in conjunction with the schematic of FIG. 35, a solenoid 152 is operatively connected to the device 150 and arranged, when the device electrically changes state, to actuate the clamp 132. The solenoid 152 operates a lifter 154 illustrated in FIGS. 23, 25 and 35. Referring to FIG. 25, it will be seen that, when the lifter 154 is moved from its illustrated solid-line position to its illustrated broken-line position, the clamp 132 is moved from its document-releasing position to its document-engaging position.

The bed 126, which extends in the direction of the arrow 136 substantially throughout the length of the system 122, is provided with an elongated slot 156 in which the clamp 132 moves. This slot is best seen in FIGS. 24, 25 and 27. Referring to these figures, it will be seen that the clamp 132 is mounted for pivotal movement on the carriage 134 about an axis 157 and that a pinion gear 158 is journal mounted on the carriage for rotation about the axis 157. The pinion gear 158 and the clamp 132 are connected so that rotation or rocking of the pinion gear produces pivotal movement of the clamp. A spur gear 159 is journal mounted on the carriage 134 and meshed with the pinion gear 158 and a spring means 160 is provided for yieldably urging the spur gear in one direction about its axis to hold the clamp 132 in its document-engaging position, the illustrative spring means 160 being a tension spring connected to the carriage 134 as indicated at 161 and to the spur gear 159 as indicated at 162. Latch means, indicated generally by the reference numeral 163, is provided for holding the spur gear 159 in opposition to the spring 160, thereby to hold the clamp 132 in its document-releasing position. The illustrative latch means 163 comprises a member 164 mounted on the carriage 134 for pivotal movement about an axis defined by the pin 165, a leaf spring 166 connected to the member 164 as indicated at 167 and arranged to engage an axially extending pin 168 carried by the spur gear 159. A hook element 168' is connected to the member 164 as indicated at 169. This hook

element 168' is provided with a hook portion 170 arranged, when the member 164 is in its FIG. 24 position, to engage a pin 171 carried on the carriage 134. Specifically, an abutment or stop 172 is placed in the path of movement of the member 164 at the end of the travel of the member in the direction of the arrow 136 to provide means for cocking the latch means 163 to hold the clamp 132 in its document-releasing position. That is, movement of the member 164 in the direction of the arrow 136 after it engages the abutment 172 will rotate the spur gear 159 in a clockwise direction (FIGS. 24 and 25) in opposition to the spring 160 to move the clamp 132 to its document-releasing position. When the member 164 is pivoted an amount sufficient to permit the hook portion 170 to engage the pin 171, the member 164 will be held in its FIG. 24 position. It will be seen that the hook portion 170 is provided with a cam surface 174 which, when the member 164 is pivoted counterclockwise, (FIG. 24), will raise the hook portion 170 so that it can drop into engagement with the pin 171.

When the carriage 134 is at the beginning of its travel, i.e., the position illustrated in FIG. 25, the latch system 163 is released by movement of the lifter 154 upwardly to lift the hook portion 170 out of engagement with the pin 171. When the hook portion 170 is so disengaged from the pin 171, the spring 160 will rotate the spur gear 159 to move the clamp 132 from its document-releasing position to its document-engaging position. The condition of the latch means 163 in FIG. 24 represents its cocked condition and the condition of the latch means in FIG. 25 represents its released condition.

A mandrel 176 is mounted on the carriage 134 and arranged to cooperate with the clamp 132. Specifically, when the clamp 132 is in its document-engaging position, the clamp holds a document against the upper surface 176' of the mandrel 176. When a document 124 has been moved by the clamp 132 and carriage 134 to the position illustrated in FIG. 24 and the clamp 132 is moved to its document-releasing position, movement of the mandrel 176 and clamp 132 with the carriage 134 in the direction opposite to the arrow 136 will preferably not move the document 124. Thus, other means which will be described hereinafter is preferably provided for moving the document from its FIG. 24 position in the direction of the arrow 136 and out of the system 122.

The carriage 134 is shown in its starting position in FIG. 23. From this position, the carriage 134 will move in the direction of the arrow 136 in a step-by-step manner as mentioned previously. That is, control means must be provided for stopping movement of the carriage 134 at selected positions along its path of movement. In FIG. 23, I have shown a plurality of pins 178 which are carried in a selector bar or program bar 179 which extends parallel to the guide bar 138 on which the carriage 134 reciprocates. As best seen in FIG. 27, the selector bar 179 is inserted into a dovetail groove formed in a bar 180 fastened to the floor 181 of the housing for the system 122. Further, the bar 179 is provided with a knob 182 (FIGS. 12 and 23) so that an operator may remove the bar by pulling it from the system 122 in the direction opposite to the arrow 136.

Each pin 178 carried by the bar 179 represents the position of a line of data on the document. Thus, the position of the bar 179 is critical. In order to provide assurance that the bar 179 is in its proper position, a switch 183 (FIGS. 23 and 35) is arranged to sense the position of the bar.

The bar 179 is referred to as a selector bar or program bar because the pins 178 carried by the bar will, respectively, determine the points at which the carriage 134 will stop movement in the direction of the arrow 136 so that a line of data on a document can be scanned. Thus, an operator may have several different program bars 179, one bar for each particular document to be scanned.

Each pin 178 constitutes an actuator for a switch means. In the illustrative embodiment, as best seen in FIG. 27, each pin 178 is arranged to block light projected at a light-responsive device 184 carried by an arm 185 extending outwardly from the carriage 134. A light source 186 is also carried by the arm 185, the device 184 being on one side of the row of pins 178 and the light source 186 being on the opposite side of the row of pins. Conventionally, the light source 186 is arranged to project light at the device 184. When the carriage 134 moves so that a pin 178 is between the light source 186 and the light-responsive device 184, the light-responsive device will change state electrically. By operatively connecting the device 184 to the drive means for the carriage 134, as will be more fully discussed hereinafter, I can just stop the carriage 134 at locations determined by the positions of the pins 178.

The bar 179 is, therefore, a support member or support means for the switch-actuating pins 178 and the arm 185 is a frame which carries a switch means which is operated by the pins 178. While, in the illustrative embodiment, I have shown a light-actuated semiconductor device 184 and a light source 186 cooperating therewith as the switch means, it will be appreciated that I may mount a mechanically operated switch on the arm 185 so that the switch will be mechanically operated by each of the pins 178.

Referring now to FIG. 28, it will be seen that I have illustrated a program bar 179' which carries a plurality of horizontally extending pins 178'. In the embodiment of FIG. 28, the light source 186' is disposed above and in vertical registry with the row of pins 178' and the light-responsive device 184' is disposed below and in vertical registry with the row of pins. The arrangement of FIG. 28 is provided so that the program bar 179 may be used with a pin setting mechanism, such as that indicated generally by the reference numeral 188 in FIG. 29. This pin setting mechanism 188 comprises a support member 190 which extends parallel to the guide member 180 which is parallel to the path of movement of the light source 186' and the light-responsive device 184'. A plurality of horizontally extending pins 191 (only one of which is shown) is reciprocably mounted in horizontally extending openings 192 in the member. The pins 191 are longitudinally spaced apart in the member 190 to define a plurality of stopping positions for the carriage 134. A knob 193 is connected to each pin 191 to provide means for moving each pin into the space between the light source 186' and the light-responsive device 184'. That is, an operator can move a knob 193 from its illustrated solid-line position to its illustrated broken-line position to move the pin 191 connected thereto into a position which will block the light projected at the device 184' when the device is adjacent the pin. The travel of each knob 193 is determined by the abutment portions 194, 195 of the member 190.

Preferably, the member 190 will be fabricated from a plastic material, such as nylon, and each opening 192 will be formed snugly to engage the pin 191 extending therethrough to provide a slight frictional resistance to the movement of the pin. Thus, a pin 191 will stay in its manually adjusted position until affirmatively moved.

A particular program bar 179' may be provided with openings, such as indicated at 196, through which a pin 191 may extend. That is, an operator may select a program bar 179' which has a plurality of fixed pins 178' disposed therealong. If it is desired that the carriage be stopped at a position other than a position corresponding to one of the fixed pins 178', a pin 191 can be moved through an opening 196 in the bar 179' to stop the carriage at the desired location. Of course, the bar 179' can be completely removed and the positions at which the carriage will stop can be established by moving selected knobs 193 and the pins 191 connected, respectively, thereto from the right to the left as viewed in FIG. 29.

In order to utilize the pin setting mechanism 188, an opening (not shown) in the housing for the system 122 must be provided so that an operator can gain access to the knobs 193.

In the illustrative embodiment of FIG. 12, I have shown a row of knobs 208 which are the knobs of a pin setting mechanism 203 which I will now discuss. The mechanism 203 is illustrated in FIGS. 30, 31, 32 and 33.

The pin setting mechanism 203 comprises a plurality of manually operated plungers 204, each of which is operatively connected to a pin 205. Each plunger 204 has a downwardly extending portion 206 which is pivotally connected to a linkage 207. Each of the linkages 207 is, in turn, pivotally connected to the pin 205 associated with its respective plunger 204. A button member 208 is mounted on the uppermost portion of each plunger 204 so that the plunger can be pushed downwardly in the direction of the arrow 209.

There is a lock-down bar 210 mounted on the underneath side of the top wall 211 of the housing for the mechanism 203, the bar 210 extending alongside each of the plungers 204. Spring means 212 are connected between each of the plungers 204 and the lock-down bar 210, the springs 212 being effective to urge the plungers in a direction opposite to the arrow 209.

The lock-down bar 210 has an L-shaped cross section with a downwardly extending flange to which each of the spring means 212 is connected and a horizontally extending flange for receiving a notched portion 213 of each of the plungers 204 when the plunger is pushed in the direction of the arrow 209. That is, when the plungers 204 are pushed downwardly, the lock-down bar 210 will restrain said plungers in their lowermost positions. The spring means 212 associated with each plunger 204 holds the notch 213 of the plunger against the lock-down bar 210 as shown in FIGS. 30 and 31.

Means, indicated generally by the reference numeral 214, is provided for releasing the plungers 204 which are restrained by the lock-down bar 210. In the illustrative embodiment, the means 214 comprises a member 215 mounted on a shaft 216 extending under and substantially parallel to the lock-down bar 210, the shaft 216 being journal mounted in bearing blocks, such as the block 217. It can be seen that the shaft 216 is formed at one end to provide a crank portion 218 which may be used to release the plungers 204 restrained by the lock-down bar 210. That is, when the crank portion 218 is moved in the direction of the arrow 219, the member 215 will be moved in the direction of the arrow 220 to release the plungers 204.

The portion 206 of each plunger 204 is pivotally connected to a linkage 207 by means of a pin 221 which extends outwardly from the linkage 207 and which is received in either of the slots 222 or 223 formed in the plunger 204. The linkages 207 are pivotally mounted on a shaft 224 extending through the housing for the pin setting mechanism 203 in a direction substantially parallel to the lock-down bar 210 and the shaft 216. It can be seen that an arcuately shaped, open slot 225 is provided in each of the linkages 207 to facilitate mounting of the linkages on the shaft 224. The linkages 207 are held in position about the shaft 224 by the spring means 212 which bias the plungers 204 against the linkages. Each pin 205 is pivotally connected to its respective linkage 207 as indicated at 226.

The pins 205 are supported, respectively, in notches 227 formed in the upper edge of a plate member 228. Means 229 for holding each pin in its notch 227 is provided, in the illustrative embodiment, this means 229 being a simple wire.

The plate member 228 is mounted on the top surface of a bottom wall 230 of the housing for the pin setting mechanism 203 and is arranged to extend substantially parallel to the lock-down bar 210.

Referring now to FIGS. 30 and 31, a versatility feature of the pin setting mechanism 203 can be visualized in conjunction with the following description. The slots 222 and 223 are spaced in each plunger 204 to permit placement of the pin 205 in its horizontal and operative position when the plunger is in either its up position or down position. Specifically, when the pins 221 are in their respective slots 223 and the plungers 204 are in their uppermost position, the linkages 207 and, consequently, the pins 205 will be horizontal as shown in FIG. 30. When the plungers 204 are pushed down and restrained by the lock-down bar 210 as suggested by the illustrated broken-line position of the plunger in FIG. 30, the linkage 207 will be tilted upwardly to pull the pin 205 inwardly with respect to the plate member 228.

When the pins 221 are in their respective slots 222 and the plungers 204 are in their uppermost position, the linkages 207 will be tilted as shown in FIG. 31 to pull the pins 205 inwardly with respect to the plate member 228. Then, when the plungers 204 are pushed downwardly, as suggested by the illustrated broken-line drawing of the plunger 204 in FIG. 31, the linkages 207 will be horizontal to extend their respective pins to their outermost positions.

As seen in FIGS. 30 and 31, each pin 205, when it is in its outermost or horizontal position, will block the light projected at the device 184' when the device is directly below the distal end of the pin. The mechanism 203, then, is primarily a push-button mechanism for selecting points at which the carriage 134 is to stop.

Referring again to FIGS. 32 and 33, it can be seen that means 230 is provided for establishing a position from which the carriage 134 will be automatically returned to its starting position. This means 230 comprises an actuator 231 for operating a switch (not shown) connected to the drive means for the carriage and arranged, when actuated, to deenergize the drive means or to disconnect the carriage from the drive means so that the carriage will return to its starting position. The actuator 231 is slidably movable along the path of movement of the carriage 134. There is a knob 232 mounted on a vertically extending pin 233 which is connected, at its lower end, to a member 234. The actuator 231 is connected to the member 234 by means of a screw 235. The pin 233 is arranged to reciprocate in a member 236 which is supported in a pair of guide means 237 for movement parallel to the lock-down bar 210. An elongated slot 238 is provided for slidably receiving the member 236. Spring means 239 is arranged between the knob 232 and the member 236 to urge the knob in a direction opposite to the arrow 240. The actuator 231 is positioned and held in downwardly opening notches 241 formed in a wall 242 of the housing for the mechanism 203. When the knob is pushed downwardly in the direction of the arrow 240 in opposition to the spring means 239, the actuator 231 is moved downwardly to clear the notches and to permit movement of the member 236 along the slot 238. The positions of the notches 241 in the wall 242 correspond to the stationary positions of the pins 205. That is, the actuator 231 can be moved to and held in a position corresponding to the stop position of a particular pin 205 so that, after a line of data on a document corresponding to the particular pin 205 is scanned, the carriage 134 will be returned to its starting position.

The means 230 is provided as a means for selectively determining the travel of the carriage 134.

In FIGS. 32 and 33, it will be seen that a door 243 is provided on a sidewall of the housing for the mechanism 203, the door covering an access opening which permits movement of the pin 221 on each of the linkages 207 to either of the slots 222 or 223 in its associated plunger 204. The door 243 is mounted by means of a hinge 244. It will be appreciated that the housing for the mechanism 203 may be an integral part of the housing for the system 122 (FIG. 12) and that such an access opening may be provided in the housing for the system at a point adjacent the knobs 208.

Each of the plungers 204 is connected to its respective linkage 207 by means of a rivet 260 which extends through an arcuate slot 261 in the plunger and a straight, longitudinal slot 262 in the linkage 207. The rivet 260 is flared at both ends, but has a shank diameter permitting movement in the slots 261 and 262. The arcuate slot 261 in each of the plungers 204 is a compound curve including the arc described by the rivet 260 being pivoted about the pin 221 when the associated linkage 207 is pivoted about the shaft 224. The curvature of each of the slots 261 must, therefore, compensate for the fact that the pins 221 can be placed either in their respective slots 222 or their respective slots 223. The elongated slot 262 in each of the linkages 207 permits movement of the plungers 204 in opposition to their respective springs 212 to move the pins 221

between their respective slots 222 and 223. The combination of the curved slot 261 and the elongated, straight slot 262 permits the plungers 204 to remain in a vertical position when the shoulders or notched portion 213 are held by the lock-down bar 210.

Movement of a pin 221 on a linkage 207 between the slots 222 and 223 on an associated plunger 204 can be accomplished by opening the door 243, holding the linkage 207 against the shaft 224, pulling the plunger 204 in the direction of the door 243 in opposition to its associated spring 212, and then moving the linkage 207 with respect to the plunger 204 to place the pin 221 in either the slot 222 or 223.

Visual means for indicating the position of each of the pins 205 with respect to the wall 242 is illustrated in FIG. 33. Each visual indicating means, indicated generally by the reference numeral 263, comprises a flexible strip of material 265 which is trained about a pair of rollers 266 and 267 to be visible through an opening 264, one opening 264 being adjacent each plunger 204. One end of the flexible strip 265 is connected to the pivot point 226 between a pin 205 and its associated linkage 207. The other end of the flexible strip 265 is spool wound about a shaft 268 which is journal mounted in the housing and spring-urged in the direction of the arrow 269. It can be seen that the strip 265 has three successive portions 270, 271 and 272, one of which is visible through the opening 264, depending upon the position of the pivot point 226. For instance, the portions 270 and 272 can be white and the portion 271 can be a bright red, luminescent color. Thus, when a linkage 207 and its associated pin 205 are horizontal to extend the pin to its outermost position, the visual indicating means 263 associated therewith will be a bright red color, thereby indicating that the pin 205 associated therewith is in its operative position. When a linkage 207 and its associated pin 205 are pivoted either downwardly or upwardly to place the pin in its innermost position, the visual indicating means 263 will show white to indicate that the pin is in its nonoperative position.

An electrical means can obviously be provided for indicating the position of the pivot point 226 of each of the linkages 207 and its associated pin 205. For instance, a small light can be placed in each opening 264 and a switch could be operated by movement of the linkage 207 associated with the opening to operate the light. In such a system, the switch would be closed and the light illuminated when the linkage 207 cooperatively associated therewith is horizontal and the switch would be open to turn the light off when the linkage 207 is pivoted to a nonhorizontal position.

It will be appreciated that the mechanism 203 may be placed in the space adjacent the program bar 179 shown in the upper, right-hand portion of FIG. 23.

Referring now to FIGS. 23, 26 and 27, it will be seen that the illustrative drive means for the carriage 134 comprises a motor 300, a first sprocket 302 mounted on a shaft 304 which is journal mounted in a block 306 and drivingly connected to the motor, a second sprocket 308 mounted on a shaft 309 which is parallel to and spaced apart from the shaft 304 and which is journal mounted in a block 310, a chain 312 trained about the sprockets 302, 308 and at least one pin 314 extending outwardly from tee chain 312. Both runs of the chain 312 are disposed parallel to and adjacent the guide bar 138 as clearly seen in FIG. 23. The carriage 134 carries a hook or hook portion 316 which extends into the path of movement of the pin 314 carried by the chain 312.

Referring to FIG. 26, it will be seen that, when the sprocket 302 is driven in the direction of the arrow 317, the pin 314 carried by the chain 312 will engage the hook 316 and move it in the direction of the arrow 136 toward the sprocket 302. As the pin 314 starts to move about the sprocket 302, and since the hook 316 is confined to moving rectilinearly, the pin and hook will be disengaged so that the carriage 134 can be returned to its initial starting position illustrated in FIG. 23 by means of a spring 318 which is shown only in FIG. 27. The spring 318 may be a conventional coiled tension spring connected between the right-hand end (FIG. 23) of the carriage 134 and a stationary portion of the housing for the system 122. I provide a rubber bumper 320 which serves as a shock absorber or a stop determining the initial starting position of the carriage 134, the bumper 320 being mounted on a stationary bracket 322 as illustrated in FIG. 23.

The carriage 134 is, therefore, reciprocated along the guide bar 138 by means of the pin 314 carried by the chain 312 and by the spring 318. The pin 314 moves the carriage 134 in opposition to the spring.

Preferably, before the pin 314 and hook 316 are disengaged to permit the carriage 134 to return in the direction opposite to the arrow 136, the clamp 132 will be moved from its document engaging position to its document releasing position. Thus, movement of the clamp 132 in the direction opposite to the arrow 136 will preferably not affect the position of the document 124. In order to move the document farther in the direction of the arrow 136, I provide a friction wheel 324 which extends through a slot 325 in the bed 126 and which frictionally engages the document 124 to drive it in the direction of the arrow 136, this friction wheel being shown clearly in FIGS. 23 and 26. In the illustrative embodiment, the friction wheel 324 is journal mounted on the housing for the system 122 and a gear 326 is mounted on the shaft 304 for rotation therewith, this gear 326 being in driving engagement with another gear 328 which is, in turn, in driving engagement with a gear 330 mounted on a common shaft 332 with the friction wheel 324. An idler wheel 334 is disposed above and in engagement with the friction wheel 324. Rotation of the gear 326 in the direction of the arrow 317 produces rotation of the frictional wheel 324 in the direction of the arrow 336 so that, when the document 124 is engaged between the friction wheel 324 and idler wheel 334, the document is moved in the direction of the arrow 136. As will be more fully discussed hereinafter, a continuous sheet or document 124 may be moved by the friction wheel 324 system just described in a step-by-step manner past the scanning head. In such a case, the document may be advanced initially by the clamp 132 to a point where it is engaged by the frictional wheel 324 and, thereafter, reciprocable movement of the clamp 132 will not affect the document 124. This is true because once the electro-optical device 144 is operated to indicate the presence of a document 124 and the solenoid 152 is energized to raise the lifter 154, the solenoid will not be energized again until light is projected through the opening 148 toward the device 150 (FIG. 14). If the document 124 is continuous, such as a tape from a computer or the like, the opening 148 will be continually closed by the document.

I prefer that the carriage 134 be rollably supported on the guide 138 by means such as the journal mounted rollers 340 illustrated in FIG. 27. Preferably, four such rollers will be disposed as illustrated in FIG. 27 at each end of the carriage 134.

Referring now to FIG. 34, it will be seen that I have illustrated a second clamp 132' carried by an arm 344 extending outwardly from the carriage 134 toward the boundary 130 of the bed 126. This second clamp 132', which is identical to the first clamp 132, moves in a slot 156' formed in the bed 126 to be adjacent and parallel to the boundary wall 130.

The second clamp 132' is moved between its document engaging position and document releasing position by means identical to that discussed in conjunction with FIGS. 24 and 25, which means are carried on a vertically extending plate 346 mounted on the distal end of the arm 344. An identical abutment stop 172' is provided at one end of the travel of the clamp 132' and a solenoid-operated lifter, such as the lifter 154, is provided at the opposite end of the travel of the clamp 132'.

The second clamp 132' is provided so that documents, such as the illustrated narrow document 124' (FIG. 34), can be clamped to the carriage 134 and positioned adjacent the left-hand boundary wall 130 of the bed 126. As this description progresses, it will be seen that the scanning head moves initially from this boundary 130. If the narrow document 124'

were clamped to the carriage **134** by the clamp **132**, it would be necessary for the scanning head to move a considerable distance before it is in registry with the document **124'**. Further, the function of the line finding means incorporated into the scanning head would be impaired.

Referring now to FIGS. **15—21** and **23**, the scanning head, indicated generally by the reference numeral **350**, of the system **122** and the means by which the scanning head is moved transversely relative to the document **124** will be discussed.

The scanning head **350** is mounted on a carriage **352** which, in turn, is mounted for reciprocation on a transversely extending guide bar **354**. The guide bar **354**, in the preferred embodiment and as illustrated in FIG. **23**, is a guide means extending generally perpendicularly to the guide bar **138** which serves as a guide means for the carriage **134**. Preferably, as best seen in FIGS. **17** and **21**, the carriage **352** is rollably supported on the guide bar **354** by journal mounted rollers such as indicated at **356**. Energy storage means, such as the illustrated spring **358**, is provided for yieldably urging the carriage **352** to its initial starting position, i.e., toward the left-hand end of the guide bar **354** as viewed in FIGS. **15** and **18** and toward the lower end of the guide bar **354** as viewed in FIG. **23**. Thus, the illustrated position of the carriage **352** in FIG. **23** is its initial starting position.

Means for moving the carriage **352** and the scanning head **350** mounted thereon in opposition to the spring **358** and away from the initial starting position of the carriage is provided. In the illustrative embodiment, such a moving means comprises a motor **360**, a sprocket **362** (FIG. **23**) mounted on a shaft **364** which is journal mounted in a block **366** and which is drivingly connected to the motor **360** by means of a flexible coupling **368**, a second sprocket **370** which is mounted on a shaft **372** which is journal mounted in a block **374**, and a chain **376** trained about the sprockets in a conventional manner. As is best seen in FIGS. **21** and **23**, the shafts **364, 372** are parallel and spaced apart and the sprockets **362, 370** are disposed in a common vertical plane. The chain **376** is a conventional endless, flexible means trained about a pair of spaced apart support means, i.e., the sprockets **362, 370**, at least one of the support means being rotatable and drivingly connected to the flexible means.

The sprockets **362, 370** are disposed to support one run of the chain **376** for movement in a direction substantially along the guide bar **354**. In the illustrative embodiment, the lower run of the chain **376** is disposed adjacent the lower edge of the guide bar **354**. A plurality of pusher pins **378** is carried by the chain **376**, each of these pins extending axially, i.e., parallel to the shaft **364**, toward the guide bar **354**. A hook member **380** is mounted on the carriage **352** an is proportioned and designed to extend into the path of movement of the pusher pins **378** as they move along the lower run of the chain **376**. Preferably, the hook member **380** will be mounted for pivotal movement on the carriage **352** by means such as indicated at **382**. The means **382** is arranged so that the hook member **380** will pivot about an axis which is parallel to the axes of the shafts **364, 372**.

As best seen in FIG. **18**, the hook member **380** is provided with a hook portion **381** which engages the pusher pins **378**. Biasing means, such as the illustrated leaf spring **384**, is provided for yieldably urging the hook member **380** out of the path of movement of the pusher pins **378**. Also, a pin **386** is rigidly mounted on the carriage **352** to serve as a stop limiting the movement of the hook member **380** toward the lower run of the chain **376**, i.e., in the counterclockwise direction as viewed in FIG. **18**. The function of this stop pin **386** will become apparent as this description progresses. A guide **388** is provided adjacent the initial starting position of the carriage **352** and is proportioned and designed, as illustrated in FIG. **18**, to move the hook member **380** to its pin **378** engaging position when the spring **358** returns the carriage **352** to its initial starting position.

A solenoid **390** is mounted on the carriage **352** and operatively connected to a lever portion **391** of the hook member **380** as indicated at **392**. When the solenoid **390** is energized, the hook member is pivoted so that its hook portion **381** is out of the path of movement of the pusher pins **378**. Thus, at any time, the solenoid **390** may be energized to disconnect the carriage **352** from the chain **376** to permit the carriage to be returned by the spring **358** to its initial starting position. Means for reading and detecting coded indicia (such as shown in FIG. **2**) printed on a document and then energizing the solenoid **390** will be discussed hereinafter.

Referring now to FIG. **18**, it will be seen that, when the sprockets **362, 370** are driven in the direction of the arrow **394**, a pusher pin **378** will move about the periphery of the sprocket **362** to engage the hook portion **381** of the hook member **380** to move the hook member in the direction of the arrow **396**. The hook member **380** will continue to move with the pin **378** engaged therewith until the pin **378** starts to move about the periphery of the sprocket **370**, i.e., the sprocket remote from the initial starting position of the hook member. Since movement of the hook member **380** in the counterclockwise direction is limited by the stop pin **386**, at a particular location about the periphery of the sprocket **370**, the pusher pin **378** will disengage the hook portion **381** to permit the spring **384** to pivot the hook member so that its hook portion is out of the path of movement of pins **378** on the lower run of the chain **376**. When the hook member **380** is so disengaged from a pusher pin **378**, the spring **358** will take over and return the hook member, i.e., the carriage **352** on which the hook member is mounted, in the direction of the arrow **398**. When the carriage **352** reaches its initial starting position, the guide **388** will engage the hook member **380** and pivot it so that its hook portion **381** is again in the path of movement of the pusher pins **378**.

At any point between the initial starting position of the hook member **380** and the position at which the hook member will be disengaged from a pin **378** moving about the periphery of the sprocket **370**, the solenoid **390** can be energized to pivot the hook member **380** in a clockwise direction (FIG. **18**) to disengage its hook portion **381** from a pusher pin **378** and to permit the hook member **380** to be returned to its initial starting position.

From the description thus far, it will be appreciated that a document is moved with the carriage **134** in a step-by-step manner longitudinally past the scanning head **350** and, each time the document is moved a step in the direction of the arrow **136**, the scanning head is moved transversely relative to the document to scan or read a transversely extending line of data printed on the document.

Flexible electrical connecting wires **400** are provided for electrically connecting the scanning head **350** to the rest of the equipment of the system **122**. In the illustrative embodiment of FIG. **23**, the wires **400** are coiled for expansion and contraction to compensate for the movement of the scanning head **350**. It will be appreciated that the coiled wires **400** are merely illustrative and that any number of techniques may be used to provide electrical connection to the reciprocable scanning head **350**.

It will be appreciated that the hook **316** on the carriage **134** which engages the pusher pins **314** carried by the chain **312** may also be operatively connected to a solenoid, such as the solenoid **390**, and arranged so that, when the solenoid is energized, the hook is moved out of the path of the pins **314**. Thus, if desired, the carriage **134** can be returned by the spring **318** to its initial starting position from any position along its travel.

Referring primarily to FIGS. **15, 17, 19, 20** and **21**, the illustrative structure of the scanning head **350** will be discussed.

Basically, the scanning head **350** comprises a frame **404** on which a line reading means and a line finding means are mounted, each of these means comprising a light source carried by the frame and arranged to project light at a document, a light-actuated semiconductor device carried by the frame, and optical means carried by the frame and arranged to pro-

ject the light reflected from such a document toward the semiconductor device. Specifically, in the illustrative embodiment, and as best seen in FIG. 19, the frame 404 of the scanning head 350 moves transversely and parallel to the top surface of the bed 126 and only a fraction of an inch thereabove.

The frame 404 includes an upper portion 406 and a lower portion 408. A pair of light sources 410, 412 is disposed in the lower portion 408 as best seen in FIG. 19, each light source comprising a light bulb 414, an iris diaphragm 416 and a positive lens 418. Each diaphragm 416 and its associated lens 418 are disposed in a cylindrical opening 419, 419' in the portion 408 and arranged to project the light provided by the bulb 414 at the top surface of the document 124. The opening 419, diaphragm 416 and lens 418 are arranged so that the light source 410 projects light at a 45° angle relative to the top surface of the bed 126 on which the document 124 lies. The light source 412, which is identical to the light source 410, is arranged to project light at an angle of 45° relative to the bed 126. The axes of the openings 419, 419' are perpendicular and the axes of the light sources 410, 412 are likewise perpendicular. Further, as best seen in FIG. 21, the axes of the light sources 410, 412 lie in a common plane which is perpendicular to the bed 126. The axes of the light sources 410, 412 preferably stay in this plane when the scanning head 350 is reciprocated.

Referring still to FIG. 19, it will be seen that a lens 420 and a diaphragm 422 are disposed in a cylindrical opening 423 in the frame 404 to provide optical means for projecting the light reflected from the document 124 toward a light-responsive diode 424. The axis of the opening 423 is perpendicular to the bed 126 and lies in the common plane with the axes of the light sources 410, 412. The opening 423 is positioned adjacent the opening 419 for the light source 410 so that light projected at the document by the light source 410 will be reflected into the opening 423. Further, a lens 426 and a diaphragm 428 are disposed in a cylindrical opening 429 in the frame 404 and arranged to project light reflected from the document 124 toward a light-responsive diode 430. The axis of this opening 429 is likewise perpendicular to the bed 126 and disposed in a common plane with the axes of the light sources 410, 412. The opening 429 is disposed adjacent the opening 419' for the light source 412 so that light projected at the document 124 by the source 412 is reflected into the opening 429.

The optical means associated with each light source 410, 412 is arranged to concentrate the light to a ray of small cross section on the upper surface of the document 124. This light which strikes the upper surface is, of course, reflected and scattered in different directions in the usual manner. Changes in illumination of the top surface of the document will affect the light-responsive diodes 424, 430. When a conventional, white document 124 is used, the illumination on the diodes 424, 430 will normally be high until a darker registration or printed data is in vertical registration with the diode, in which case the amount of reflected light from the light source 412, 410 associated with the diode will be drastically diminished. The arrangement illustrated whereby the light rays from the light source 410, 412 strike the document 124 at an angle of 45° and whereby the diode 424, 430 associated with the source is restricted or arranged to be influenced by light normal to the document reduces the risk of glare from the document affecting the diode, thereby to provide a maximum differentiation between the amount of reflected light and the absence or presence of a recording respectively.

As the scanning head 350 passes over indicia printed on the document 124, the output of the diode 430 varies and thereby reflects the presence or absence as well as the width of each bit of the indicia. Because the printed characters, as shown in FIG. 6, may have rather undefined boundaries and because the light ray from the light source 410 can only be concentrated to the point of certain diameter, the output from the diode 430 will not be a well defined square wave. Thus, circuit means, as discussed previously in conjunction with FIGS. 8 and 9, must be provided for connecting the diode 430 to an output device, such as the driving relay of a teletype machine.

FIG. 20 is a perspective view of a diaphragm, such as the diaphragms 422, 428. Each diaphragm 422, 428 is provided with a slit 431 which is effective to concentrate the reflected light on a particular and desirable portion of its associated diode 424, 430. Each diaphragm 422, 428 is also provided with a registration opening 431'. Referring now to FIG. 21, it will be seen that the slit 431 in the diaphragm 422 extends transversely and that the slit 431 of the diaphragm 428 extends longitudinally. A registration pin 432 extends through the registration opening 431' in the diaphragm 422 to hold the diaphragm in its proper position and a similar registration pin 434 extends through the registration opening in the diaphragm 428 to hold that diaphragm in its proper position.

The slit 431 of the diaphragm 422 extends transversely, i.e., perpendicularly to the direction of movement of the document 124 because its associated diode 424 is used to find a transversely extending line of data to be scanned. For instance, in the illustration of FIG. 21, the document 124 is provided with longitudinally spaced apart marks 336, each of which is disposed to represent the location of a transversely extending line of data. Thus, the document 124 is moved in the direction of the arrow 136 until one of the marks 336 is in vertical registration with the slit 431 of the diaphragm 422. Then the scanning head 350 can move along the line of data associated with the mark.

The slit 431 in the diaphragm 428 may be just slightly longer than the longitudinal length of each bit of printed data. Thus, since the slit 431 in the diaphragm 422 lies on a line which preferably bisects perpendicularly and equally the slit 431 in the diaphragm 428, if the marks 336 are properly positioned relative to their respective lines of data, the slit in the diaphragm 428 will, for an instant, be in vertical registration with each bit of data in a line as the scanning head 350 is moved along and above the line.

The line finding means, which will be described in greater detail hereinafter, does not require that the registration marks 336 be printed on a document, and, in fact, the line finding means may register with the beginning bits or bit of data printed in a line.

Referring now to FIG. 35, a preferred control circuit for the system 122 will be discussed.

The output of the diode 430 is shown connected to circuit means indicated at 450 and through the circuit means to a relay 452 which constitutes an output device. Energization of the relay 452 closes its contacts 452' to complete a circuit between the terminals 454, 456. The relay 452 may be, for instance, the driving relay of a conventional teletype machine. The circuit means 450 will process the output of the diode 430 so that the output can be used to drive a device, such as the relay 452, as well as other types of devices. Thus, the circuit 450 may correspond to that illustrated and discussed in conjunction with FIG. 8.

A read inhibit circuit 458 is connected to the circuit means 450 as illustrated. When predetermined circuit conditions in the control circuit exist, the read inhibit circuit 458 will prevent, i.e., inhibit, operation of the circuit means 450. For instance, it is desirable that the circuit means 450 be operable only when the scanning head 350 is moving away from its initial starting position and along a line of data.

The illustrated read inhibit circuit 458 is connected in parallel with a normally closed switch 460 which is mechanically connected to a normally open, manually operated eject switch 462. When the eject switch 462 is manually closed, the motor 300 which drives the carriage 134 and which is, therefore, the document feed motor, is energized by current flow from a power source placed across illustrated terminals 464, 466. When the switch 462 is closed, the switch 460 is opened to operate the read inhibit circuit 458 to prevent reading while the feed motor 300 is energized. The read inhibit circuit 458 is also connected in parallel with a switch 468 of a relay 470 as illustrated. The relay 470 includes two other switches 472,

474. When the relay 470 is energized, the switches 468, 472 and 474 are closed. The switch 472, which is a normally open switch, is connected in series with a switch 476 of a relay 478 which is, in turn, connected to the terminal 466. Thus, when the relay 470 and the relay 478 are energized, the drive motor 360 for the scanning head is energized and the switch 468 is closed to provide a circuit condition in the read inhibit circuit 458 which will permit the circuit means 450 to process the signals received from the diode 430. Thus, the control circuit is arranged so that the circuit means 450 will process the signals from the diode 430 only when the drive motor 360 for the scanning head 350 is moving the scanning head at a preferably constant rate of speed along a line of data.

The diode 424 is connected through a conventional amplifier 480 to a relay 482 having a normally open switch 484. The diode 184 is connected through a conventional amplifier 486 to a relay 488 having a normally open switch 490 connected in series with the switch 484. These two switches 484, 490 are connected in series with a normally closed switch 492 of a relay 494 and through the switch 492 to the field coil of the relay 470 and through the field coil to ground as well as to a diode 496 and through the diode to the field coil of a relay 498 and through this field coil to ground. Thus, when the switches 484, 490 are simultaneously closed, current can flow from the positive voltage terminal 500 through the switches and through the normally closed switch 492 to energize the relay 470 and the relay 498.

The relay 498 comprises a normally open switch 502, a normally closed switch 504 and a normally open switch 506 and the relay 494 comprises, in addition to the normally closed switch 492, a normally open switch 508.

When the relay 498 is energized to close its switch 502 and the relay 494 is energized to close its switch 508, current can flow from the positive voltage terminal 510 through the switch 502 and the switch 508 and the field coil of the relay 494 to maintain the relay 494 energized. Similarly, when the illustrated switch 514 is closed, current can flow from the illustrated positive voltage terminal 512 through the switch 514, the switch 506 and the field coil of the relay 498 to maintain the relay 498 energized. The switch 514 is disposed and arranged to be engaged by the carriage 352 or the scanning head 350 to indicate when the scanning head is in its initial starting position. Conventionally, the diode 496 directs the flow of current from the terminal 512 through the field coil of the relay 498 and another diode 516 directs the flow of current from the terminal 510 and through the switch 502 through the switch 508 and the field coil of the relay 494. The relay 494 may be energized initially by current flow from a logic circuit indicated at 518. Thus, once the relay 494 is energized, it will maintain itself energized through its switch 508 and thereby maintain the switch 492 open.

The logic circuit 518, which is conventionally connected to the control circuit through a diode 520, is the carriage 352 return-recognition logic for the system 122. Specifically, the logic circuit 518 is arranged to detect or recognize the presence of a printed code indicating the end of a line of data being scanned. When this particular code is recognized, the logic circuit 518 establishes a circuit condition which will energize the relay 494 and which will, through another diode 522, energize the solenoid 390 which, as discussed previously, disconnects the carriage 352 from the chain 376, thereby to permit the carriage and the scanning head 350 to be returned to their initial starting positions. One suitable form of a logic circuit 518 will be discussed in conjunction with FIG. 36.

The logic circuit 518 will also energize a relay 524 to close its switch 526 so that current can flow from a positive voltage terminal 528 through the switch 526 and through a switch 530 to the switch 474. The switch 530 is disposed and arranged to indicate the end of the travel of the scanning head 350. That is, the switch 530 is operated when the scanning head 350 moves adjacent the sprocket 370 which is remote from its initial starting position. The switch 530 is in its illustrated position at all times except when the scanning head is at the end of its travel.

The diode 150 is connected through an amplifier 532 to a relay 534 which includes switches 536, 538, 540. The switch 536 is normally closed to connect a light bulb 542 and the solenoid 140 for the stop 128 to a switch 544 which is disposed to be operated by the carriage 134 when it is in its initial starting position. The switch 544 is connected directly, as illustrated, to a positive voltage terminal 546, the switch 544 being in its illustrated position at all times except when the carriage 134 is in its initial starting position. Thus, when the carriage 134 is in its initial starting position, current can flow from the terminal 546 through the normally closed switch 536 and the field coil of the solenoid 140. When the relay 534 is energized, the switch 536 is opened to deenergize the solenoid 140 and the light bulb 542 which serves as an indicator that the stop 128 is in a position to stop a document 124. The stop 124, therefore, moves out of such a position when the solenoid 140 is deenergized. Thus, when the light projected through the opening 148 at the diode 150 is blocked, a circuit condition is created which will cause the stop 128 to move out of its blocking position.

The switch 538 is arranged, when the carriage 134 is in its initial starting position, normally to energize a relay 548 which includes switches 550 and 552. When the relay 548 is so energized, its switch 550 is closed to maintain current flow from the terminal 546 through the field coil of the relay as long as the carriage 134 is in its initial starting position. The switch 552 of the relay 548 is connected in series with the normally open switch 540 of the relay 534 so that, when these two switches are closed, the solenoid 152 which operates the lifter 154 associated with the clamp 132 is operated. When a document closes the opening 148 above the diode 150, and the carriage 134 is in its initial starting position, the relay 534 is operated to move its switch 538 so that current can flow from the terminal 546 through the switch 544, a diode 554, the switch 538 and the field coil of the aforementioned relay 478. In addition to the switch 476, the relay 478 includes a switch 556 which is closed when the relay is energized to connect the field coil of the relay to the positive voltage terminal 546. That is, when the carriage 134 is away from its initial starting position, the switch 544 is in series with the switch 556 to maintain the relay 478 energized. At any time when the carriage 134 is away from its initial starting position, a switch 558, which is the reset switch for the system 122, may be closed so that current can flow from the terminal 546 through the switch 544, the switch 558, a diode 560 and the field coil of the solenoid 390 which, as discussed previously, disconnects the carriage 352 from its driving chain 376.

It will be seen that the switch 183 must be closed by the program bar 179 before the light source 186 is energized. Further, there is a switch 562 which is arranged to be closed by movement of the carriage 134 to the end of its travel remote from its initial starting position. When the switch 562 is closed, movement of the light source 186 and device 184 with the carriage 134 back toward the initial starting position of the carriage will not operate the relay 488.

With the above description of the circuit of FIG. 35 in mind, it will be appreciated that the several relays have particular functions, which functions are identified in the following paragraphs:

The primary function of the relay 494 is to permit the line finding means to operate. The relay 494 is energized at all times except when the scanning head 350 is in its initial starting position, at which position the line finding means is operable.

The relay 498 provides holding voltage for the relay 494 as well as a holding voltage for the feed motor 300, this holding voltage being removed by opening switch 514 which is the home position or initial starting position switch for the scanning head 350.

The relay 470 serves to prevent simultaneous operation of the motors 300, 360 and controls the read inhibit circuit 458. When the motor 360 is energized, the read inhibit circuit 458 is deactivated so that the circuit means 450 can process signals received from the diode 430. Relay 470 is provided with a

holding voltage through switch 530 and switch 526 of the relay 524. The relay 470 is also energized through the switch 492 of the relay 494 when the relay 494 is deenergized.

Relay 478 controls the current flow to the motors 300, 360. Relay 478 is energized by relay 534 and its holding voltage is applied through switch 544. Relay 478 can be energized by closing switch 558.

The primary function of relay 548 is to operate the solenoid 152 associated with the lifter 154.

The relay 534 is effective to operate the document stop 128 and the lifter 154 as well as to energize relay 478.

Relay 488 associated with the program bar 179 and the relay 482 associated with the line finding means of the scanning head 350, in the illustrative and preferred embodiment, cooperate to stop the feed motor 300 so that the diode 430 of the scanning head 350 is in proper registration with a line of data to be scanned. It will be seen that, in order for the relay 498 to be energized to open its switch 504 to deenergize the motor 300, both switches 484, 490 must be simultaneously closed. Thus, each line of data on a document must be represented by a properly positioned pin 178 on the program bar 179. That is, when it is desired that a particular line of data be read or scanned, the line of data must be positioned on the document so that, when it is in registration with the diode 424, the light source 186 and light-responsive device 184 must be on diametrically opposite sides of the pin 178 corresponding to the line of data. Preferably, each pin 178 is located on the bar 179 so that the relay 488 is operated slightly before the relay 482 is operated. That is, the line-select diode 184 senses the absence of light to close the line-select relay 488 so that the motor 300 is actually stopped by operation of the relay 482 when the diode 424 is properly registered with a line of data to be scanned. This feature is provided so that it will not be necessary to have the positioning of the pins 178 on the bar 179 critical with respect to the positioning of the lines on the paper. In other words, the combination of the line find means and the program selector bar means of the present invention allow for some error in the registration of printing on a document. This, of course, is a valuable feature because, in most cases, the data will be printed on a document with a conventional typewriter. More specifically, the pins 178 are positioned in my system 122 so that each pin will establish a condition which will permit the line find means, i.e., the diode 424, to operate and to stop the feed motor 300 just slightly before the document 124 is fed to the point where the diode 430 is in registration with the desired line of data and, the diode 424 must sense this point and stop the feed motor 300.

Conventionally, a relay or any combination of relays and switches, even light actuated diodes and other such semiconductor devices are, generally speaking, switch means for changing circuit conditions. The control means for the feed motor 300, therefore, includes first switch means for deenergizing the feed motor to stop relative longitudinal movement between the document 124 and the scanning head 350 and a plurality of switch actuating means longitudinally spaced apart to define a plurality of preselected relative positions for the scanning head and the document, each of the actuating means being arranged to actuate the first switch means. In such a case, generally speaking, the first switch means comprises the light source 186, the diode 184, the relay 488 and its switch 490, the relay 494 and its switches and the relay 498 and its switches while the said actuating means comprises the pins 178 on the program bar 179. That is, in one embodiment of the present invention, the line find means may be eliminated and a document may be stopped at points represented solely by the pins 178. The preferred and illustrated embodiment, however, includes means for finding a line of data to be scanned, the finding means including means for detecting the presence of a line of data on a document and deenergizing the feed motor 300, the detecting and the energizing means being disposed in series with the said first switch means. The relays 482 and 488 may be considered first and second relays connected in series with a third relay 498 which, when it is deenergized, maintains the motor 300 energized. Thus, energization simultaneously of relays 482 and 488 operates the relay 498 to deenergize the motor 300.

Finally, with reference to the circuit of FIG. 35, it will be appreciated that certain of the described operational characteristics of the components are unimportant as to the overall functions of the control circuit. For instance, the fact that the switches of a relay may be normally closed or open regardless of whether the relay is energized or deenergized is a matter of design and not particularly pertinent to the overall concept of the invention. For instance, the diode 150, amplifier 532 and relay 534 may be arranged, if desired, so that the relay is energized when light impinges on the diode 150 or, alternatively, so that the relay is energized when no light or substantially less light impinges on the diode 150.

Referring now to FIG. 36, the logic circuitry associated with the control circuits for the system 122 will be discussed.

The logic circuitry of FIG. 36 comprises a first bit gate 570, a read gate 572, a read flip-flop 574, a control timing logic circuit 576, a data shift register 578 and a plurality of code recognition gates 580, 582, 584, 586, to the output of each of which is connected an amplifier 588, 590, 592, 594. One of these code recognition gates 584 is shown in phantom to indicate that it is available to use in the recognition of any appropriate code.

The output of a circuit, such as the circuit shown in FIG. 8, may be connected to the inputs of the first bit gate 570 and the read gate 572. The output of the first bit gate 570 is connected to the input of the control timing logic circuit 576. The output of the read gate 572 is connected to the input of the read flip-flop 574.

One output 596 of the control timing logic circuit 576 is connected to the first bit gate 570 to enable the first bit gate until the first bit or start bit from the read circuitry triggers the first bit gate. A first bit pulse is then generated to start the control timing logic circuit which, after a predetermined period of time disables the first bit gate 570. Once the control timing logic circuit 576 is started by a pulse from the first bit gate 570, the circuit begins generating search pulses which process data from the read circuitry (FIG. 8) through the read gate 572 into the read flip-flop 574. Thus, another output 598, i.e., the search pulse output of the control timing logic circuit 576, is connected to the read gate 572 as an input. After each search pulse, the circuit 576 generates a shift pulse which is effective to shift the contents of the read flip-flop 574 into the data shift register 578, and, preferably, the shift pulse trailing edge resets the read flip-flop to allow the sampling of the next bit from the read circuitry. This continues until all five data bits are loaded into the data shift register. Thus, the shift pulse output, indicated at 600, of the circuit 576 is connected to the read flip-flop 574 and to the data shift register 578. The control timing logic circuit 576 then generates a strobe pulse, indicated as output 602, which tests the code recognition gates 580, 586, and if any of the prewired codes is recognized, activates the corresponding solenoid or relay. For instance, the code recognition gate 580 may be wired to recognize a particular code, i.e., a particular arrangement of bits from the data shift register 578, for carriage 352 return. Thus, when the gate 580 recognizes such a code, it provides an output through its amplifier 588 which energizes the solenoid 390 to disconnect the carriage 352 from its driving chain 376. In a similar manner, the gate 582 may be wired to recognize a stop code and the gate 586 may be wired to recognize an eject, i.e., eject of the document 124, code. The gate 584 (shown in phantom) may be wired to recognize codes for skipping data, eliminating data, etc. I have shown an input terminal 604 connected to each gate 580, 582, 584, 586. It will be appreciated that these terminals may be connected as desired to receive pulses representing the particular codes.

It will be appreciated that the several circuits comprising the logic circuitry of FIG. 36 may be conventional and well known circuits in the computer art. Thus, it is not necessary, in this description, to describe each such circuit.

Referring again to FIG. 35, and remembering the discussion of the circuitry of FIG. 36, it will be appreciated that the carriage return logic indicated at 518 is a means for stopping movement of the scanning head 350 away from its initial starting position when there is a particular code printed in the line of data being scanned. In most cases, the scanning head 350 will be returned to its initial starting position from a point at which such a code appears. If there is no carriage return code printed in a line of data, the carriage will be returned automatically at the end of its travel because the pusher pin 378 moving the carriage will move about the periphery of the sprocket 370 to leave the hook portion 381 as described previously.

Referring still further to FIG. 35, it will be seen that if the relay 488 is energized continually by means such as a simple switch which may be mechanically operated to connect the field coil of the relay to a current source, the line selector means comprising the pins 178, bar 179, diode 184 and light source 186 may be disabled. Thus, I have shown such a switch 610 connected between the relay 488 and a positive voltage terminal 612. When the switch 610 is closed, an elongated document such as discussed previously may be driven through my system 122 by means of the friction wheel 324 (FIG. 26) and, in that case, the document will be stopped at each line of data by the line finding means carried by the scanning head.

What I claim is:

1. A system for scanning data on a document comprising a scanning head arranged for transverse movement relative to such a document, drive means for providing relative longitudinal movement between said scanning head and such a document, control means for said drive means, said control means including first switch means for deenergizing said drive means to stop such relative movement, and a plurality of switch actuating means longitudinally spaced apart to define a plurality of preselected relative positions for said scanning head and such a document, each of said actuating means being arranged to actuate said first switch means.

2. The system of claim 1 in which said control means includes means for finding a transversely extending line of data to be scanned, said finding means including means for detecting the presence of a line of data on such a document and deenergizing said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line.

3. The system of claim 2 in which said detecting and deenergizing means is disposed in series with said first switch means, whereby, when said first switch means is actuated by one of said actuating means and said detecting means simultaneously detects the presence of a line of data corresponding to said one actuating means, said drive means will be deenergized.

4. The system of claim 2 in which said detecting and deenergizing means includes electro-optical means for detecting indicia printed on a document.

5. The system of claim 2 in which said detecting and deenergizing means includes a light source arranged to direct light at such a document, a light-actuated semiconductor device and optical means for projecting the light reflected from such a document toward said semiconductor device.

6. The system of claim 5 in which said first switch means includes a first relay and means cooperatively associated with said actuating means and effective to operate said first relay, and including a second relay operatively connected to and operated by said semiconductor device, said first and second relays being connected in series, whereby, when said first switch means is actuated by one of said actuating means and said detecting means simultaneously detects the presence of a line of data corresponding to said one actuating means, said first and second relays will be operated to deenergize said drive means.

7. The system of claim 6 including a third relay effective, when deenergized, to maintain said drive means energized, said third relay being connected to the series circuit of said first and second relays, whereby, when said first and second relays are simultaneously operated, said third relay is energized to deenergize said drive means.

8. The system of claim 1 in which said drive means is arranged to move such a document longitudinally past said scanning head.

9. The system of claim 1 in which said drive means is arranged to move such a document longitudinally past said scanning head, and in which said control means includes means for finding a transversely extending line of data to be scanned, said finding means including means for detecting the presence of a line of data on such a document and deenergizing said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line.

10. The system of claim 9 in which said detecting and deenergizing means is disposed in series with said first switch means, whereby, when said first switch means is actuated by one of said actuating means and said detecting means simultaneously detects the presence of a line of data corresponding to said one actuating means, said drive means will be deenergized.

11. The system of claim 1 in which said drive means is arranged to move such a document longitudinally past said scanning head, said drive means including a carriage arranged for longitudinal reciprocation relative to said scanning head, and clamp means carried on said carriage and arranged to clamp such a document for movement therewith.

12. The system of claim 11 in which said clamp means includes a clamp member mounted on said carriage for movement between a document engaging position and a document releasing position, spring means for yieldably urging said clamp member to its document engaging position, latch means for holding said clamp member in its document releasing position in opposition to said spring means, said latch means being supported by said carriage, means for cocking said latch means, said cocking means being disposed adjacent one end of the travel of said carriage, and means for releasing said latch means, said releasing means being disposed adjacent the opposite end of the travel of said carriage.

13. The system of claim 12 in which said cocking means includes an abutment disposed in the path of movement of said latch means and arranged to cock said latch means when said carriage reaches said one end of its travel.

14. The system of claim 12 in which said releasing means includes a solenoid effective, when energized, to release said latch means.

15. The system of claim 13 in which said releasing means includes a solenoid arranged, when energized, to release said latch means.

16. The system of claim 11 in which said clamp means includes a clamp member mounted on said carriage for pivotal movement between a document engaging position and a document releasing position, a pinion gear rigidly connected to said clamp member and journaled on the pivot axis thereof, a spur gear journaled on said carriage and meshed with said pinion gear, spring means for yieldably urging said spur gear in one direction about its axis to hold said clamp member in its document engaging position, latch means for holding said spur gear in opposition to said spring means, thereby to hold said clamp member in its document releasing position, means for cocking said latch means to hold said clamp member in its document releasing position, said cocking means being disposed on one side of the transverse path of movement of said scanning head, and means for releasing said latch means so that said clamp member can be moved to its document engaging position, said releasing means being disposed on the opposite side of said transverse path.

17. The system of claim 16 in which said cocking means includes an abutment disposed in the path of movement of said latch means and arranged to cock said latch means when said carriage reaches one end of its travel and in which said releasing means includes a solenoid-operated device effective, when energized, to release said latch means.

18. The system of claim 17 including means for detecting the presence of a document and energizing said solenoid-operated device when such a document is in a position to be engaged by said clamping means.

19. The system of claim 18 in which said detecting and energizing means includes a light-actuated semiconductor device operatively connected to said solenoid-operated device, a light source arranged to project light at said semiconductor device, said light source and said semiconductor device being positioned so that, when such a document is in a position to be engaged by said clamp, the document is effective to block the light projected at the semiconductor device, thereby to establish a circuit condition effective to energize said solenoid-operated device.

20. The system of claim 19 including a solenoid-operated stop arranged to position such a document to be engaged by said clamping means, said solenoid-operated stop being movable, when energized, to a position out of the path of movement of such a document, said semiconductor device being operatively connected to and effective to energize said solenoid-operated stop.

21. The system of claim 12 including a frictional drive roller for engaging and moving such a document longitudinally past said scanning head, said drive roller being drivingly connected to said drive means and positioned and arranged to continue to move such a document longitudinally after said clamp member is moved to its document releasing position and said carriage is returned toward said other end of its travel.

22. The system of claim 1 including a support member extending in the direction of relative movement between said scanning head and such a document, each of said switch actuating means being a pin carried by said support member.

23. The system of claim 22 in which said first switch means includes a frame, a light-actuated semiconductor device and a light source arranged to direct light at said semiconductor device, said light source and said semiconductor device being mounted on said frame, said frame being arranged for movement along and relative to said support member with said light source on one side of said pins and said semiconductor device on the opposite side of said pins, each pin being proportioned and designed, when said semiconductor device is adjacent thereto, to block the light directed thereat by said light source.

24. The system of claim 23 in which each of said pins is selectively movable between an operative position effective, when said semiconductor device is adjacent thereto, to block the light directed thereat by said light source, and an inoperative position which is not effective to block the light directed at the semiconductor device.

25. The system of claim 24 including a pushbutton associated with each of said pins and linkage means arranged to connect each of said pins to its associated pushbutton and to move said pin transversely to the direction of relative movement between said scanning head and such a document.

26. The system of claim 23 in which said support member is a bar and in which each of said pins is selectively slidably movable in said bar between an operative position effective, when said semiconductor device is adjacent thereto, to block the light directed thereat by said light source, and an inoperative position which is not effective to block the light directed at the semiconductor device.

27. The system of claim 25 including a housing for said system, said housing having an aperture associated with each of said pins, a visual indicating means operatively connected to each of said pins to indicate the position thereof, each of said last-mentioned means being adjacent one of said apertures.

28. The system of claim 27 in which each of said visual indicating means comprises a movable member having a first position corresponding to the operative position of its associated pin and a second position corresponding to the inoperative position of its associated pin, each of said movable members having its first and second portions alternatively visible through the adjacent aperture.

29. The system of claim 25 including manually operated means for moving said pins to their respective inoperative positions, said manually operated means being operatively connected to said linkage means.

30. The system of claim 1 including transversely extending guide means for said scanning head, energy storage means for urging said scanning head toward its starting position and along said guide means, means for moving said scanning head along said guide means and in opposition to said energy storage means, said moving means comprising a pair of spaced apart support means, an endless, flexible means trained about said support means, at least one of said support means being rotatable and drivingly connected to said flexible means, said support means being positioned to support one run of said flexible means for movement in a direction substantially along said guide means, a pusher carried by said flexible means, a hook member arranged to extend into the path of said pusher defined by said one run, means for mounting said hook member on said scanning head, whereby, when said hook member is engaged by said pusher, said scanning head will be moved away from its starting position and along said guide means, said hook member being proportioned and designed so that, when said pusher starts to move about said support means at the end of said one run remote from the starting position of said scanning head, said hook member will disengage the pusher so that said scanning head will be returned to its starting position.

31. The system of claim 30 in which said mounting means is arranged so that said hook member is movable on said scanning head between a first position in the path of said pusher and a second position out of the path of said pusher, said hook member being biased toward its second position, and means, adjacent the starting position of said scanning head, for moving said hook member from its second position to its first position.

32. The system of claim 31 including a solenoid cooperatively connected to said hook member and arranged, when energized, to move said hook member from its first position to its second position, thereby to disengage said pusher.

33. The system of claim 32 including code reading and detecting means carried by said scanning head and operatively connected to said solenoid, said reading and detecting means being effective to energize said solenoid upon detecting a coded indicia printed on such a document and representing the end of a line of data to be read.

34. The system of claim 33 including means for inhibiting said code reading and detecting means when said solenoid is energized and said scanning head is being returned to its starting position.

35. The system of claim 1 in which said scanning head comprises a frame, a light source carried by said frame and arranged to project light at such a document, a light-actuated semiconductor device carried by said frame, and optical means carried by said frame and arranged to project the light reflected from such a document toward said semiconductor device.

36. The system of claim 35 in which the axis of said light source is disposed at an angle of approximately 45° to such a document and the optical axis of said optical means is disposed substantially perpendicularly to such a document.

37. The system of claim 35 in which the axes of said light source and said optical means lie in a transverse plane which is perpendicular to such a document and which includes the transverse path of movement of said scanning head.

38. The system of claim 37 in which said optical means includes a diaphragm having a slit elongated in a direction substantially perpendicular to the transverse path of movement of said scanning head, said slit being effective to concentrate reflected light on a particular portion of said semiconductor device.

39. The system of claim 38 in which said control means includes means for finding a transversely extending line of data to be scanned, said finding means including means for detect-

ing the presence of a line of data on such a document and deenergizing said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line, said detecting and deenergizing means including a second light source carried by said frame and arranged to project light at such a document, a second light-actuated semiconductor device carried by said frame and second optical means carried by said frame and arranged to direct light reflected from such a document toward said second semiconductor device.

40. The system of claim **39** in which the axis of said second light source is disposed substantially perpendicularly to the axis of the first-mentioned light source, the axis of said second optical means is disposed substantially perpendicularly to such a document, said first-mentioned semiconductor device, said second semiconductor device, said first-mentioned light source and said second light source being disposed on the same side of such a document, and all of said axes lie in said transverse plane.

41. The system of claim **40** in which said second optical means includes a diaphragm having a slit elongated in a direction substantially parallel to the transverse path of movement of said scanning head, this last-mentioned slit being effective to concentrate reflected light on a particular portion of said semiconductor device.

42. The system of claim **39** in which the axis of said second light source is disposed substantially perpendicularly to the axis of the first-mentioned light source, the axis of said second optical means is disposed substantially perpendicularly to such a document, said first-mentioned semiconductor device, said second semiconductor device, said first-mentioned light source and said second light source being disposed on the same side of such a document, and all of said axes lie in said transverse plane.

43. The system of claim **42** in which said second optical means includes a diaphragm having a slit elongated in a direction substantially parallel to the transverse path of movement of said scanning head, this last-mentioned slit being effective to concentrate reflected light on a particular portion of said second semiconductor device.

44. A system for scanning and optically reading transversely extending lines of data on a document comprising a scanning head arranged for transverse movement relative to such a document and along such a line of data, drive means for providing relative longitudinal movement between said scanning head and such a document, control means for said drive means, said control means including means for finding a transversely extending line of data to be scanned, said finding means including electro-optical means for detecting the presence of a line of data on such a document and operating said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line, said electro-optical means being longitudinally stationary relative to said scanning head, said electro-optical means including a light source arranged to project light at such a document, a light-actuated semiconductor device, and optical means for projecting the light reflected from such a document toward said semiconductor device.

45. The system of claim **44** in which said drive means is arranged to move such a document longitudinally past said scanning head, said drive means including a carriage arranged for longitudinal reciprocation relative to said scanning head, and clamp means carried on said carriage and arranged to clamp such a document for movement therewith.

46. The system of claim **44** including transversely extending guide means for said scanning head, energy storage means for urging said scanning head toward its starting position and along said guide means, means for moving said scanning head along said guide means and in opposition to said energy storage means, said moving means comprising a pair of spaced apart support means, an endless, flexible means trained about said support means, at least one of said support means being rotatable and drivingly connected to said flexible means, said support means being positioned to support one run of said flexible means for movement in a direction substantially along said guide means, a pusher carried by said flexible means, a hook member arranged to extend into the path of said pusher defined by said one run, means for mounting said hook member on said scanning head, whereby, when said hook member is engaged by said pusher, said scanning head will be moved away from its starting position and along said guide means, said hook member being proportioned and designed so that, when said pusher starts to move about said support means at the end of said one run remote from the starting position of said scanning head, said hook member will disengage the pusher so that said scanning head will be returned to its starting position.

47. The system of claim **44** in which the axes of said light source and said optical means lie in a transverse plane which is perpendicular to such a document and which includes the transverse path of movement of said scanning head, the axis of said light source being inclined relative to the axis of said optical means within said transverse plane.

48. The system of claim **44** in which said drive means includes an electrically operated motor and means for engaging such a document, said engaging means being drivingly connected to said motor and arranged to move such a document longitudinally past said scanning head, and in which said control means includes circuit means for operatively connecting said semiconductor device to said drive means.

49. The system of claim **48** including second drive means for transversely reciprocating said scanning head relative to such a document and along and above lines of data thereon, said control means including additional circuit means for operating said second drive means, said additional circuit means being cooperatively associated with said first-mentioned circuit means and effective, when said first-mentioned circuit means stops such relative longitudinal movement, to start said second drive means to move said scanning head along and above a corresponding line of data.

50. A system for reading graphically printed data disposed in transverse lines on a document, said system comprising a scanning head arranged for transverse movement relative to such a document, means for moving said scanning head along a line of data at a constant, predetermined speed, light source means carried by said scanning head and arranged to project light at such a line of data on such a document, a light-responsive semiconductor device carried by said scanning head, optical means for projecting light reflected from such a document toward said semiconductor device, said optical means being carried by said scanning head, whereby the concentration of light on said semiconductor device depends on the presence or absence as well as the width and spacing of graphical symbols in the line of data being scanned, an output device, and circuit means for operatively connecting the semiconductor device to said output device.

51. The system of claim **50** in which the axis of said light source is disposed at an angle of approximately 45° to such a document and the optical axis of said optical means is disposed substantially perpendicularly to such a document.

52. The system of claim **51** in which the axes of said light source and said optical means lie in a transverse plane which is perpendicular to such a document and which includes the transverse path of movement of said scanning head.

53. The system of claim **52** in which said optical means includes a diaphragm having a slit elongated in a direction substantially perpendicular to the transverse path of movement of said scanning head, said slit being effective to concentrate reflected light on a particular portion of said semiconductor device.

54. The system of claim **52** including drive means for providing relative longitudinal movement between said scanning head and such a document, and control means for said drive means, said control means including means for finding a transversely extending line of data to be scanned, said finding means including means for detecting the presence of a

line of data on such a document and deenergizing said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line, said detecting and deenergizing means including a second light source carried by said frame and arranged to project light at such a document, a second light-actuated semiconductor device carried by said frame and second optical means carried by said frame and arranged to direct light reflected from such a document toward said second semiconductor device.

55. The system of claim **50** including drive means for providing relative longitudinal movement between said scanning head and such a document, and control means for said drive means, said control means including means for finding a transversely extending line of data to be scanned, said finding means including means for detecting the presence of a line of data on such a document and deenergizing said drive means to stop relative movement between said scanning head and such a document, whereby said scanning head can scan such a line, said detecting and deenergizing means including a second light source carried by said frame and arranged to project light at such a document, a second light-actuated semiconductor device carried by said frame and second optical means carried by said frame and arranged to direct light reflected from such a document toward said semiconductor device.

56. The system of claim **55** in which said drive means includes a servomotor, and in which said control means includes a servoamplifier, the input of which is operatively connected to the output of said second semiconductor device, whereby said drive means is effective continually to position such a document so that a line of data on the document is always directly under the scanning head irrespective of any skew of the line.

57. The system of claim **55** in which said means for moving said scanning head includes second drive means for transversely reciprocating said scanning head, in which said control means includes circuit means for operatively connecting said second semiconductor device to said first-mentioned drive means and additional circuit means for controlling said second drive means, said additional circuit means being cooperatively associated with said first-mentioned circuit means and effective, when said first-mentioned circuit means stops such relative longitudinal movement, to start said second drive means to move said scanning head along and above a corresponding line of data on such a document.

58. The system of claim **57** in which the axis of said second light source is disposed substantially perpendicularly to the axis of the first-mentioned light source, the axis of said second optical means is disposed substantially perpendicularly to such a document, said first-mentioned semiconductor device, said second semiconductor device, said first-mentioned light source and said second light source being disposed on the same side of such a document, and all of said axes lie in said transverse plane.

59. The system of claim **50** in which said circuit means includes means for registering a predetermined code representing the end of a line of data to be scanned and providing a predetermined output effective, when coupled to said moving means for said scanning head, to cause said scanning head to be returned to its initial starting position.