

July 23, 1957

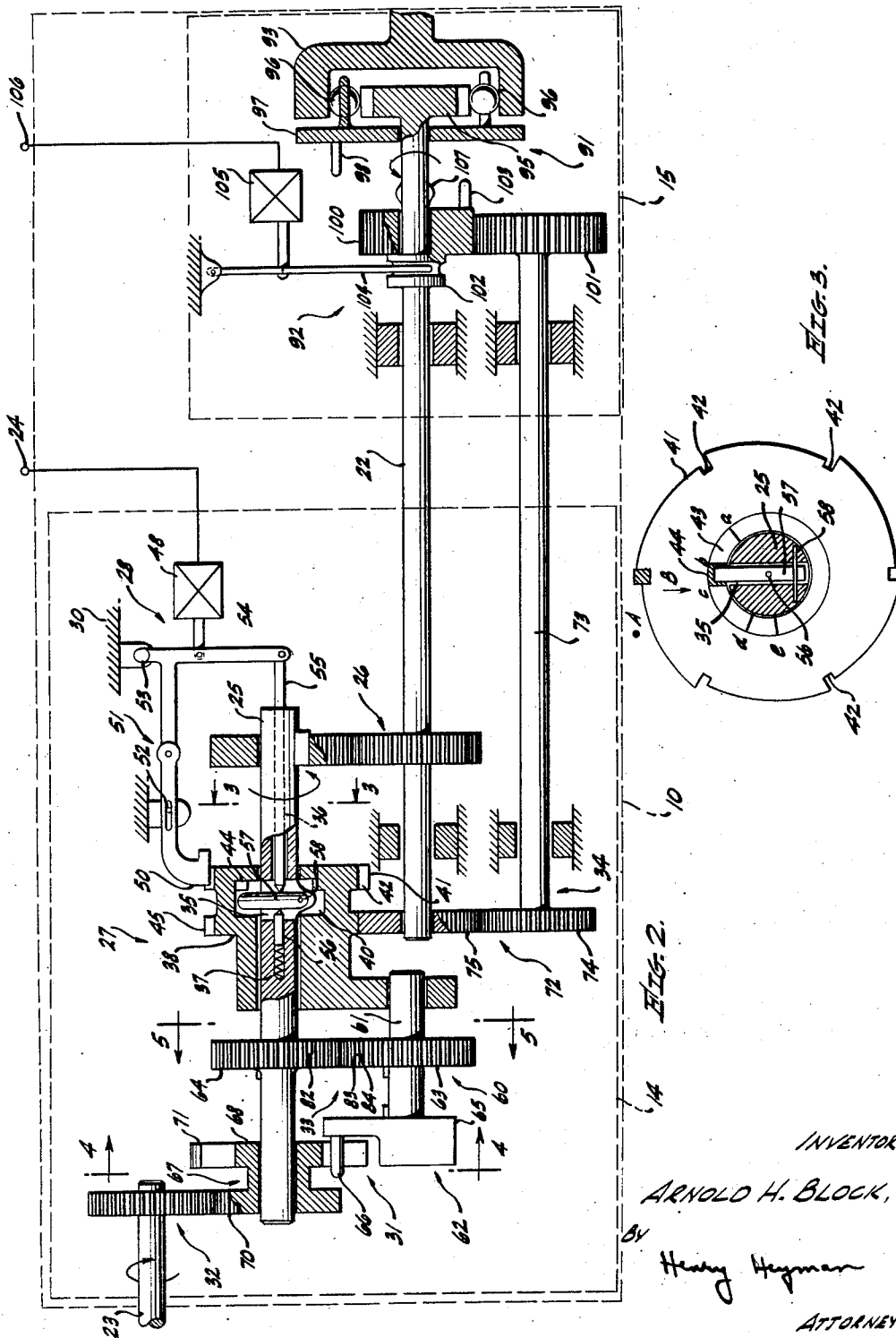
A. H. BLOCK

2,800,073

HIGH SPEED PAPER ADVANCE SYSTEM

Filed Dec. 17, 1954

3 Sheets-Sheet 2



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3 Sheets-Sheet 3

FIG. 4.

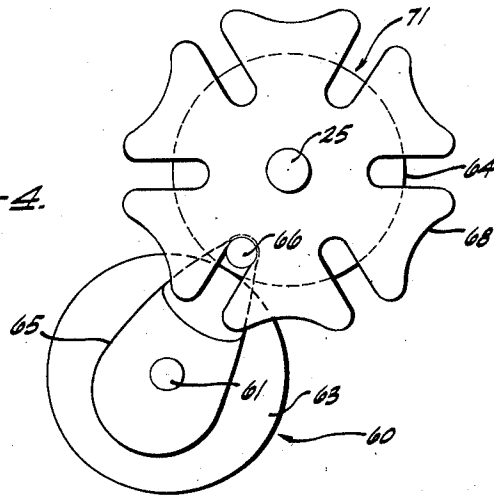


FIG. 6.

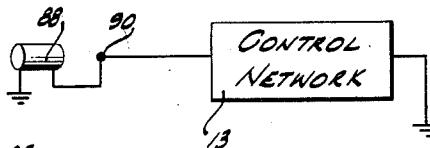
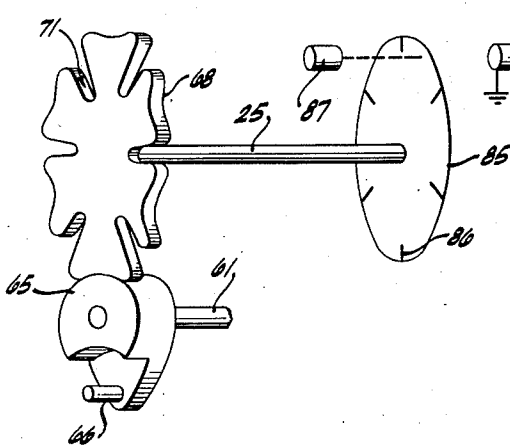


FIG. 5.

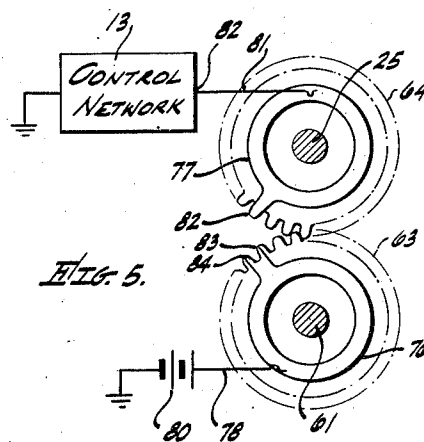
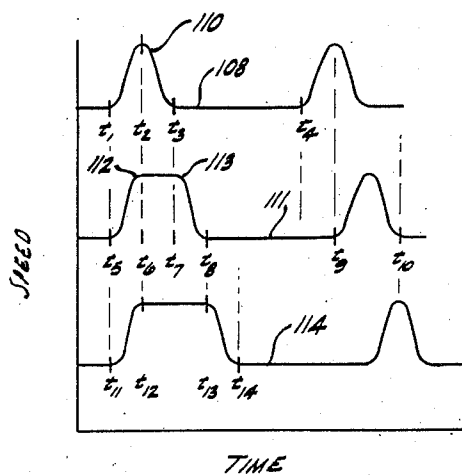


FIG. 7.



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1

2,800,073

HIGH SPEED PAPER ADVANCE SYSTEM

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21 Claims. (Cl. 101—93)

The present invention relates to systems for advancing recording media and more particularly to a paper advance system for a high-speed printer that advances the paper at high speeds either intermittently, one line at a time, or continuously, a selected number of lines.

The advent of high-speed printers to legibly record information developed in the form of electrical signals by high-speed data processing machines has fostered the need for correspondingly high-speed paper advance systems to rapidly advance the paper, including carbon copies, upon which the information is printed. More specifically, there has been an ever-increasing need in the printer art for a paper advance system that can quickly accelerate and decelerate the paper and accurately position it at the high speeds required by high-speed printers without tearing the paper.

Controlled paper motion is obtained in one type of prior art paper advance system by selectively coupling the paper through a dog-type clutch to a driving mechanism, such as a motor. The clutch essentially includes a toothed input member coupled to the motor and a similarly toothed output member coupled to the paper which is intermittently advanced by alternately engaging and disengaging the toothed clutch members. More specifically, the paper is intermittently advanced one line at a time by periodically engaging the clutch members for a predetermined interval of time corresponding to the individual spacing between successive lines and slewed or continuously advanced a selected number of lines by engaging the members for a relatively longer interval of time corresponding to the selected number of lines slewed or skipped. In other words, the spacing between successively printed lines of information is determined entirely by the length of time the clutch members are engaged, the printed lines being single spaced by recurrently engaging the clutch members for equal periods of time and multiple spaced by engaging the members for proportionately longer periods of time.

The prior art paper advance system mentioned above may be classified as an impact or brute force type of system wherein the clutch members are subject to relatively severe shock each time they are engaged and disengaged. Accordingly, all elements of the system coupled to the clutch members are correspondingly subject to shock which significantly decreases the life expectancy of the clutch and associated elements. Furthermore, as a consequence, the paper is very sharply accelerated and decelerated so that the motion of the paper is comparatively jerky. Consequently, the speed of the paper must be limited to relatively low values to prevent the paper from being torn.

An additional disadvantage of a paper advance system utilizing a dog-type clutch is that the clutch inherently lacks the ability to accurately regulate the spacing between lines to be printed. As a result, a system employing such a clutch must also include intricate timing and control circuits to measure and control the periods of engagement and disengagement of the clutch input and out-

2

put members. Obviously, variations in the operating characteristics of the timing and control circuits will cause corresponding variations in the aforementioned periods of engagement and disengagement with the result that the spacing between printed lines will be unequal.

Smoother intermittent and continuous paper motion is secured in another type of paper advance system of the prior art by selectively coupling the paper to a motor through a slip-type clutch. The clutch basically includes a frictional input member coupled to the motor and a frictional output member coupled to the paper, the input and output members being frictionally engaged for coupling the paper to the motor. As before, the spacing between successively printed lines of information is determined entirely by the length of time the clutch members are engaged, the printed lines being single spaced by recurrently engaging the clutch members for equal periods of time and multiple spaced by engaging the members for proportionately longer periods of time.

A principal disadvantage of this prior art type of paper advance system is that friction is depended upon to engage the clutch output member to the input member. As a result, the output member slips with respect to the input member each time the clutch members are engaged and when the transmitted power becomes excessive so that digital positioning between them is lost. In other words, since the spacing between printed lines is determined solely by the period of engagement between the clutch members, slippage between the members results in unequal spacing of the lines. Consequently, intricate error detection and timing circuits must be employed in the system to determine at all times and take into account the extent of the slippage between the members and to correct for it.

Furthermore, it will be recognized that, as in the paper advance system utilizing a dog-type clutch, a system using a slip-type clutch inherently lacks the power to control the spacing between the lines to be printed. Accordingly, another disadvantage of a system employing a slip-type clutch is that the system must include complex timing and control circuits to measure and control the periods of engagement and disengagement of the circuits. As mentioned previously, variations in the operating characteristics of the timing and control circuits will produce corresponding variations in the periods of engagement and disengagement of the clutch members with the result that the spacing between printed lines will be unequal.

The present invention overcomes the above and other disadvantages of the paper advance systems of the prior art by providing a paper advance system that accurately advances the paper at high speeds either intermittently, one line at a time, or continuously, a selected number of lines, without tearing the paper. According to the basic concept of the invention, controlled paper motion is obtained by coupling the paper to a paper advance mechanism which, at all times during the printing operation, is coupled through a clutch mechanism to a source of mechanical energy. The paper advance mechanism utilizes the mechanical energy to normally cyclically advance the paper, each cyclical advance including a point of maximum speed, and, in response to an electrical pulse produced at a point of maximum speed of a selected cycle to continuously advance the paper a selected number of lines at the maximum speed.

More particularly, according to an embodiment of the present invention, a rotatable power shaft is drivingly coupled to a motor through a single-revolution clutch whose input and output members are engaged during the entire printing operation for continuously rotating the shaft at a constant speed. A spider arm is mounted on the power shaft and is selectively actuable under the control of an electro-mechanical detent mechanism for either rotating

3

with the power shaft or remaining fixed with respect to a frame member. A Geneva drive mechanism is coupled to the power shaft and the spider arm and is actuatable from either the power shaft or the arm, depending upon the energization of the detent mechanism, for advancing the paper either intermittently or continuously. Finally, a mechanical feedback mechanism is coupled between the arm and clutch for synchronizing the clutch with the output of the Geneva drive mechanism in such a manner that clutch disengagement and engagement for stopping and starting the motion of the paper, respectively, can only occur at a predetermined point in the printing cycle.

One of the principal advantages of the paper advance system of the present invention is that it advances the paper at high speed without tearing the paper. During intermittent paper advance, the paper is quickly brought from standstill to a relatively high maximum speed of advance and just as quickly returned to standstill. However, the paper is at first gradually accelerated from standstill and then rapidly accelerated until the paper attains the maximum speed following which the order of motion is reversed and the paper is at first rapidly and then gradually decelerated to standstill. It will be recognized that the gradual initial acceleration and final deceleration of the paper from and to standstill provide transitional periods of limited acceleration and deceleration which prevent the paper from being subjected to excessive tearing stresses. During a slewing operation, the paper is continuously advanced a plurality of lines at the maximum paper speed previously mentioned. However, the paper is accelerated to and decelerated from the maximum speed as during intermittent paper advance. Consequently, during the slewing period, the transition from standstill to the slewing speed and back again to standstill is accomplished smoothly, that is, with substantially no sudden acceleration or deceleration of the paper.

Another significant advantage inherent in the paper advance system of the present invention is that the spacing between lines to be printed can accurately be regulated. The Geneva drive mechanism includes a rotatable starwheel having a predetermined plurality of indexing stations and a rotatable crank having a pin which is engageable with the stations. During each revolution of the crank, the pin engages a station to rotate the starwheel exactly a predetermined number of degrees equal to $360^\circ/n$, where n is the number of stations of the starwheel. The paper is coupled to the starwheel and is intermittently advanced equal increments during the periodical rotations of the starwheel. Consequently, the present paper advance system equally spaces successively printed lines without the use of additional timing and control circuits required by the prior art paper advance systems.

An additional advantage of the paper advance system of the present invention is that clutch engagement and disengagement for starting and stopping the motion of the paper can only occur at a predetermined point in the printing cycle. Consequently, digital positioning of the paper is never lost by discontinuing the motion of the paper. Furthermore, by selecting a suitable point in the printing cycle for disengaging the clutch, ample time is at all times provided subsequent to engagement of the clutch for bringing the power shaft to its operational speed and for replenishing the memory storage device of the printer with information required for printing a line before the paper is advanced to the next line to be printed.

It is, therefore, an object of the present invention to provide an improved system for intermittently or continuously advancing a recording medium at high speeds.

It is another object of the present invention to provide a paper advance system for a printer wherein the paper is selectively advanced either intermittently, one line at a time, or continuously, a selected number of lines, while maintaining equal spacing between lines.

It is a further object of the present invention to provide

4

a paper advance system that selectively transforms the motion of a continuously rotating power shaft into intermittent or continuous motion of the paper.

It is an additional object of the present invention to provide a paper advance system wherein the paper is intermittently advanced by first gradually and then rapidly accelerating the paper from standstill to a relatively high predetermined maximum speed following which the paper is first rapidly and then gradually decelerated to standstill, the transitional periods of limited acceleration and deceleration permitting the paper to be advanced intermittently at high speeds without tearing by preventing the paper from being subjected to excessive tearing stresses.

It is still another object of the present invention to provide a paper advance system wherein the paper is slewed at the maximum speed attained by the paper during a cycle of intermittent paper advance, the high slewing speed of the paper being attained with a minimum of tearing stress by accelerating and decelerating the paper to and from the slewing speed, respectively, as in a cycle of intermittent paper advance.

It is yet another object of the present invention to provide a paper advance system that is actuated and deactuated only at a predetermined point in the printing cycle.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings in which an embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention.

Fig. 1 is a schematic diagram, partly in block form, of a paper advance system according to the present invention;

Fig. 2 is an elevation view, partly in cross-section, of the paper advance system shown in block form in Fig. 1;

Fig. 3 is a sectional view of the spider arm included in the paper advance system of Fig. 2 taken along the line 3—3 of Fig. 2;

Fig. 3a is a development of the outer surface of the section of the spider arm shown in Fig. 3 in the direction of arrow A;

Fig. 3b is a development of surface a, b, c, d, e, of the section of the spider arm shown in Fig. 3 in the direction of arrow B;

Fig. 4 is a sectional view of the Geneva drive mechanism of the paper advance system taken along the line 4—4 of Fig. 2;

Fig. 5 is a sectional view of a gear train forming part of the paper advance system taken along the line 5—5 of Fig. 2 and illustrates a contact type of sensing device;

Fig. 6 is a view in perspective of a photo-electric type of sensing device; and

Fig. 7 is a composite diagram illustrating the speed of the paper during various intermittent and continuous paper advance operations.

Referring now to the drawings, there is shown in Fig. 1 a high-speed paper-advance system 10, according to the present invention, for advancing a paper printing medium 11, such as a paper strip, upon which lines of information are printed, either intermittently, one line at a time, or continuously, a selected number of lines. High-speed paper-advance system 10 is operable in conjunction with a printer 12 and under the control of electrical pulses received from an electrical control network 13, and comprises two basic elements, namely; a paper advance mechanism 14 for advancing paper strip 11 either intermittently or continuously in response to electrical pulses selectively applied by control network 13, and a clutch mechanism

15 mechanically coupled both to printer 12 and paper advance mechanism 14 and responsive to an electrical pulse from the control network 13 for selectively inter-coupling the printer with the paper advance mechanism.

Control network 13 includes electronic circuits and mechanical components, not shown, for producing printing pulses representing the information to be printed, a control pulse for stopping and starting the paper advance, and a slewing pulse for continuously advancing printing strip 11 a selected number of lines. Broadly stated, the function of control network 13 is to selectively actuate printer 12 to print the desired information, and to synchronize the operation of the paper advance system with that of the printer. An example of the kind of circuits and components that may be used in control network 13 is disclosed in co-pending U. S. patent application, Serial No. 379,045, for "A High-Speed Printing System," by E. C. Nelson, filed September 8, 1953.

High-speed printer 12 is responsive to the printing pulses produced by control network 13 to print the desired information and includes four basic elements, namely; a drive mechanism, such as a motor 16, a rotatable printing cylinder 17 mechanically coupled to motor 16, a transducer network, including a plurality of selectively energizable printing transducers 18-1, 18-2 . . . 18-(n-2), 18-(n-1), and 18-n, and a traction mechanism 20. The printing transducers are positioned adjacent printing cylinder 17 and are adapted to cooperate with the printing cylinder for printing the desired information on paper printing strip 11, while traction mechanism 20 includes sprocket wheels coupled to printing strip 11 through sprocket holes 21 uniformly distributed along the sides of the printing medium and is energizable from paper-advance mechanism 14 for applying the necessary force to the printing medium to advance the printing medium either intermittently or continuously under the control of the paper-advance mechanism.

Printing transducers 18-1, 18-2 . . . 18-(n-2), 18-(n-1), and 18-n are operable under the control of control network 13 and are preferably of the type disclosed in co-pending U. S. patent application, Serial No. 377,818, for "High-Speed Electro-Mechanical Printing Transducers," by S. M. Fomenko et al., filed September 1, 1953, now Patent No. 2,766,686. These transducers are preferred because of their relatively high efficiency and their exceptionally high operating speeds. It will be recognized, however, that other printing transducers may be utilized with the high-speed paper-advance system of the invention.

Printing cylinder 17 is preferably continuously rotated by motor 16 and may be either a skewed-type printing cylinder, similar to that disclosed in co-pending U. S. patent application, Serial No. 360,998, for "Printing Cylinders for High-Speed Printing Systems," by R. A. Hartley, filed June 11, 1953, now Patent No. 2,776,618, or a conventional straight-line type in which rows of type characters are longitudinally disposed about the periphery of the printing cylinder. In each of these two basic forms of printing cylinders, one row of type characters is provided for each different type character which may be printed, each row including a plurality of identical type characters corresponding in number to the number of printing transducers employed in the printer.

Traction mechanism 20 is mechanically coupled to paper-advance mechanism 14 and includes a plurality of sprockets engageable with the sprocket holes in paper printing medium 11 for moving the paper in accordance with the actuation of the paper-advance mechanism. When paper-advance mechanism 14 is operated for either intermittent or continuous advance of the paper, traction mechanism 20 is driven either intermittently or continuously and paper printing medium 11 is correspondingly advanced either intermittently or continuously. Any conventional type of traction mechanism may be employed

with the present invention, such as the type known in the art as the Moore Formaliner which is commercially available from Moore Business Forms, Inc., of Niagara Falls, New York.

Referring now to Fig. 2, there is shown in detail paper-advance system 10, according to the invention, the system comprising, as previously stated, paper-advance mechanism 14 and clutch mechanism 15. Paper-advance mechanism 14 is responsive to rotation of an input shaft 22 for selectively rotating an output shaft 23 either intermittently or continuously under the control of the slewing pulse impressed on an input terminal 24 by electrical control network 13 shown in Fig. 1. Input shaft 22 is driven by motor 16 through printing cylinder 17, power shaft 94 and clutch mechanism 15 in a manner to be described in detail hereinafter. It will be recognized that input shaft 22 also constitutes the output drive member of clutch mechanism 15, while output shaft 23 is connected to traction mechanism 20, as shown in Fig. 1, for advancing the printing medium.

Essentially, paper-advance mechanism 14 includes a rotatable power shaft 25 drivingly coupled to input shaft 22 through a gear train 26; an arm, generally designated 27, mounted on shaft 25 and selectively actuatable under the control of an electro-mechanical detent mechanism, generally designated 28, for either rotating with shaft 25 or remaining fixed with respect to a fixed frame member 30; a Geneva drive mechanism, generally designated 31, which is coupled to output shaft 23 through a gear train 32 and which is actuatable from either shaft 25 through a gear train 33 or from arm 27, depending upon the energization of detent mechanism 28; and a mechanical feedback mechanism, generally designated 34, which is coupled between arm 27 and clutch mechanism 15 for synchronizing the clutch mechanism with the output of the paper advance mechanism in such a manner that clutch disengagement can only occur at a predetermined point in the paper advance cycle.

Power shaft 25 has a slot 35 machined therethrough, as shown in Figs. 2 and 3, and a hole 36 drilled in its right hand end and extending longitudinally from the end of the shaft to slot 35. In addition a blind hole 37 has been drilled in shaft 25 on the opposite end of slot 35, this hole extending toward the left-hand end of the shaft, as viewed in Fig. 2.

Arm 27 is rotatably mounted on shaft 25 and includes a body member 38 having an annular inner chamber 40 that surrounds shaft 25 adjacent slot 35, as shown in Fig. 2. Arm 27 may selectively be held either rigidly in position relative to frame 30 or fixed to the shaft for rotation therewith, and for this purpose includes an outer cam 41 integral with body member 38 and having a plurality of outer detents 42, and an inner cam 43 integral with body member 38 and having an inner detent 44. These cams and their associated detents are shown more clearly in Figs. 3, 3a, and 3b, Fig. 3 being a sectional view taken through plane 3-3 in Fig. 2. Arm 27 also includes a gear 45 fixed on body member 38 and coupled through mechanical feedback mechanism 34 to clutch mechanism 15.

Referring to Fig. 3, it will be noted that outer cam 41 is substantially of spiral curvature between outer detents 42, while Fig. 3b illustrates that inner cam 43 has a graduated approach 46 and a graduated exit 47 to and from, respectively, inner detent 44. The significance of the number of outer detents 42, the spiral curvature of outer cam 41, and graduated entrance 46 and exit 47 to and from inner detent 44 will be explained more fully below in connection with the operation of the paper advance system.

Electro-mechanical detent mechanism 28 includes a plunger type solenoid 48, an outer catch 50 positioned adjacent the outer cam of arm 27 and adaptable to engage the detents therein, and a plurality of links, generally designated 51, which mechanically couple the outer catch

to the solenoid plunger. Links 51 are mounted on linkage pins such as pins 52 and 53 and are operable upon movement of the solenoid plunger in the direction of arrow 54 to move outer catch 50 into engagement with a preselected one of outer detents 42 on arm 27, as shown in Fig. 3.

Detent mechanism 28 also includes a push rod 55 which is movable in hole 36, a spring actuated plunger 56 slidably mounted in blind hole 37, and a key 57 rotatably mounted in the slot 35 of shaft 25 by a pin 58, push rod 55 being connected to one end of links 51 and being movable forward or backward substantially along the axis of power shaft 25 when solenoid 48 is energized or de-energized. Key 57 is maintained in substantially point contact with the left hand end of push rod 55 by the action of spring plunger 56, as shown in Fig. 2, and is selectively moveable out of or into engagement with inner detent 44 by the push rod when solenoid 48 is either energized or de-energized.

Geneva drive mechanism 31 is mechanically coupled to power shaft 25 and arm 27 and selectively transforms the rotational motion of the shaft into either intermittent or continuous motion of the printing medium depending upon whether solenoid 48 is energized or de-energized. More specifically, Geneva drive mechanism 31 comprises a drive unit, generally designated 60, which includes a shaft 61 rotatably journaled at one end of arm 27, a Geneva crank, generally designated 62, integral with the other end of shaft 61, and a gear 63 rigidly mounted on shaft 61 and in mesh with a gear 64 rigidly mounted on shaft 25. Geneva crank 62, in turn, includes a body member 65 and a drive pin 66 protruding from the body member, pin 66 being rotatable about the axis of shaft 61 in accordance with the rotation of the shaft, the rotational speed of pin 66 and shaft 61 being determined by the rotational speed of shaft 25 and the gear ratio of gears 63 and 64.

Geneva drive mechanism 31 also includes a driven member, generally designated 67, rotatably mounted on shaft 25, driven member 67 comprising a Geneva star wheel 68 and a gear 70 fixed thereto, gear 70 constituting a portion of output gear train 32 for intercoupling the paper traction mechanism with the Geneva star wheel. Geneva star wheel 68, as shown in greater detail in Fig. 4, includes a plurality of indexing stations 71, each of the stations being sequentially engageable with pin 66 in a manner such that each revolution of shaft 25 rotates the star wheel a predetermined number of degrees equal to 360 degrees divided by the number of stations. Rotation of the star wheel through this predetermined number of degrees, in turn, results in actuation of traction mechanism 20, shown in Fig. 1, to advance printing medium 11 one line.

Mechanical feedback mechanism 34 includes a gear train 72 and a feedback shaft 73 which is coupled through the gear train to arm 27; more particularly, gear train 72 comprises a driven gear 74 fixedly mounted on feedback shaft 73 and an idler gear 75 rotatably mounted on input shaft 22, idler gear 75 being meshed both to driven gear 74 and to gear 45 of arm 27 for coupling the feedback shaft to the arm, as mentioned above.

In addition to the basic structure of paper advance mechanism 14 as set forth above, the paper advance mechanism preferably also includes a sensing device for synchronizing the position of paper printing medium 11 to the system printing cycle as will be described more fully below. Two different types of sensing devices have been found to be readily utilizable with the paper advance system of the present invention, one type being termed a contact type sensing device and the other type being termed a photoelectric type sensing device.

One suitable type of contact type sensing device is shown in Fig. 5 and includes a pair of gears, which may be gears 63 and 64 shown in Fig. 2, each gear 63 and 64 having on its lateral surface a conducting ring 76 and

77, respectively. Ring 76 is electrically coupled through a first brush contact 78 to a source of positive potential, such as a battery 80, the negative terminal of the battery being grounded, as shown. Ring 77 is electrically connected through a second brush contact 81 to an output terminal 82 which is connected to control network 13.

The teeth of gear 64, except for tooth 82, and the teeth of gear 63, except for portions of adjoining teeth 83 and 84, are made of an electrically insulating material, while tooth 82 and the aforementioned portions of teeth 83 and 84 are made of an electrically conducting material, as shown in Figs. 2 and 5. Furthermore, gears 63 and 64 are meshed together in such a manner that tooth 82 meshes once with teeth 83 and 84 during each revolution of the gears, thereby completing the electrical circuit between battery 80 and control network 13 to cause an electrical signal to be applied to the control network. By properly relating the meshing of the electrically conductive teeth with the actuation of the Geneva drive mechanism, the electrical signal may be made to coincide in time with the completion of the advance of paper printing medium 11. Consequently, the electrical signal may be used in control network 13 to indicate when the printing signals produced by the control network are to be applied to the associated printing transducers for printing the next line of information on the paper printing medium.

Referring now to Fig. 6, there is shown a perspective view of one form of a photoelectric type of sensing device which may be employed with the paper advance mechanism of the invention. This sensing device comprises a disk 85 secured to power shaft 25 and having a plurality of evenly spaced radial slits 86 cut in its periphery, the number of slits preferably being equal to the number of indexing stations in star wheel 68. This sensing device also includes a source of light 87 for projecting a thin beam of light toward the periphery of disk 85 and a photocell 88 disposed on the opposite side of the disk, the photocell being electrically connected between ground and an output terminal 90 which is connected to control network 13. Photocell 88 is responsive to light passed through the slits in disk 85 for applying electrical pulses to the control network. Disk 85 is fixed to shaft 25, as shown schematically in Fig. 6, and is rotatable in accordance with rotation of star wheel 68. In order to provide proper timing between the indexing movement and the light beam, the relative position of light source 87 and photocell 88 with respect to slits 86 of disk 85 is such that the beam normally impinges upon disk 85 midway between neighboring slits and is allowed to impinge upon photocell 88 only when a slit is rotated past the beam. As will be understood more completely from the description of operation set forth below, a slit is directly beneath the light beam midway during the advance of paper printing medium 11 to the next line to be printed, at which time the light beam impinges upon the photocell and an electrical pulse is applied to control network 13.

It will be recognized that although the electrical pulse is generated prior to the completion of the paper advance operation, the pulse may be delayed by a suitable delay network, not shown, so that the electrical pulse corresponds to any selected instant in the printing cycle, such as the moment the paper completes its advance to the next line to be printed. Accordingly, the electrical pulse may be used in control network 13 to indicate when the printing signals, produced by the control network, are to be applied to the printing transducers for printing the next line of information.

Referring again to paper advance system 10 of Fig. 2, clutch mechanism 15, which is mechanically coupled, as previously explained, between paper advance mechanism 14 and type cylinder 17 shown in Fig. 1, essentially comprises a single-revolution clutch, generally designated 91, for obtaining automatic, positive, substantially non-slipping motor drive for the paper advance mechanism and which permits rotation of the driven part in one direction

only, and a clutch disengage mechanism, generally designated 92, for disconnecting the paper advance mechanism from its motor drive at a predetermined point in the cycle of operation.

Single-revolution clutch 91 is shown schematically and includes an input driving member 93 fixedly mounted on a driving shaft 94 which connects the driving member through type cylinder 17 to motor 16 and an output or driven member 95 fixedly attached to input shaft 22 which connects the driven member to the paper advance mechanism through output shaft 23. Clutch 91 also includes a plurality of clutch rollers 96 positioned between driving and driven members 93 and 95 and a rotatable clutch cage 97 for selectively positioning clutch rollers 96 to either drivingly couple driving member 93 to driven member 95 or to disengage the driving and driven members. In addition, a trip pin 98 is attached to clutch cage 97 substantially as shown and is rotatable with the clutch cage about shaft 22 when the driving and driven members of the clutch are engaged. Illustrations and descriptions of several different types of single-revolution clutches which may be utilized in the system of the invention, together with auxiliary mechanisms, may be found in the brochure, entitled "The Hilliard Single-Revolution Clutch," Bulletin 239, published by the Hilliard Corporation of Elmira, New York.

Clutch disengage mechanism 92 includes a gear 100 slidably journaled on input shaft 22 and coupled to feedback shaft 73 through a spur gear 101 fixedly mounted on the feedback shaft. A collar 102 is fixed to one side of gear 100 and a stop pin 103 is integral with and extends from the other side of gear 100. Collar 102 is coupled through a mechanical linkage 104 to a plunger type of solenoid 105 which is responsive to the electrical control pulse applied to an input terminal 106 by control network 13 of Fig. 1 for sliding gear 100 along shaft 22 until the gear butts against a pair of pimples 107 on the shaft. As a result, stop pin 103 is projected into the path of rotation of trip pin 98, the engagement of pins 98 and 103 resulting in the decoupling of driving and driven members 93 and 95, respectively, by disengaging clutch rollers 96 from the driving and driven members, thereby disconnecting paper-advance mechanism 14 from its motor drive. It should be noted that in order to properly reference single-revolution clutch 91 with output shaft 23, the gear ratio between gear 100 and gear 45 of arm 27 preferably is 1:1.

In discussing the operation of the paper-advance system shown in Fig. 2, it will arbitrarily be assumed as an initial operating condition that paper advance mechanism 14 is coupled through clutch mechanism 15 and type cylinder 17 to motor 16 and that paper printing medium 11 is being advanced intermittently, one line at a time. Accordingly, shaft 25 of paper advance mechanism 14 is rotating at a constant speed and arm 27 is held in a fixed position with respect to the shaft by electro-mechanical detent mechanism 28. More specifically, solenoid 48 is de-energized so that outer catch 50 is engaged with one of outer detents 42 of outer cam 41 as shown in Fig. 3. Simultaneously, key 57 is maintained in its disengaged position with respect to inner detent 44 of inner cam 43 by push rod 55 which has been pushed forward in hole 36 by the de-energized solenoid.

Owing to the fact the arm 27 is held stationary with respect to frame 30 during intermittent paper advance, gears 63 and 64 function to rotate drive member 60 of Geneva drive mechanism 31 at a constant speed about the axis of shaft 61. Accordingly, pin 66 of drive member 60 is rotated at a constant speed about the axis of shaft 61 and, during each revolution, engages a station 71 of Geneva starwheel 68 to rotate the starwheel a predetermined number of degrees equal to $360^\circ/n$, where n is the number of stations in the starwheel. Intermittent rotation of starwheel 68, in turn, results in intermittent rotation of output shaft 23 so that paper

traction mechanism 20 of Fig. 1 is intermittently actuated to intermittently advance paper printing medium 11 past the printing transducers, the paper being advanced one line for each intermittent motion of the starwheel.

During the rotation of starwheel 68 and the advance of paper printing medium 11, both the starwheel and the paper are accelerated from standstill to a maximum speed and then decelerated to standstill. These variations in speed are shown by curve 108 in Fig. 7 and, as may be seen therefrom, prior to instant t_1 , which represents the initial engagement of a starwheel station by pin 66, starwheel 68 and paper 11 are at zero speed and a line of information is being printed upon the paper. At instant t_1 , a starwheel station 71 is engaged by pin 66, at which instant starwheel 68 and paper 11 are accelerated until they reach a maximum speed at instant t_2 , as indicated by point 110 of curve 108.

Following instant t_2 , starwheel 68 and paper printing medium 11 are decelerated until, at instant t_3 , the starwheel and the paper are again at zero speed. It should be noted that point 110 is midway between instants t_1 and t_3 and that, at point 110, starwheel 68 is rotating about the axis of shaft 25 at the same speed as the shaft. Between instants t_3 and t_4 , starwheel 68 and paper printing medium 11 remain at zero speed, that is, stationary, and control network 13 applies printing signals to the printing transducers for printing information upon the line to which the paper has been advanced. At instant t_4 , the line of information has been printed and starwheel 68 and paper 11 are again accelerated and decelerated, as previously described for the time interval from t_1 to t_3 . Thus, each cycle of intermittent operation comprises first and second intervals of time, a first interval for printing information upon the paper printing medium and a second interval for advancing the paper to the next line to be printed.

It should be noted that if paper advance mechanism 14 includes a contact type of sensing device, such as that shown in Fig. 5, an electrical pulse is produced by the sensing device and applied to control network 13 at the end of the second time interval, that is, at instant t_3 , to indicate that the printing signals produced by the control network should be applied to the printing transducers. On the other hand, if paper advance mechanism 14 includes a photoelectric type of sensing device, such as that shown in Fig. 6, the electrical pulse produced by the sensing device is applied to control network 13 in the middle of the second time interval, that is, at instant t_2 . Since point 110 of curve 108, as shown in Fig. 7, coincides in time with instant t_2 , it will at once be recognized that the electrical pulse produced by the sensing device coincides in time with point 110 at which time starwheel 68 and paper 11 have attained their maximum speed of rotation and advance, respectively.

When the photo-electric sensing device is utilized, control network 13 preferably includes a delay network, such as an electronic counter supplied with suitable timing pulses, for measuring off the time interval from t_2 to t_3 to indicate when the paper advance operation has been completed and when the printing signals produced by the control network may be applied to the printing transducers.

Consider now the operation of paper advance mechanism 14 when it is desired to slew the paper printing medium, that is, to continuously advance the paper a selected number of lines from the last line of information printed. For purposes of description, reference is made to curve 111 of Fig. 7 which illustrates the variations of speed of starwheel 68 and paper strip 11 during a specific slewing operation in which the paper is continuously advanced two lines from the last line printed. Accordingly, at instant t_5 arm 27 is held in a fixed position with respect to shaft 25 and a complete line of information has been printed on paper printing medium 11. Furthermore, at instant t_5 a station 71 is

initially engaged by pin 66 and starwheel 68 and paper 11 are accelerated from standstill at instant t_5 to a maximum speed of rotation and advance, respectively, at instant t_6 , as shown by point 112 on curve 111 and as previously described for time interval t_1 to t_2 of curve 108.

Assume now that during the interval between instant t_5 and instant t_6 , preferably not too close to instant t_6 , a slewing pulse is applied to input terminal 24 by control network 13 of Fig. 1 to energize solenoid 48. When solenoid 48 is energized, links 51 of electro-mechanical detent mechanism 28 move toward the right and hence function to try to move outer catch 50 out of engagement with outer detent 42 of outer cam 41, as shown in Figs. 3 and 3a. Simultaneously, links 51 tend to rotate key 57 into engagement with inner detent 44 of inner cam 43 by partially withdrawing push-rod 55 from hole 36.

It will be recognized, however, from Figs. 2, 3a and 3b, that catch 50 cannot move out of engagement with outer detent 42 until key 57 is engaged with inner detent 44. It will also be recognized that key 57 cannot engage detent 44 until the key, which is rotating with shaft 25, is aligned with inner detent 44, which is held stationary by virtue of the stationary position of arm 27. Accordingly, if the slewing pulse is applied immediately after instant t_5 (Fig. 7) key 57 is urged forward into engagement with graduated approach 46, as shown in Fig. 3b, and slides in the direction of arrow 120 along the approach until the key is aligned with inner detent 44 at instant t_6 , at which time the key slides into the inner detent to rigidly connect arm 27 to shaft 25 while catch 50 is moved clear of outer detent 42. Hence, arm 27 will now rotate with shaft 25.

The engagement of arm 27 with power shaft 25 forces the arm and drive member 60 mounted on the arm to rotate with shaft 25 at the same constant rotational speed of the shaft. Consequently, pin 66, which is engaged with a starwheel station 71, locks the starwheel to shaft 25 through drive member 60 and arm 27 and causes the starwheel to rotate at the speed of the shaft. Moreover, since the maximum speed of rotation attained by starwheel 68 at instant t_6 is equal to the speed of shaft 25, the locking of the starwheel with the shaft is accomplished smoothly, that is, with substantially no acceleration of the starwheel or the paper traction mechanism.

It will be noted that if paper printing medium 11 is continuously advanced two lines, the constant rotational speed of the starwheel is only maintained for a period sufficient to advance the printing medium one line, since the acceleration and deceleration periods of the starwheel each function to advance the paper one half a line. Consequently, after instant t_6 , starwheel 68 is rotated at the speed of shaft 25 and paper 11 is concomitantly uniformly advanced at a maximum speed until instant t_7 , corresponding to point 113 of curve 111, at which time the paper has been advanced one and one half lines since instant t_5 . After instant t_7 , the starwheel, the paper traction mechanism, and the paper are again decelerated to a point of zero velocity at instant t_8 in a manner to be presently explained, the deceleration period serving to advance the paper a final half line so that its total advance equals the desired two lines.

Consider now the operation of paper advance mechanism 14 in switching from uniform paper advance prior to instant t_7 to a decelerating advance after instant t_7 . At some point during the interval between instants t_6 and t_7 , preferably not too close to instant t_7 , the slewing pulse applied to input terminal 24 by electrical control network 13 is terminated and solenoid 48 is again de-energized, the de-energized solenoid tending to move catch 50 into engagement with a detent 42 of outer cam 41 and to move key 57 out of engagement with inner detent 44 of inner cam 43, as shown in Figs. 3, 3a and 3b. Accordingly, key 57 starts to move out of inner detent 44 but is restrained from leaving the detent com-

pletely by reason of the fact that catch 50 rides along one of the spirally curved surfaces of outer cam 41 until catch 50 is aligned with an outer detent 42.

It should be pointed out that in the present instance, wherein the paper is being slewed two lines, the outer detent engaged will be the one following the detent which was disengaged prior to instant t_6 . It should also be pointed out that catch 50 engages the outer detent at the precise instant that the paper has completed an advance of one line at uniform speed, this instant being instant t_7 .

Graduated exit 47, as shown in Fig. 3b, is designed so that key 57 is moved free of inner detent 44 at the same time that outer catch 50 initially engages outer detent 42, thereby precluding the possibility that either the outer catch or the key will be broken by being engaged at the same time. Thus, as outer catch 50 engages an outer detent 42, key 57 is simultaneously permitted to disengage from inner detent 44, graduated exit 47 thereafter functioning to push key 57 to its normal position in slot 35 as shown in Fig. 2, and, through the intercoupling of links 54, to push catch 50 deeper into the outer detent with which it has become engaged. Consequently, the engagement of catch 50 with an outer detent results in the disengagement of arm 27 from shaft 25 and returns the arm to its stationary position.

It will be remembered that at instant t_6 , that is, at the instant starwheel 68 was locked through drive member 60 and arm 27 to shaft 25, pin 66 was completely within station 71, as shown in Fig. 4. Pin 66 remains in this position relative to the starwheel during the time interval from t_6 to t_7 , and is permitted to withdraw from the station only after instant t_7 when arm 27 is disengaged from shaft 25. At instant t_7 , therefore, drive member 60 begins to rotate about the axis of shaft 61 and pin 66 begins its withdrawal from the starwheel station, thereby decelerating the starwheel and, consequently, paper printing medium 11. Starwheel 68 and paper 11 are smoothly decelerated from a maximum speed of rotation and advance, respectively, at instant t_7 , to standstill at instant t_8 , as previously discussed for the time interval from t_2 to t_3 of curve 108, thereby completing the slewing operation in which the paper is continuously advanced two lines.

Assuming that the contact type of sensing device shown in Fig. 5 is being used with paper advance mechanism 14, the sensing device applies a pulse to control network 13 at instant t_8 to indicate that the printing pulses produced by the control network may be applied to printing transducers 18-1, 18-2, . . . 18-(n-2), 18-(n-1), 18-n to print the next line of information. Starwheel 68 and paper printing medium 11 remain stationary from instant t_8 until instant t_9 and, during this period which has heretofore been termed the first time interval, the line of information is printed. Following instant t_9 , paper 11 may again be intermittently advanced, as illustrated by that portion of curve 111 shown between instants t_9 and t_{10} and as previously discussed in connection with the operation of the paper advance mechanism during intermittent paper advance.

It will be obvious from the foregoing discussion of a slewing operation, in which paper printing medium 11 was continuously advanced two lines, that paper advance system 14 may be employed to slew the printing medium any desired number of lines. Curve 114 in Fig. 7, for example, is illustrative of a slewing operation in which paper printing medium 11 is continuously advanced three lines. It will be noted from curve 114 that the paper is accelerated from a stationary position at instant t_{11} to a maximum speed of advance at instant t_{12} , advanced two lines at this maximum speed until instant t_{13} , and then decelerated to a stationary position at instant t_{14} in the manner previously described.

It should be noted that an inherent characteristic of Geneva drive mechanism 31 is that the maximum speed of rotation to which starwheel 68 is accelerated is ap-

proximately twice the average speed of rotation of the starwheel during an intermittent rotation period in which paper printing medium 11 is advanced one line. In other words, with reference to curve 108 of Fig. 7, at point 110, corresponding to instant t_2 , the speed of rotation of starwheel 68 is twice the average speed of rotation of the starwheel during the time interval between instants t_1 and t_3 .

In a similar manner, it will be recognized that the maximum speed of advance to which paper printing medium 11 is accelerated is twice the average speed of the paper during one intermittent paper advance period. Accordingly, in the interval between the initial and final periods of acceleration and deceleration of the paper during a slewing operation, the paper is advanced two lines in the time required to advance the paper one line during intermittent motion. For example, paper printing medium 11 is advanced two lines during the time interval from t_{12} to t_{13} of curve 114 and is advanced only one line during the time interval from t_1 to t_3 of curve 108, although the two time intervals are equal. Since shafts 25 and 61 may be rotated at very high speeds and since starwheel 68 may have a relatively large number of drive or indexing stations, it will at once be obvious that the paper advance system of the invention provides the high-speed paper advance required for modern high-speed printers.

Continuing now with the operation of paper advance system 10 as shown in Fig. 2, assume that paper printing medium 11 is again being intermittently advanced one line at a time and that it is desired to entirely discontinue or stop the motion of the paper. Accordingly, referring to clutch mechanism 15, a control pulse is applied to input terminal 106 by control network 13 of Fig. 1 for de-energizing solenoid 105. In response thereto, linkage 104 is rotated toward clutch 91 to slide gear 100 against pimples 107. As a result, stop pin 103 is projected into the path of rotation of trip pin 98, the engagement of pins 98 and 103 resulting in the decoupling of driving and driven members 93 and 95, thereby disconnecting the paper advance mechanism from its source of power.

Prior to stopping the paper motion and while the paper is being intermittently advanced, trip pin 98 of clutch mechanism 15 and pin 66 of Geneva drive mechanism 31 are rotating at the same speed around shafts 22 and 61, respectively, pin 98, as shown in Fig. 2, being at a high point in its circular path around shaft 22 when pin 66 is completely in a station of starwheel 68 and, 180 degrees later, at a low point in its path when pin 66 is at the furthest point from a starwheel station. Furthermore, stop pin 103 is positioned relative to trip pin 98 so that engagement of pins 98 and 103 can occur only when pin 98 is at a low point in its path. Accordingly, driving and driven members 93 and 95 are decoupled and pin 66 ceases to rotate only when pin 66 is at the furthest point in its path from a starwheel station.

During a slewing operation, when arm 27 rotates Geneva drive mechanism 31 a selected number of degrees around shaft 25, as previously explained, arm 27, acting through feedback mechanism 34, also rotates gear 100 an equal number of degrees around shaft 22 in the same direction as that of the Geneva drive mechanism. Consequently, the above-mentioned positional relationship between pins 98 and 103 is maintained and, upon a return to intermittent paper advance, the engagement of pins 98 and 103 can occur only when pin 66 is at the furthest point in its path from a starwheel station.

When it is desired to again print information on paper printing medium 11, a control signal is again applied to input terminal 106 by control network 13 of Fig. 1, and in response thereto, solenoid 105 is energized to rotate linkage 104 away from clutch 91. As a result, trip pin 98 is disengaged from stop pin 103 and driving member 93 is coupled to driven member 95. Thus, the paper advance mechanism is coupled to its source of power and

pin 66 commences to rotate from its stopping point toward a station of starwheel 68, the interval of time elapsing until the paper is advanced to the next line to be printed being used to replenish the memory storage device of the printer with the information to be printed and to bring shaft 25 to its constant operational speed.

What is claimed as new is:

1. A system for advancing a recording medium upon which lines of information are to be recorded, said system comprising: a source of mechanical energy; mechanism mechanically coupled between the recording medium and said source for normally cyclically advancing the recording medium one line at a time, each cyclical advance including a point of maximum velocity; and means for producing a signal at a selected one of said points of maximum velocity, said mechanism being coupled to said means and operable in response to said signal for continuously advancing the recording medium a selected number of lines at said maximum velocity.

2. In a high speed printer wherein lines of information are to be printed on a printing medium, a system for advancing said printing medium, said system comprising: electrical control means for producing first and second signals; a source of mechanical energy; drive means mechanically coupled to the printing medium and electrically coupled to said electrical control means, said drive means being energizable from said source for cyclically advancing the printing medium one line at a time and, in response to said first signal, for continuously advancing the printing medium a selected number of lines; and clutch means mechanically coupled between said source and said drive means for normally energizing said drive means, said clutch means being operable in response to said second signal for de-energizing said drive means.

3. In a high speed printer wherein lines of information are to be printed on a printing medium, a system for advancing said printing medium, said system comprising: electrical control means for producing first and second signals; a source of mechanical energy; drive means mechanically coupled to the printing medium and electrically coupled to said electrical control means, said drive means being energizable from said source for cyclically advancing the printing medium one line at a time and, in response to said first signal, for continuously advancing the printing medium a selected number of lines, each cyclical advance of the medium including first and second predetermined intervals of time, a line of information being printed during said first interval of time and the printing medium being advanced to the next line to be printed during said second interval of time; and clutch means mechanically coupled between said source and said drive means for normally energizing said drive means, said clutch means being operable in response to said second signal for de-energizing said drive means.

4. The system defined in claim 3 wherein said clutch means includes selectively operable decoupling means responsive to said second signal for de-energizing said drive means at a predetermined instant during said first interval of time.

5. The system defined in claim 4 wherein said drive means includes feedback means coupled to said decoupling means for synchronizing said decoupling means with the advance of the printing medium in such a manner that de-energization of said drive means can only occur at the predetermined instant during said first interval of time.

6. In a high speed printing system for printing lines of information upon a printing medium, each line having a predetermined plurality of characters, the combination comprising: electrical control means for producing printing and slewing pulses; a plurality of printing transducers corresponding to the plurality of characters in a line of information to be printed and electrically connected to said control means, said transducers being positioned adjacent one surface of the printing medium in a plane ex-

tending through the printing medium along the line to be printed and selectively energizable in response to said printing pulses for striking said adjacent surface of the printing medium; a printing cylinder rotatable about an axis in the plane of said transducers, said cylinder being positioned adjacent the other surface of the printing medium and having a series of rows of type characters longitudinally disposed about the periphery thereof, each of said rows corresponding to a different character to be printed and including a plurality of identical type characters corresponding to said plurality of transducers; means mechanically coupled to said printing cylinder for rotating said cylinder at a constant speed to sequentially pass each row of type characters beneath said transducers; and drive means mechanically coupled between the printing medium and said printing cylinder for cyclically advancing the printing medium one line at a time, said drive means being selectively operable in response to said slewing pulses for continuously advancing the printing medium a selected number of lines.

7. In a high speed printing system for printing lines of information upon a printing medium, each line having a predetermined plurality of characters, the combination comprising: electrical control means for producing printing and slewing pulses; a plurality of printing transducers corresponding to the plurality of characters in a line of information to be printed and electrically connected to said control means, said transducers being positioned adjacent one surface of the printing medium in a plane extending through the printing medium along the line to be printed and selectively energizable in response to said printing pulses for striking said adjacent surface of the printing medium; a printing cylinder rotatable about an axis in the plane of said transducers, said cylinder being positioned adjacent the other surface of the printing medium and having a series of rows of type characters longitudinally disposed about the periphery thereof, each of said rows corresponding to a different character to be printed and including a plurality of identical type characters corresponding to said plurality of transducers; means mechanically coupled to said printing cylinder for rotating said cylinder at a constant speed to sequentially pass each row of type characters beneath said transducers; and drive means mechanically coupled between the printing medium and said printing cylinder for cyclically advancing the printing medium one line at a time, each cyclical advance including a first interval of time for printing a line of information and a second interval of time for accelerating the medium from zero speed to a maximum and thereafter decelerating the medium again to advance the medium to the next line to be printed, said drive means being selectively operable in response to a slewing pulse produced at an instant of maximum speed in a selected cycle to continuously advance the printing medium at said maximum speed for a selected number of lines.

8. The combination defined in claim 7 wherein said drive means includes sensing means for producing an electrical pulse at the end of said second interval of time.

9. The combination defined in claim 7 wherein said drive means includes sensing means for producing an electrical pulse at an instant of time during said second interval of time having a fixed time relationship with respect to the end of said second interval.

10. In a paper advance system wherein the paper is normally intermittently advanced one line at a time and, in response to a slewing signal, continuously advanced a selected number of lines, a paper advance mechanism, said mechanism comprising: a shaft rotatable about its axis; a source of power coupled to said shaft for rotating said shaft about said axis at a constant speed; an arm rotatably mounted on said shaft; means for selectively holding said arm stationary on said shaft or fixing said arm to said shaft for rotation therewith, said means normally holding said arm stationary and being responsive to the slewing signal

for fixing said arm to said shaft to rotate said arm about said axis at said constant speed; and paper advance means mechanically coupled to said shaft and said arm for advancing the paper, said paper advance means intermittently advancing the paper one line at a time when said arm is held stationary by said means and continuously advancing the paper the selected number of lines when said arm is fixed to said shaft by said means.

11. In a paper advance system wherein the paper is normally intermittently advanced one line at a time and, in response to a slewing signal, continuously advanced a selected number of lines, a paper advance mechanism, said mechanism comprising: a shaft rotatable about its axis; input means coupled to said shaft for rotating said shaft about said axis at a constant speed; an arm rotatably mounted on said shaft; electro-mechanical means for selectively holding said arm stationary on said shaft or fixing said arm to said shaft for rotation therewith, said electro-mechanical means normally holding said arm stationary and being responsive to the slewing signal for fixing said arm to said shaft to rotate said arm about said axis at said constant speed; and output means mechanically coupled to said shaft and said arm for advancing the paper, said output means intermittently advancing the paper one line at a time when said arm is held stationary by said electro-mechanical means and continuously advancing the paper the selected number of lines when said arm is fixed to said shaft by said electro-mechanical means.

12. In a paper advance system wherein the paper is normally intermittently advanced one line at a time and, in response to a slewing pulse, continuously advanced a selected number of lines, a paper advance mechanism, said mechanism comprising: a shaft rotatable about its axis; input means mechanically coupled to said shaft for rotating said shaft about said axis at a constant speed; an arm rotatably mounted on said shaft; electro-mechanical means for selectively holding said arm stationary on said shaft or for fixing said arm to said shaft for rotation therewith, said electro-mechanical means normally holding said arm stationary and being responsive to the slewing pulse for fixing said arm to said shaft to rotate said arm with said shaft at said constant speed; a driven member rotatably mounted on said shaft and mechanically coupled to the paper for advancing the paper, said driven member being periodically rotatable through a fixed predetermined angle to intermittently advance the paper one line at a time and being rotatable through a selected angle corresponding to the selected number of lines for continuously advancing the paper the selected number of lines; and driver means rotatably mounted on said arm and mechanically coupled to said shaft for periodically rotating said driven member through said fixed predetermined angle and for rotating said driven member through said selected angle, said driver means having a driver axis and being rotated about said driver axis for periodically rotating said driven member through said fixed predetermined angle when said arm is held stationary by said electro-mechanical means and being rotated about said shaft axis for rotating said driven member through said selected angle when said arm is fixed to said shaft by said electro-mechanical means.

13. The paper advance mechanism defined in claim 12 wherein said driven member further includes electrical contact means for periodically producing an electrical pulse corresponding to a predetermined instant during each intermittent advance of the paper.

14. The paper advance mechanism defined in claim 12 wherein said mechanism further includes photo-electric sensing means coupled to said driven member for producing an electrical pulse at a predetermined instant during each intermittent advance of the paper.

15. In a paper advance system wherein the paper is normally cyclically advanced one line at a time and, in response to a slewing signal, continuously advanced a

17

predetermined number of lines, a paper advance mechanism, said mechanism comprising: a fixed frame; a shaft rotatable about its axis; input means mechanically coupled to said shaft for rotating said shaft about said axis at a constant speed; an arm rotatably mounted on said shaft; electro-mechanical means for selectively connecting said arm to said frame or to said shaft, said electro-mechanical means normally connecting said arm to said frame and being responsive to the slewing pulse for simultaneously disconnecting said arm from said frame and connecting said arm to said shaft; a Geneva starwheel rotatably mounted on said shaft and mechanically coupled to the paper; and driver means rotatably mounted on said arm and mechanically coupled to said shaft, said driver means rendering said Geneva starwheel operable to cyclically advance the paper when said arm is connected to said frame and to continuously advance the paper for the selected number of lines when said arm is rigidly connected to said shaft.

16. The paper advance mechanism defined in claim 15 wherein said arm includes an outer cam having a predetermined number of outer detents and an inner cam having an inner detent.

17. The paper advance mechanism defined in claim 15 wherein said electro-mechanical means includes a solenoid, an outer catch and an inner catch coupled to said solenoid and operable thereby, said outer catch being rotatably connected to said frame for connecting said arm to said frame, and said inner catch being rotatably connected to said shaft for connecting said arm to said shaft.

18. The paper advance mechanism defined in claim 15 wherein said arm includes an outer cam having a predetermined number of outer detents and an inner cam having an inner detent; and said electro-mechanical means includes an outer catch rotatably connected to said frame and being engageable with said outer detents, said outer catch normally being engaged with one of said outer detents, an inner catch rotatably connected to said shaft and being engageable with said inner detent, said inner catch normally being disengaged from said inner detent, and a solenoid coupled to said catches and responsive to the slewing signal for disengaging said outer catch from said one outer detent and simultaneously engaging said inner catch with said inner detent.

19. A high speed paper advance system energizable from a source of mechanical energy for selectively advancing the paper cyclically, one line at a time, and in response to a slewing pulse, continuously, a selected number of lines, said system being operable in response to a control pulse for stopping said paper at a predetermined point in the cyclical advance of said paper, said system comprising: a shaft energizable from the source for rota-

18

tion at a constant speed about its axis; a clutch mechanically coupled between the source and said shaft for normally energizing said shaft, said clutch being operable in response to the control pulse for de-energizing said shaft; an arm rotatably mounted on said shaft; electro-mechanical means for selectively holding said arm stationary with respect to said shaft or for fixing said arm to said shaft, said electro-mechanical means normally holding said arm stationary and being responsive to the slewing pulse for fixing said arm to said shaft to rotate said arm with said shaft at said constant speed; output means mechanically coupled to said shaft and said arm for advancing the paper, said output means including mechanism for intermittently advancing the paper one line at a time when said arm is held stationary by said electro-mechanical means or for continuously advancing the paper the selected number of lines when said arm is fixed to said shaft by said electro-mechanical means; and mechanical feed back means connected between said arm and said clutch for synchronizing said clutch with the advance of the paper in such a manner that de-energization of said shaft can only occur at the predetermined point in the cyclical advance of the paper.

20. The system defined in claim 19 wherein the mechanism of said output means includes a driven member rotatably mounted on said shaft and mechanically coupled to the paper for advancing the paper, said driven member being periodically rotatable through a fixed predetermined angle to cyclically advance the paper one line at a time and being rotatable through a number of predetermined angles corresponding to the selected number of lines for continuously advancing the paper the selected number of lines; and driven means rotatably mounted on said arm and mechanically coupled to said shaft for periodically rotating said driven member through said fixed predetermined angle when said arm is held stationary by said electro-mechanical means and for rotating said driven member through said number of predetermined angles when said arm is fixed to said shaft by said electro-mechanical means.

21. The system defined in claim 19 wherein said clutch includes an input member mechanically coupled to the source, an output member mechanically coupled to said shaft and normally coupled to said input member, and means responsive to the control pulse for decoupling said output member from said input member; said mechanical feedback means includes a shaft mechanically coupled between said arm and said means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,800,073

July 23, 1957

Arnold H. Block

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 43, for "Dick 85" read --Disk 85--; column 9, line 64, for "the", second occurrence, read --that--; column 18, line 33, for "driven" read --driver--.

Signed and sealed this 26th day of November 1957.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents