Dec. 31, 1935. W. C. ROE ET AL 2,025,778

TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

Original Filed Sept. 11, 1926 6 Sheets-Sheet 1

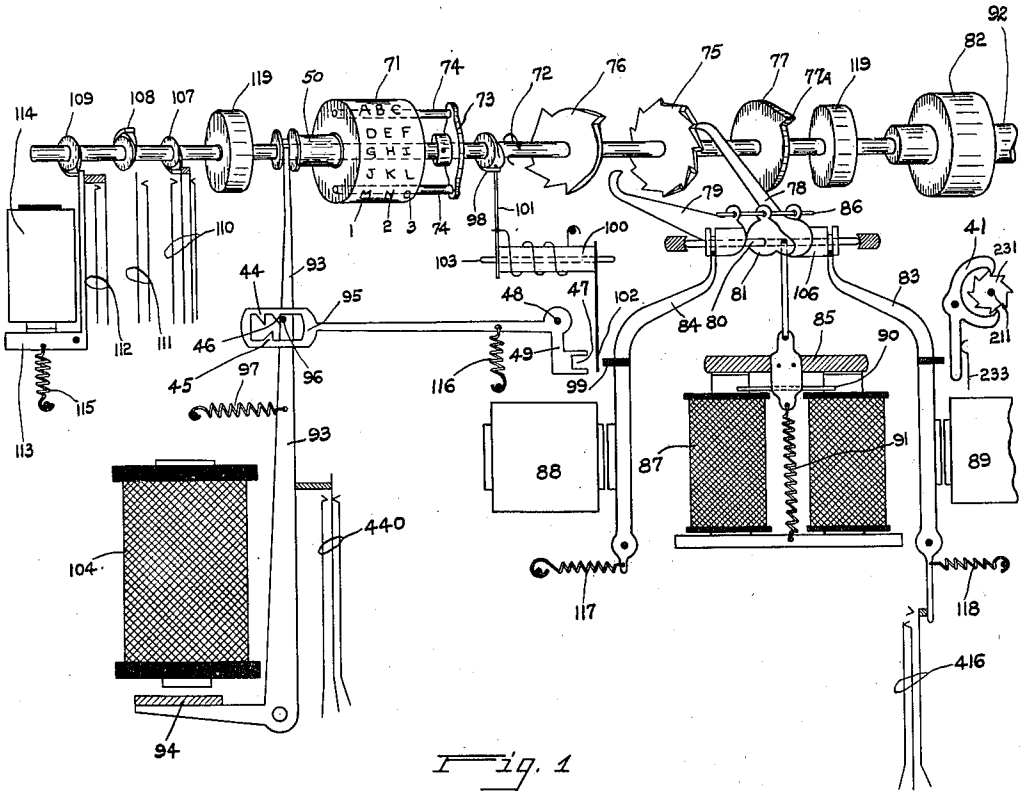


Fig. 1

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TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

Original Filed Sept. 11, 1926 6 Sheets-Sheet 2

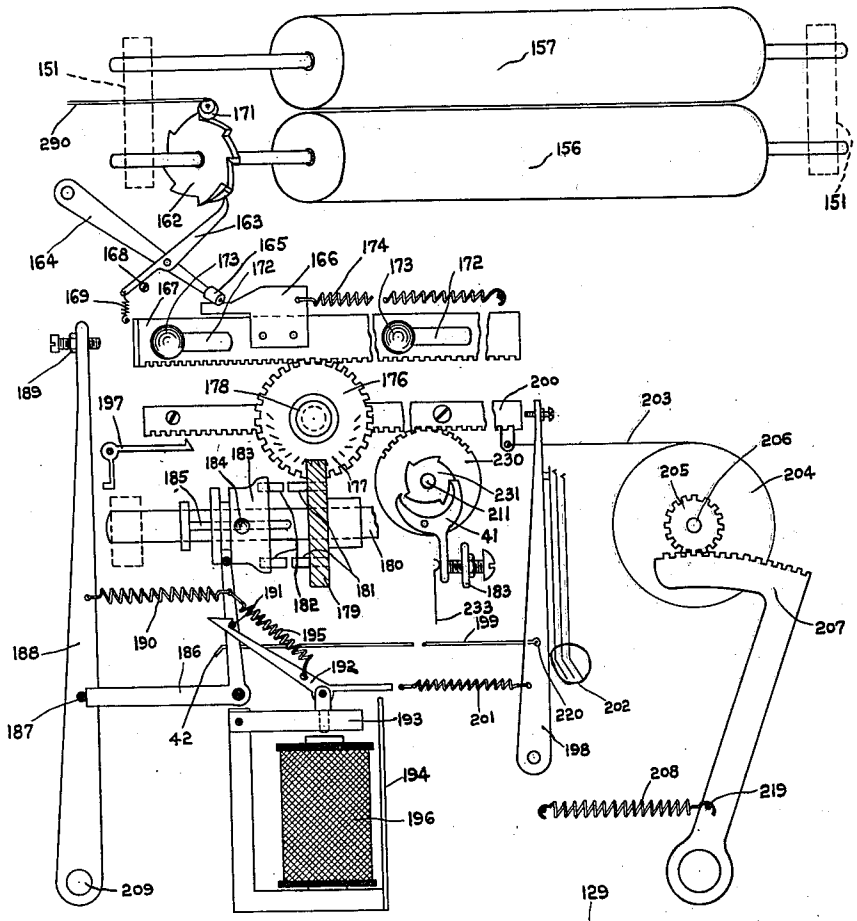


Fig. 6

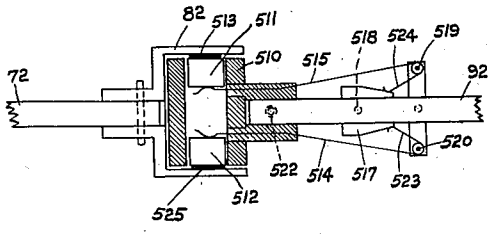


Fig. 2

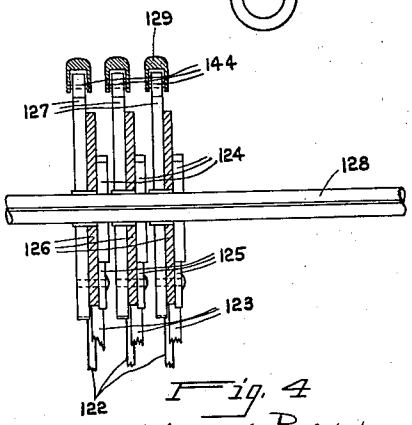


Fig. 4

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Dec. 31, 1935. W. C. ROE ET AL 2,025,778

TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

Original Filed Sept. 11, 1926 6 Sheets-Sheet 3

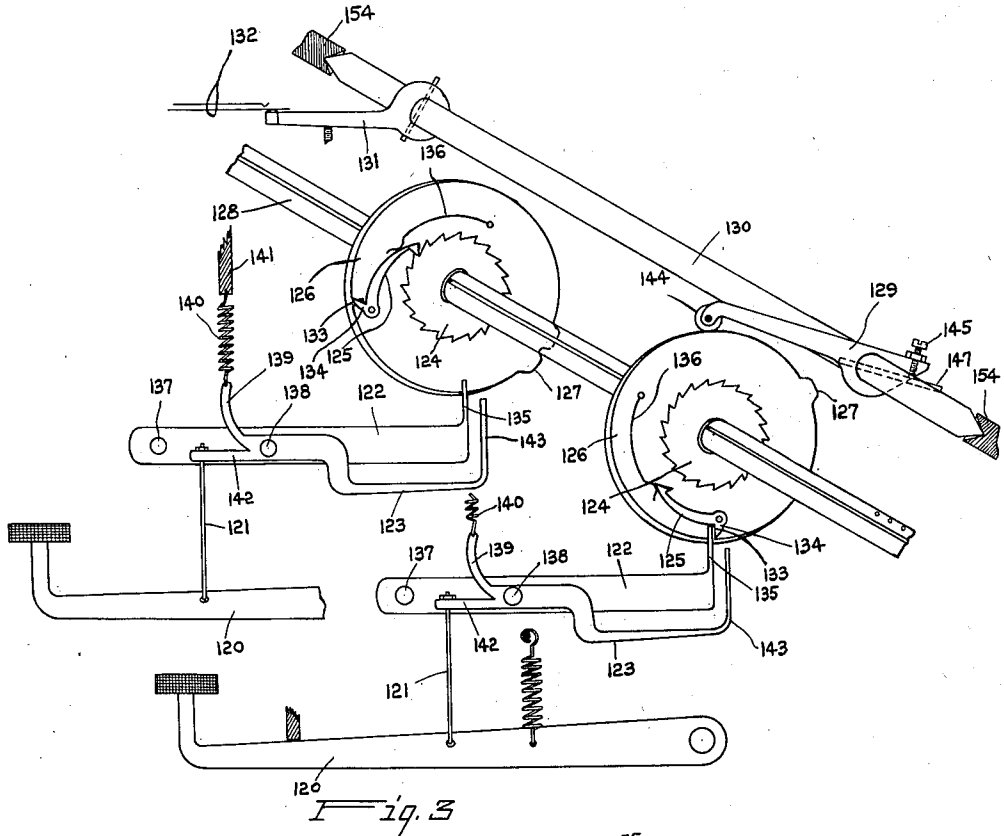


Fig. 3

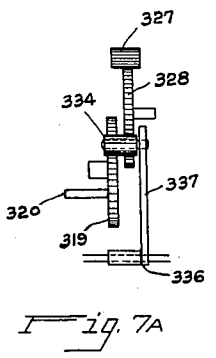


Fig. 7A

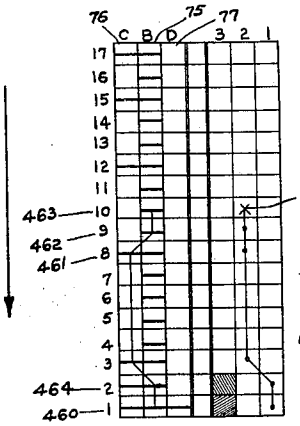


Fig. 10

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Dec. 31, 1935. W. C. ROE ET AL 2,025,778

TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

Original Filed Sept. 11, 1926 6 Sheets-Sheet 4

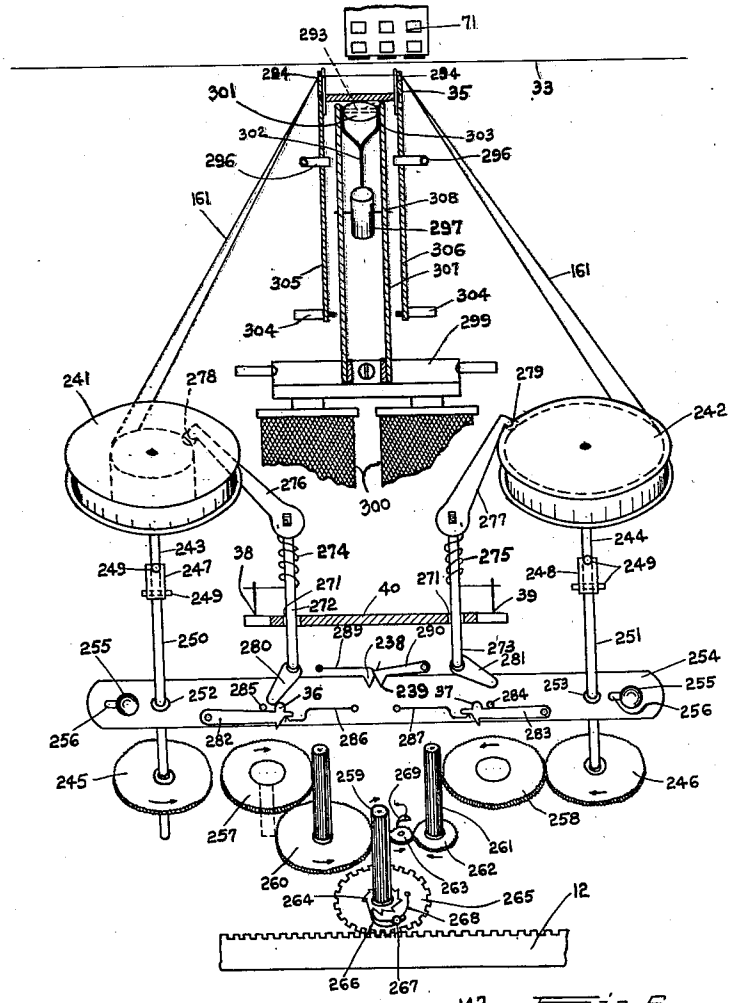


Fig. 5

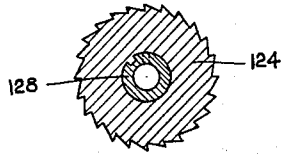


Fig. 12

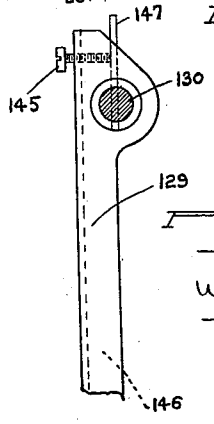


Fig. 11

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TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

Original Filed Sept. 11, 1926 6 Sheets-Sheet 5

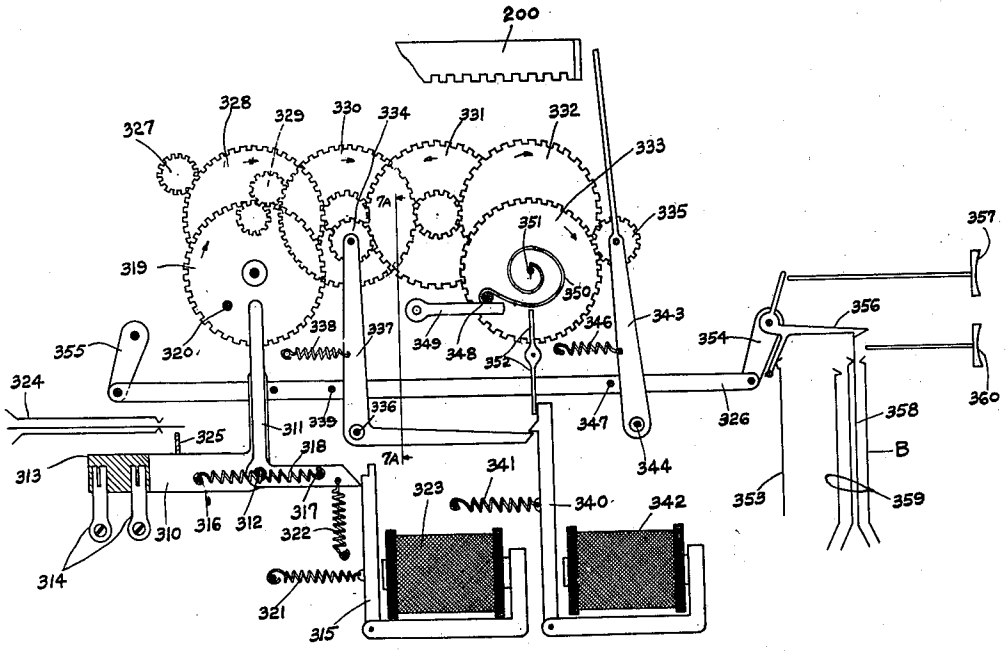


Fig. 7

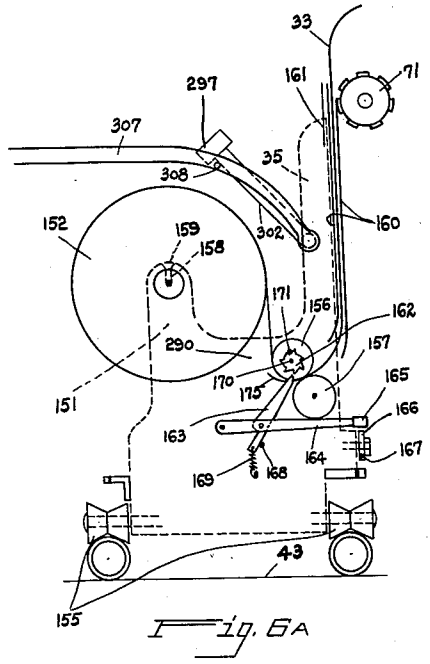


Fig. 6A

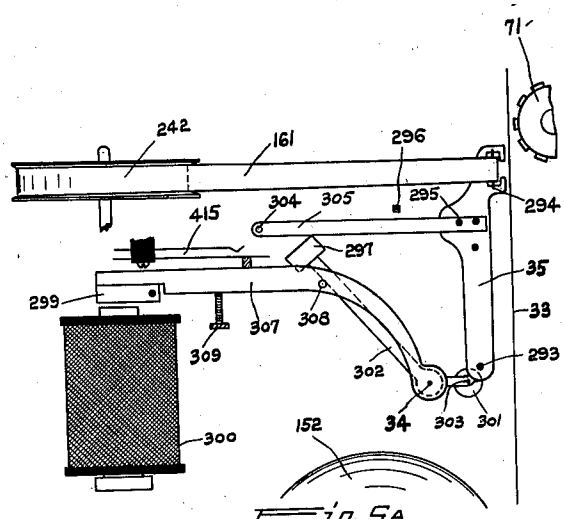


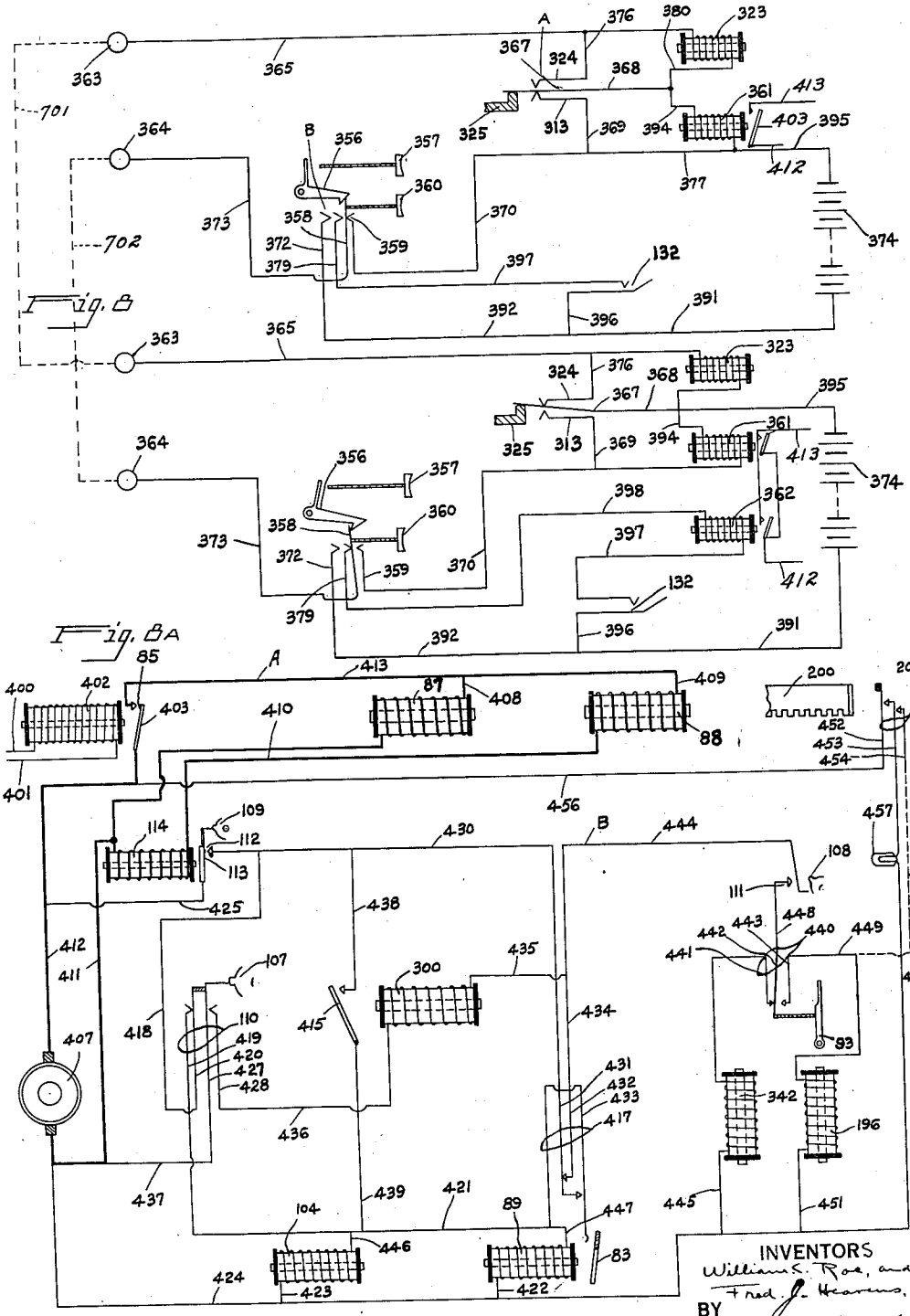
Fig. 5A

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TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

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Patented Dec. 31, 1935

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UNITED STATES PATENT OFFICE

2,025,778

TELEGRAPH TYPEWRITER SYSTEM AND APPARATUS

William C. Roe and Fred J. Heavens, Elyria, Ohio, assignors, by mesne assignments, to Printel Communication Systems, Inc., New York, N. Y., a corporation of New York

Application September 11, 1926, Serial No. 134,882
Renewed March 28, 1934

39 Claims. (Cl. 178—23)

Our invention relates to telegraph typewriter systems and apparatus therefor, of the general type wherein a telegraphic message transmitted from a station, may be automatically received at a distant station and reproduced in printed characters thereat.

Among the objects of our invention are the following:

To accomplish the full automatic and un-attended operation of receiving.

To accomplish the printing of the message at the distant station under the control of a sending machine in a system where synchronism between sending and receiving machines, as the term is used, is substantially unnecessary.

To accomplish two-way printing telegraphic service employing readily portable machines.

To provide a system and apparatus therefor capable of operating by power which may be taken from commercial electrical power mains.

To accomplish the operation of the apparatus of the system under electrical control and to prevent the use of power of any kind when the machines are not in use.

To accomplish the telegraphic function employing line currents of small strength.

To accomplish two-way communication through the use of suitable control switches at the stations and to accomplish the automatic stopping of each of the machines if the operator neglects to do so.

To accomplish the transmission of telegraphic messages in a system wherein printed copies of the messages may be automatically produced at both the transmitting and receiving stations.

To provide apparatus for the transmission of such messages which may be operated under the control of a keyboard such as is commonly used for ordinary typewriters, whereby no special training is required for its operation.

To provide apparatus sufficient for all transmitting and receiving purposes at each station but which shall be light in weight.

To accomplish the continuous feeding of paper to the printing mechanism and to permit the loading of both sending and receiving machines with sufficient paper for a considerable period of operation.

To provide an electrical system capable of accomplishing the desired telegraphic and printing functions but wherein no current will be required to flow over the line intermediate the stations at any time, except when the telegraph impulses are transmitted thereover.

To accomplish the telegraphic and printing functions desired in a system wherein the variation of voltage and frequency allowable in commercial electrical power plants, from which the operating current for the system may be taken, will have no substantial effect in reducing the accuracy or efficiency of the machine.

To accomplish the selection, starting and stopping of a given one or more machines on a common line circuit.

To accomplish the above results in a system employing machines of unit construction wherein all units thereof are interchangeable with like units of the other machines.

To accomplish a satisfactory speed of message transmission and reception, with a minimum of wear of the mechanical parts of the machines.

Other objects of our invention and the invention itself will be apparent from the following description of an embodiment thereof, and in which description reference will be had to the accompanying drawings, illustrating, most diagrammatically, the said embodiment.

Referring to the drawings:

Fig. 1 shows in schematic view the controlling apparatus for positioning the typewheel for printing operations in an embodiment of our invention;

Fig. 2 shows, mostly in section, a slipping clutch through which motion is communicated to apparatus of the embodiment of our invention herein illustrated and described;

Fig. 3 shows in isometric view the transmitter operating mechanism;

Fig. 4 is a view partly in section showing the arrangement of portions of the apparatus of the transmitting mechanism of Fig. 3;

Fig. 5 is a schematic view of printing mechanism adaptable for use in the said embodiment of our invention;

Fig. 5A is a view of some of the apparatus of Fig. 5 in said elevation;

Fig. 6 is a schematic view of paper carriage controlling mechanism adapted to be employed in the said embodiment;

Fig. 6A is a side elevational view of a paper carriage and associated mechanism adapted to be employed in the said embodiment;

Fig. 7 is a view of controlling mechanism comprising a motor circuit switching means adaptable for use in apparatus of the said embodiment;

Fig. 7A is an end view of some of the apparatus illustrated in Fig. 7;

Fig. 8 is a circuit diagram of some of the electrical circuits which may be employed in the said embodiment of our invention;

Fig. 8A is a view of the circuit arrangement of Fig. 8 but with certain of the apparatus thereof indicated in a different operative position;

Fig. 9 is a diagrammatic view of an electrical circuit adapted to be employed in the said embodiment of our invention;

Fig. 10 is a diagram chart relating to character type selection; and

Figs. 11 and 12 are views of a contact finger and ratchet wheel, respectively, illustrated in Fig. 3.

In the above different figures of drawings, the same parts are designated by like reference characters.

Before discussing the drawings, however, it is well to note, generally, that in the illustrated system embodying our invention—operation of the receiving station is controlled through the use of an impulse system of short and long impulses, which makes it possible to transmit and select a comparatively large number of characters with few impulses and with a reasonably simple machine. In the main the transmission of the character impulses is accomplished with a standard typewriter keyboard and a series of motor driven cams, operating upon a common contact, and, the selection is made possible through a three way operation of a pair of escapement fingers on three escape wheels, combined with a type wheel having three rows of type characters around its periphery. The short impulses advance the type wheel one division at a time and the longer impulses advance the wheel one or more divisions for each impulse and shift the wheel to one of the three rows of characters. Apparatus is also provided for the spacing and return of the paper carriage, the starting and stopping of the machine (both manual and automatic) ink ribbon feed and control, printing, signaling and for the power supply (mechanical and electrical).

The description of the system, the details of construction of the apparatus and mode of operation thereof is hereafter given, for convenience, under the following headings:—

Selector mechanism, illustrated in Figures 1 and 2.

Transmitter mechanism, illustrated in Figures 3 and 4, 11 and 12.

Paper feed and carriage return, illustrated in Figures 6 and 6A.

Ink ribbon feed and printing mechanism, illustrated in Figures 5 and 5A.

Motor and line switch, illustrated in Figures 7 and 7A.

Line circuit and operation, illustrated in Figures 8 and 8A.

Machine circuit and operation, illustrated in Figure 9.

Escape wheel and typewheel chart, illustrated in Figure 10.

Selector mechanism

The typewheel **71**, upon which the printing type characters appear, has, in the embodiment illustrated, three rows of type around its periphery, the three rows being herein arbitrarily called channels **1**, **2** and **3** (left to right) and, each row of three characters across the face of the wheel is herein arbitrarily called a division. The wheel is loosely mounted, but is keyed to the rotatable driven shaft **72** in such a manner that the wheel will rotate with the shaft at all times, but it can also be shifted longitudinally of the shaft at any time. The wheel has, in addition to the hole in its hub for the shaft **72**, two separate holes near its rim through which two pins protrude, and which pins are carried by a yoke **73**, which is rigidly secured to the shaft **72**. As the shaft **72** is rotated the yoke and pins **74** will cause the typewheel to be rotated also, and at the same time, the wheel may be axially shifted longitudinally on the shaft and pins. This arrangement makes it possible to bring any one of the several printing type characters on the typewheel **71** to a position in alignment with the path of the printing hammer, later to be described. The selection of the individual characters in any one channel is accomplished by the operation of an escapement unit which will now be described.

Three escape wheels **75**, **76**, and **77** are preferably closely positioned together and associated as one unit in practice, but, in the drawings, these are shown separately, in order to better explain and illustrate the essentials and mode of operation of the unit. Escape wheel **75**, has a definite number of teeth, the amount depending upon the largest number of divisions provided in any of the channels; one tooth is provided for each of the divisions thereof. Additional teeth may be provided for various operative purposes. Escape wheel **76** is preferably of the same general design, except that it has fewer suitably spaced teeth. Escape wheel **77** is also preferably of the same type with the exception that it has but one tooth. The number and disposition of the teeth on the different wheels that make up the escapement unit are varied for reasons which will be apparent from the following description.

This set of escape wheels is rigidly mounted on shaft **72** and rotate therewith. Operating in conjunction with, and, controlling the movement of the escape wheels is a set of two finger units, comprising pawls, **78** and **79**, each finger unit being composed of a finger and a grooved sleeve **106** capable of sliding on a shaft **80**. The shaft **80** is pivoted at each end so as to oscillate to the limit of the finger movement on the escape wheels. Fixed to the center of shaft **80** is a hub **81**, to which is connected a link through which the oscillations are transmitted to the shaft. The hub also carries a pin **86** which passes loosely through a hole in each of the two fingers and which communicates the oscillatory movements from the hub **81** to the fingers and at the same time permitting the fingers to move freely longitudinally of the shaft. The oscillatory, or rotary motion of the shaft **80** and fingers **78** and **79**, is communicated through the link extending from the armature **85** of magnet **87**. The armature **85** is pivoted on a pin **90** spaced therefrom toward the observer and spring **91** spaced from the pin toward the observer normally retracts it from magnet **87** and also keeps finger **78** in engagement with escape wheel **75** through the link connection. The horizontal motion of the fingers **78** and **79** is controlled by the magnets **89** and **88** through armatures **83** and **84**. In their normal position the fingers **78** and **79** are in alignment with escape wheel **75**, the finger **78** engaging same at the top. Should magnet **88** be energized, its armature **84** being engaged in the slot in the hub of finger **79** will cause the finger to move to the left along shaft **80** and align it with escape wheel **76**. This same operation also takes place with magnet **89**, armature **83** and finger **78**, this finger aligning with escape wheel **77** when moved along the shaft **80** to the right.

When magnet **87** is energized, armature **85** through its link connection to shaft **80** will cause finger **78** to move upward and free of the tooth of escape wheel **75** and bring finger **79** upward into

engagement with another tooth of the escape wheel 75.

The shaft 72 carries at its right hand end, one clutch element of a friction clutch 82, the second clutch element associated with the element 82 (see Fig. 2 to be described), being driven by an electric motor while the machine is operating. The shaft 72 is adapted to be driven through the friction clutch 82 by a motor driven shaft 92. During such periods wherein current is not applied to the magnet 87, the finger 78 holds the shaft 72 stationary, by engaging a tooth on escape wheel 75 and by virtue of the slipping occurring between the two elements of the friction clutch 82. Owing to the frictional drag of the clutch unit, there is applied to the shaft 72 a steady torque which causes rotation of this shaft at all such times when it is released by the escapement unit.

If now, energy is applied to magnet 87, fingers 78 and 79 will be raised, allowing the escapement unit and typewheel to advance one-half division, as finger 78 will release the tooth with which it is engaged and, finger 79 will engage with the approaching tooth on the under side of the escape wheel. When the magnet 87 is de-energized, the operation of the fingers will be reversed and the shaft and wheels will advance another half division. Each cycle as explained, will advance the typewheel one division, and, if a series of impulses is applied to the magnet 87 the typewheel will be advanced to some predetermined division, depending upon the number of impulses in the series.

As can be understood at this time, if all the escape wheels were divided into a great many divisions, it would require a long series of impulses to rotate the typewheel to the desired characters. This would require a comparably longer time for transmission so in order materially to reduce the number of impulses required for a definite number of characters and, consequently, to considerably reduce the time required for telegraphic transmission thereof, the escape wheel 76 is brought into operation through the shifting of finger 79, resulting from a movement of the armature 84, into alignment with escape wheel 76. Armatures 85 and 83 so differ from armature 84 in weight and other factors affecting their inertia and the forces effective upon them are so proportional that they differ in their rates of responsiveness to the operative magnetic forces exerted upon these characteristics to cause armatures 85 and 83 to respond very quickly whereby they will be actuated by both short and long impulses of current passed through their electro-magnets and armature 84 is relatively sluggish and responds only to longer continued impulses of current. From the foregoing, it is obvious that, if current is applied to magnets 87 and 88, at the same time, if only for a sufficiently short period of time, only armature 85 will operate and the typewheel will be stepped around accordingly, as before described; however, should a longer impulse be simultaneously applied to both magnets, both armatures 85 and 84 will be operated.

As before stated, upon each operation of the armature 85, the typewheel 71 will be rotatively advanced one division, and if the impulse should be a long one whereby armature 84 is also operated, finger 79 will be shifted over in alignment with escape wheel 76; if now the finger 79 comes into engagement with such a tooth on wheel 76, as may be disposed one division further around the wheel than the normal position of the finger, the typewheel will then be advanced but one division; however, should finger 79 be brought into relation with escape wheel 76 at a point where the approaching teeth in its rotation have been receded, the result of the longer impulse will be to allow the typewheel to travel a greater distance, or, several divisions depending upon the number of teeth omitted on the wheel in the distance moved. The typewheel can, therefore, be advanced to selected position much faster with fewer impulses than would be otherwise possible. It has been above stated that if finger 79 comes into alignment with a tooth on escape wheel 76 which follows the tooth in normal relation with the finger 79, the typewheel will be advanced but one division. Now, this condition holds good for the first two divisions that the typewheel is advanced by any series of impulses; the typewheel is never advanced more than one division for each of the first two impulses, whether they be long or short, due to the fact that there are two teeth provided on wheel 76 that engage with the finger 79 on the first two divisions, if the impulses received while the finger is aligned with wheel 76 are of the longer continued character.

This makes it possible to utilize the movement of armature 84 on the first two impulses for the shifting of the type wheel from its normal position in channel 1, to either of the channels 2 or 3.

The shift and control of the typewheel is accomplished as follows:—Typewheel 71 is held in its normal position by arm 93 secured to the armature 94 of magnet 104 engaging within a slot in the typewheel hub 50 and, as shown, is pivoted at its lower end. Any movement of arm 93 to the left, will cause typewheel 71 to be moved along the shaft 72 in the same direction and, for the same distance. The movement of wheel 71 through arm 93 is controlled by an escapement arm 95 and a pin 96. The arm 95 is pivoted at its extreme right end 48 which, also carries a right angle slotted extension 49. It can be seen, that, if an impulse is imparted to the slotted extension, in line with the slot 47 and, in a left hand direction, the first tooth 46 in the escapement which engages pin 96 will be lifted clear of the pin, and the arm 93 will move to the left until pin 96 engages the single tooth 45 on the lower side of the arm. Following the impulse, the arm will drop back to its normal position, allowing the pin to shift from the lower to the second of the upper teeth 44 of the escapement. This permits an axial movement of the typewheel moved by the spring 97 an amount equal to the width of one channel and aligns the second channel with the printing hammer not herein shown but adapted to be reciprocated in a plane at right angles to the axis of the shaft 72 to compress interposed layers of typewriter printing ribbon and a sheet of paper upon which the typewritten record is to be made against the type raised characters on the typewheel 71 as hereinafter more specifically described. A second impulse to the arm 95 will cause the wheel to be shifted to the third channel in the same manner as to the second, the impulses mentioned, being communicated to the arm 95 by movement of armature 84, which in turn operates responsively to long impulses of current through electromagnet 88.

By virtue of the axial positioning of the typewheel, controlled by the first two impulses in magnet 88 and due to the fact that its armature 84 only operates responsive to the longer im-

pulses, the typewheel may be shifted to any desired channel by the transmission of the first two impulses of any series in a combination of long and short impulses. For example, although two short impulses will not effect the armature 84 to shift the wheel, one short and one long impulse will shift it to the second channel; two long impulses will shift the wheel to the third channel since the long impulses are effective to operate armature 84, which controls the actuation of escapement 95.

Contact between attracted armature 84 and escapement arm 95 would cause the typewheel to shift from the first to the second or third channel; so it is desirable that this should not happen on any but the first two impulses in any one series since, otherwise, the desired selection would not be accomplished. To prevent such undesired operation, control over the escapement 95 is exercised by a cam 98 on the shaft 72 adapted to actuate a baffle plate element, comprising a sleeve 100 to one end of which is fixed an arm 101 operated by cam 98, and to the other end a flexible thin metallic guard or baffle plate 102 is secured. This unit is free to turn on the shaft 103. When the arm 101 is, once during each rotation of the shaft 72, raised by the cam 98, the flexible guard or baffle plate is disposed directly between the projection 99 on armature 84 and a bifurcated end of the arm 95. The cam holds the baffle plate in this position while wheel shaft 72 rotates two divisions from normal. Just before the third division is reached in the rotation of the shaft 72 the cam 98 releases the arm 101 and the baffle plate swings clear of, and out of alignment with the bifurcated arm of escapement 95 and armature 84. In this position the armature has no effect upon the escapement 95 due to the projection 99 on the armature passing freely between the forks of the end of the escapement lever arm and the typewheel will remain in the position previously achieved through the influence of the first or second impulses of a particular series.

The typewheel is restorable to its normal position by the attraction of magnet 104 on the armature end of the arm 93. The armature 84 operates the typewheel shifting mechanism and armature 83 operates the paper carriage shift by actuating the paper carriage escapement pawl 41; a projection armature 83 is adapted to activate the escapement pawl 41 directly and at any time the armature 83 is moved. The carriage escapement is described elsewhere herein and may vary in construction, the usual typewriter spring-propelled carriage being suitable for the purpose.

The armature 83 engages the groove in the sleeve 106 of finger 78 and when magnet 89 is energized, its armature 83 will shift the finger 78 to the right and in alignment with escape wheel 77 which has but one tooth.

This operation permits the shaft 72 with all its associated units to return to normal position, after the second division in the revolution is reached. The single tooth 77A is in alignment with the normal position of the finger 78 on the escapewheel 75 and after one or more divisions have been traversed by the units on the shaft 72 and the finger 78 shifted to escape wheel 77, the shaft and associated units will continue to rotate for the remainder of one revolution after which the finger engages the single tooth 77A at which time the mechanism will again be in normal position. This restoring takes place after the selection and printing of each character, as the shaft 72 and typewheel 71 complete one revolution of each cycle of operation.

Cams 107, 108, and 109 operate contact combinations 110 and 111 and 112 at times predetermined by the radial disposition of the cams on the shaft, during each revolution of the shaft 72. Cam 109 operates contacts 112 indirectly through the movement of armature 113. When shaft 72 is in its normal position, cam 109 is in engagement with armature 113 and holds same in an operated position in relation to the magnet 114 and keeps contacts 112 open. The relation and functioning of this combination will be explained later.

Springs such as 91, 97, 115, 116, 117, and 118, are provided for the return operation of the armatures and all moving parts. 119 represents bearings for shaft 72. It will be understood that suitable adjustable stops of well known types, but not shown herein may also be provided to limit the movement of the several oscillating members.

The friction clutch 62 is a part of the selector unit and the clutch element thereof attached to the shaft 72 is shown (Fig. 2) as a hollow chamber or drum supported from one end by a sleeve encircling shaft 72. The clutch element thereof fastened to the drive shaft is shown as a block through which is cut a hole at a right angle to the shaft. Riding free within each end of this hole, is a thin sleeve into which is placed a friction pad of preferably fibrous material, such as felt which acts to frictionally engage the drum to rotate same when the clutch unit is assembled and operated. This block rotates within the drum and two springs pressing against the under side of the sleeves force the friction pads against the inner surface of the drum. With a tapered sleeve as shown on shaft 72 the springs can be adjusted to the right tension and a very smooth and positive operation of the clutch obtained.

The secured typewheel shift member 93 also operates the contact group 440, the right hand contacts being closed when the wheel is set in the first channel, and, the left contacts are closed when the wheel is in the second or third channel.

Transmitter mechanism

Referring now to Figs. 3 and 4, wherein a unit of the transmitter is schematically shown, the transmitter comprises preferably a bank of units each unit being substantially the same with the exception of the indentations in the periphery of cams thereof. As all units are alike in their construction, only one will be described, it being understood that a group of these units are assembled on a common shaft and disposed parallel with each other. The combination composing a complete unit comprises a key lever 120, a connecting rod 121, a set of escapement fingers 122 and 123, a ratchet wheel 124, a pawl 125, a slotted disk 126, a cam 127, a drive shaft 128, a contact finger 129, a finger shaft 130, a contact arm 131 and a set of contact springs 132. The shaft 128 is driven in any suitable way, such as by an electric motor, and keyed to the shaft is a ratchet wheel 124, which revolves with the shaft at all times. Closely associated with the ratchet wheel on shaft 128 is a cam 127 slotted disk 126 and a pawl 125 which as shown in Fig. 4 is combined as one unit on a sleeve. This unit is loosely carried on the drive shaft and is held stationary by the escape fingers when the unit is not being operated. The pawl is loosely mounted on the surface of the slotted disk adjoining the ratchet wheel and in

such a manner that the hooked end can be engaged with the teeth of the ratchet wheel and whereby the inside edge of the small right angle tail projection 134 on the pivot end of the pawl is parallel to, and, adjoining the slot 133 in the disk 126. An angularly disposed end 135 of the escape finger 122 is shaped so as to enter the slot in the disk and hold the pawl clear of the ratchet wheel, and at the same time keep the cam and the disk from rotating. Should the finger 122 be withdrawn from the slot in the disk, the pawl will be brought into engagement with the ratchet wheel by the pawl spring 136 and the cam unit will be carried around with the rotating shaft 128. If now, the finger is released before one revolution of the disk takes place, the end of the finger will come into contact with, and ride on, the edge of the disk until such a time as it reaches the slot in the disk and the pawl thereon. Just before the end of the finger again enters the slot it will engage the angle portion 134 of the pawl, which at this time covers the slot due to its being in engagement with the ratchet wheel and, therefore, tipped at a greater angle, and will carry the same back and parallel with the slot. The pawl is thus disengaged from the ratchet wheel and the finger permitted to re-enter the slot, thereby locking the disk and cam against further rotation. This operation only obtains when the finger 122 is released before one revolution of the shaft 128 is completed, since if the finger 122 is held away from the disk for a greater period of time, the cam unit would make more than one revolution which is not desirable. The escapement action of the two fingers 122 and 123 and the pawl 125, provides for automatically insuring correct operation in this respect. The finger 122 is pivoted at 137 at its end, opposite the disk; the finger 123 is pivoted on the finger 122 at 138 about midway of its length. The right hand end of the finger 123, adjoining the disk, is angularly so disposed and shaped as is the end of finger 122 so as to permit it to enter the slot in the disk and engage the end of the pawl, under certain conditions when obtained. The opposite end of the finger is bifurcated, one fork thereof, 139, being curved upwardly and at its end is secured an end of a helical restoring spring 140, attached at its other end to a support 141 and disposed to exert an upward effort substantially in a direction at right angles to the main portion of the finger 122. The other fork 142 extends toward the pivot 137. The adjustable link 121 connects the end of the fork 142 to the key lever 120, the connection to 120 occurring at a point midway thereof.

If now, the key lever 120 be depressed, the link 121 will exert a downward pull on the extension 142 of finger 123 and on the restoring spring 140 rocking the finger 123 counter-clockwise as viewed in Fig. 3. The opposite end of the finger 123 is thereby raised up against the disk by the rocking of finger 123 on its pivot 138 on finger 122.

During this movement of the finger 123, finger 122 will remain in its normal position, due to the relative positioning of the parts, the upward pull of the spring 140 being exerted on a three point suspension,—namely, the pivot rod 137 at one end, the disk at the opposite end and the pivot of finger 123 at its center. If, after the end of the finger 123 comes into contact with the disk, the link 121 is moved farther downward by depression of the key lever 120, the pivot point of finger 123 will be moved downward also, the end of the finger in contact with the disk acting as a pivot. As the finger 123 is pivoted on finger 122, this operation will cause finger 122 to be drawn down and rotated on its pivot rod 137 in the left-hand end. This movement of finger 122 will effect the withdrawal of its end 135 out of the slot in the disk and free the disk 126. At the moment the finger is withdrawn from the slot 133, the pawl will be spring pressed into engagement with the ratchet wheel, and thus the cam unit will be rotated by the drive shaft. When one revolution thereof is nearly completed and the finger 123 is held against the disk by the pressure on the key lever, the end 143 of the finger 123 will enter the slot 133 and effect the disengagement of the pawl from the ratchet wheel, thus locking the cam unit as mentioned before. Now, the pressure on the key 120 being removed and the key returned to its normal position, the spring 140 will raise finger 122 into contact with the disk, after which with a continued upward movement the key finger 123 will be withdrawn from the slot 133 and through the operation of the pawl and ratchet wheel the cam unit will be advanced until finger 122 enters the slot 133 and again releases the pawl and locks the cam unit.

The arrangement of the escapement as a whole is such that the cam unit will make but one revolution for each complete operation of the key lever, regardless of the length of time that the key lever is held in a downward position. The action of the two fingers on the disk and pawl is to always bring the idle finger into operative position before the withdrawal of the locking finger from the slot in the cam unit, the idle finger causing the release of the locking finger by the movement of the fulcrum points along the length of the fingers. The key lever used may be of the type common to all typewriters and requires no explanation. The cam section of the unit just referred to has a toothed edge, the teeth being so disposed thereon as to operate the contact 132 according to the impulse code to be transmitted by that particular cam. In contact with and operated by the toothed cam is one end of a contact finger 129, this end of which holds a roller 144 for the reduction of friction between the finger and the cam. As shown in Fig. 11, the finger is constructed with a hole through the opposite end through which passes a finger shaft 130. An adjusting screw 145 is preferably provided in the end projecting beyond the shaft 130. The finger has a slot 146 throughout its length receiving the roller 144 at its one end and a pin 147 rests within the slot at the other end of the finger. The finger is loosely mounted upon the shaft 130 and directly in line with the slot, a hole being cut through the shaft at right angles thereto, into which is secured the pin 147. The slot 146 is of such dimension that the pin does not come into contact with the body of the finger, in its movement on the shaft, but the pin does engage the end of the adjusting screw 145 provided in that end of the finger.

It can be seen that an upward movement of the finger by the cam will cause the shaft 130 to be rotated, and also that the shaft could be rotated in a clockwise direction, as seen from the right, without imparting any movement to the finger. Each time that the cam is rotated the irregular surface of the cam will cause the finger to be intermittently raised to impart movement to the shaft through the screw and pin, but in the case where two or more like cam units are mounted upon the same shaft, the operation of one cam and finger unit will not affect the others, as the

shaft 130 can be rotated in a clockwise direction by any one unit and through the functioning of the screws and pins, the others will remain stationary.

Thus, a series of impulses are communicated to the contacts 132 through any contact finger 129 from one of a number of cam units without interference. The contact arm 131 secured on shaft 130 causes the contacts 132 to be operated responsive to movements of any selected finger riding on the irregular surface of a cam. This construction makes it possible to use but one set of electrical contacts for an indefinite number of cams, resulting in a comparatively simple but positive impulse transmitter. Shaft 128 which is the power driven shaft, is preferably equipped with bearings, not shown, as is also the shaft 130, as indicated at 154. In operating the transmitter, the depression of any key will cause the cam associated with that key to make one revolution. Each cam, having a different series of teeth on its edge, will cause its associated contact finger to oscillate the finger shaft, which in turn will close and open the set of contacts 132 in unison therewith. In this way the desired series of impulses, corresponding to any character, can be transmitted over a wire. A further explanation of its relation to the line and selector will be found elsewhere in the description.

Paper feed and carriage return

In the typewriting portion of our improved mechanism, the carriage return and the paper line feed is cooperatively effected. This part of the description will cover the paper carriage mechanism shown in Figs. 6 and 6A, which includes the carriage frame, the paper feed rolls, the carriage and paper shifting rack and gears, the driving clutch, the spacing escapement gears, the paper shift ratchet and the carriage rollers and track. The paper carriage consists of two parallel end frame members, one of which is shown in dotted lines at 151 in Fig. 6A secured together by connecting bars, which act also as spring supports, stops, etc., the spacing between the frame members being sufficient to accommodate a roll of paper 152, the feed rollers 156 and 157 and the paper line spacing mechanism, the preferred relation of the equipment being indicated in Fig. 6A.

Four grooved rollers 155 are disposed one at each of the four corners of the carriage frame having the end frame members 151, to permit the frame to travel on a pair of preferably circular rails fixed to the machine bed 43. The roll of paper 152 is placed upon a movable shaft 158 which is suspended on and between the end frame members 151 of the carriage, the ends of the shaft being so reduced in diameter as to enter and rotate freely in a slot 159 in each end member. After the paper is placed in the carriage, the free end of the paper is directed between the two feed rollers 156 and 157, which feed and control the movement of the paper through a set of vertical guides 160 that direct the paper upwards and over the top of the machine to cause it to pass between the typewheel 71 at the rear of the carriage and the inking ribbon 161 and printing hammer 297 at the front.

The paper roll being mounted upon and moving with the carriage continuously is in alignment with the feed rolls and guides and, therefore, the paper will not have its edges entangled in the guides and mutilated, rendering the machine inoperative. The lower ends of the paper guides 160, as well as the inner guide 175 are so shaped that the end of the paper will be directed to and between the feed rollers 156 and 157 and upward through the vertical guides when the paper roll is inserted in the carriage and rotated in the proper direction.

Knobs are provided in connection with the shaft ends of the top feed roll in order to rotate same when the paper is being threaded through its channel. As can be noted, although the paper might be fed into the feed rolls from the bottom, rather than from the side of the roll, this half turn of the paper around the upper feed roll takes a part of the curl from the paper and leaves just enough as to cause the paper to follow over the back of the machine after it passes out of the guides at the top of the carriage.

It is evident that to reverse the direction of rotation of the paper roll in the carriage would mean that the paper would travel over and in front of the carriage and key board and would not only interfere with the operation of the machine but would cut off all visibility in respect to the printing. As the roll of paper is free to rotate in the carriage the feed rolls 156 and 157 unwind the paper from the roll 152 and force it up through the guides 160 and 175 and out of the top of the carriage, passing the typewheel and the printing apparatus.

On one end of the feed roll shaft 156 is a ratchet wheel 162 which is engaged by a pawl 163 pivotally carried on the lever arm 164. The arm 164, pivoted at one end, terminates in a roller 165 at the other, which roller contacts with the cam 166 on the carriage return rack 167. The lower end of the pawl 163 rests on a pin 168 when in its normal position. The angular position of the spring 169 relative to the pawl and arm, causes the pawl and arm to be drawn downward and at the same time brings the pawl into contact with the pin. The movement of the lower end of the pawl over the pin swings the upper end away from, and free of the ratchet wheel which permits rotating of the paper feed rolls in either direction during the threading of the paper.

If now the roller end of the arm 164 be raised, the pawl will be carried away from the pin and the upper end of the pawl will engage a tooth in the ratchet wheel. A further movement of the arm will rotate the ratchet wheel and feed the roller until the arm movement is arrested, to move the paper up through the guides a definite distance. The number of teeth in the ratchet wheel will determine the movement of the paper since each movement of the arm turns the ratchet and roll the distance of one tooth space. To insure an arcuate line shift spacing of the paper an indent roller 171 and leaf spring 290 is associated with the ratchet wheel and is adapted to center the ratchet wheel.

Mounted upon the back of the paper carriage is the toothed return rack 167 for the return of the carriage to its right hand position on the machine, effective to shift the paper each time that the carriage is returned. The rack is slotted at 172, Fig. 6, near each end and is suspended on the carriage by two screws 173 passing through the slots and into the frame end members 151 of the carriage. Through the screw and slot suspension, the rack can be moved a definite distance lengthwise along the carriage, being restorable to normal position by the spring 174. Mounted upon the rack 167 and in line with the paper shift arm 164 is a cam 166.

Each time that the rack is moved along the carriage on the screws 173 the cam will raise the shift arm by virtue of the roller carried on its end, riding up the incline on the top edge of the cam. This causes shifting of the paper in the carriage, an amount equal to one typewritten line for each movement of the rack.

When the end of the slots in the rack engage the screws 173 a further movement of the rack will pull the carriage along its track to the end of its travel across the machine. Should the carriage be in its extreme starting position on the right hand end of the machine and the rack be moved on its supporting screws the paper will be shifted up but no movement of the carriage will take place. The mechanism for moving the rack 167 to shift the paper or to shift the paper and return the carriage will now be described.

Engaged with the rack is a gear 176 combined as a unit with a helical gear 177 which rotates on a stud 178. The helical gear is meshed with a similar gear 179 on the drive shaft 180.

This gear carries two pins 181 projecting from one side thereof with which two like pins 182 in a sliding sleeve 183 is adapted to engage. The sleeve 183 is loosely carried on the drive shaft 180, but is keyed to the shaft and rotatable thereby. The key pin 184 in the hub of the sleeve extends into a slot 185 in the shaft. If the sleeve is moved along the shaft until the pins carried on the sleeve 183 engage those carried by the gear 179 the shaft will cause the gear combination 176—177 to rotate, which in turn will move the rack 167.

Engaging within a slot in the sleeve 183 is one arm of a bell crank 186 which is pivoted at the junction of two arms. It engages a pin 187 on a lever arm 188 at the end of the second arm. The lever arm 188 is pivoted at 209 at one end and extends to a point in line with the movable rack 167 on the carriage, this extension carrying an adjusting screw 189 which contacts with the end of the rack. The lever 188 is also tied to the bell crank 186 by a spring 190. About the center of the upper arm of the bell crank 186 is a pin 191 which engages a hook on the pawl 192 pivoted on the top of the armature 193. The pawl 192 has a small extension beyond its pivot point which contacts with a stop 194 a spring 195 holding the pawl in engagement with the pin 191 in the bell crank 186 also holds the armature 193 in its inoperated position. Cooperating with the armature 193 is a magnet 196 and upon energization thereof the mechanism will operate to return the carriage as will presently appear.

When the armature 193 is attracted by the magnet 196 it will, through the pawl 192, move the bell crank 186 on its pivot, to cause the sleeve 183 to be moved along the shaft 180 to effect interlocking the pins 181 of gear 179 with the pins 182 of the sleeve. At the same time the lower arm of the bell crank lever 186 is raised above the pin 187 in the lever arm 188 and this arm will then be drawn against a pawl 197 by the spring 190. As the lever arm 188 moves over toward the pawl 197 the pin 187 will be projected under the lower arm of the bell crank 186, locking it against return to normal position and locking the clutch pins into clutching engagement. The drive shaft 180 through the clutch and gears now causes the rack 167 to move the carriage, if the carriage is not in its extreme right hand position, until the end of the rack 167 contacts with the contact screw 189 of the lever arm 188.

Continued motion of the rack will move the lever arm 188 back to its normal position, thereby increasing tension of the spring 190 and freeing the lower end of the bell crank lever 186 from the locking action of the pin 187, releasing the bell crank which will be returned to normal position, and disengaging the clutch and locking the lever arm 188 in normal position.

Near the extreme end of the stroke of the armature 193 above referred to, the extension of pawl 192 makes contact with the stop member 194 giving the hooked end of the pawl 192 a downward motion to disengage the hooked end of pawl 192 from the pin 191 in the bell crank, freeing the same to permit it to return to normal under the control of lever arm 188.

By virtue of this disengagement of the pawl, current through the magnet 196 may be prolonged indefinitely without interfering with the disengaging of the clutch.

Provision is also made for the engagement of the clutch elements 181—182 when the carriage has reached its limit of movement across the machine toward the left and it is required that the carriage be returned to the opposite end by the motor, not shown, driving shaft 180. This is accomplished by actuation of the lever arm 198 and the connecting rod 199. When the carriage travels to the left end of the machine within the fixed rack 200 comes into contact with the upper end of the lever arm 198, moving it against the power of the spring 201. Connected to the arm 198 and bell crank 186 is the connecting rod 199, one end of which is hooked into a hole 220 in the arm 198 and the other end of which is passed around the upper arm of the bell crank lever 186 and has its extreme end then bent at a right angle, to engage the bell crank to move the same whenever pulled by the arm 198. As the carriage moves along, the rack 200 will move the arm 198 and the rod 199 until the hooked end 42 of the rod 199 operates the clutch mechanism in the same manner as before described for operation by the movement of armature 193.

By operating a set of contacts 202 by movement of the lever arm 198, the carriage may also be returned by the energization of the magnet 196 by current flowing through normally open contacts of the set 202. By energizing the magnet 196 the carriage can be brought to its starting position at any time, or it will be always automatically returned to this position upon reaching the extreme opposite position on the machine; also the paper will be shifted upward each time that the carriage is moved to return it or as many times as is desired after the carriage has reached its limit of return travel by energizing the magnet 196 a corresponding number of times.

To prevent the paper carriage from spacing when the carriage and paper are being shifted, the small bell crank lever 197 above mentioned is positioned between the fixed rack 200 on the carriage and the lever arm 188. At such times when the lever arm 188 is in an operated position, during the time the clutch is engaged, the lever arm will contact with the projection on the bell crank lever 197 and by rotating on its pivot, the bell crank lever will engage with teeth on the fixed rack 200 with its hooked end and prevent it and the carriage from moving in a spacing direction, but as the hooked end of the bell crank lever 197 has a beveled end face it will not arrest movements of the carriage in the other direction.

While the carriage is being returned to the

start position, the beveled end of the bell crank lever will cause it to ride over the teeth on the rack, the spring 190 acting as a tension member through the lever arm 188. The shaft 180 is driven by a motor through suitable gearing.

The following description applies to the driving of the carriage in the spacing direction. Attached to the fixed rack 200 on the paper carriage is one end of a tape 203, the other end of which is wound around a tape drum 204, carrying a gear 205. Both gear and drum rotate on the stud 206.

Meshed with the gear 205 is a sector gear 207, pivoted at its lower end and operated by the spring 208. By virtue of the pull exerted by the spring 208 the sector gear 207 will exert a rotational effort upon the gear 205 and the drum 204, winding the tape on the drum and pulling the carriage across the machine when released by an escapement mechanism comprising a double acting pawl 41, and escape wheel 231. The angular position of spring 208 in relation to the sector gear 207 is preferably such that when the sector gear is at that one extreme position wherein the spring 208 exerts the least effort upon it, a line through the pin 219 and the center of the sector pivot stud will be disposed substantially at right angles to the spring 208.

Such an arrangement results in the spring 208 exerting an effort through greatest leverage, upon the sector gear at the time that the spring is extended the least, and this results in a more even torque being applied to the drum 204 by the spring at all points in its rotation, causing the tractive effort exerted upon the carriage by the spring to be nearly equal throughout its travel.

Supported upon the fixed frame of the machine, is the escapement unit comprising a gear wheel 230 meshed with the rack 200 and having a ratchet wheel 231 rigidly secured to one face thereof. This gear and ratchet wheel rotate on a stud 211 fixed to the machine frame.

Co-operating with the ratchet 231 is the double acting pawl 41 which permits the ratchet wheel to advance one tooth for each oscillation. This pawl is operated in one direction by a spring 233 and in the other by the armature extension 83 as shown in Fig. 1. Upon armature 83 being operated by its magnet 89, the escape or ratchet wheel 231 will be advanced one tooth as will the gear 230, the rack 200 and the paper carriage, the stepping of these parts being imparted by the spring 208. When the carriage is being returned by power of the motor as before described, to the starting position, the pawl and the ratchet wheel will, through their angle of contact, act in a well-known manner as a free escapement and exert but little retardation on the carriage.

Fig. 6A shows the relation of the paper carriage parts to the typewheel 71, printing hammer 297 and carriage supporting tracks. In the system described the paper can be spaced upward, the carriage can be returned to the starting position, and the carriage moved in a step-by-step manner across the machine as the printing goes on, every operation being accomplished automatically or manually as desired.

It will be understood that suitable bearings and supports are provided for all parts throughout the machine, these being well understood and omitted herein for simplicity of illustration of the operative parts. The V-shaped rollers and round tracks upon which the paper carriage travels, comprise a self cleaning and self-aligning traction system and practically eliminates any interference or undue friction because of accumulation of dirt.

Ink ribbon feed and printing mechanism

A standard typewriter ribbon 161 is preferably used for the ink supply for printing purposes and we preferably employ improved mechanism to control the movements of the ribbon during the printing process. This mechanism is so arranged that the ribbon is moved in a fully automatic manner whereby the machine may be operated to receive telegraphic messages when unattended.

With this in view we provide a pair of ribbon roll carrying spools 241 and 242 which are mounted upon and loosely keyed to the upper ends of vertical shafts 243 and 244, respectively. These shafts are driven by gear pinions 245 and 246, respectively, through universal joint connections 247 and 248, respectively; which are so made as to comprise laterally extending arms 249 carried by the ends of the shafts 243 and 244 projecting within an upper bifurcated clutch element swiveled at 249 upon the upper ends of shafts 250 and 251, and upon which latter shafts the pinions 245 and 246 are rigidly secured.

While both of the shafts are free to rotate, the ribbon can be withdrawn from either spool and rewound on the other spool by rotation of the shaft carrying the latter. The shafts 250 and 251 are each journaled at 252 and 253, respectively, in the shiftable plate 254. The sliding plate is adapted to be moved longitudinally upon the retaining pins 255 which have enlarged heads with reduced shanks passing through longitudinally extending slots 256 disposed at each end of the sliding plate. The universal joint connections 247 and 248, permit lateral displacement of the shafts 251 and 250 relative to the shafts 243 and 244, whenever the sliding plate 254 is shifted longitudinally to displace laterally the shafts 250 and 251, and the gears are carried with the shafts at such time.

In alignment with the spur gears 245 and 246 carried on the lower ends of shafts 250 and 251, are a pair of spur gears 257 and 258 which are so disposed that when the gear 246 is in mesh with the gear 258, the opposite set of meshable gears 245 and 257 will be demeshed. Contrawise when the gears 245 and 247 are in mesh the gears 258 and 246 will be demeshed.

The gears 257 and 258 are meshed with and driven by a train of other gears from a common driving pinion 259. The intermediate gear for the gear 257 being shown at 260, and for the gear 258 there is provided an interconnecting gearing comprising a pinion 261 having an enlarged gear portion 262, affixed thereto and a pinion 263 intermediate the gear portion 262 and the pinion 259. Non-rotatably secured on the gear pinion 259 is a ratchet wheel 264. Journaled on the shaft carrying the pinion 259 and the ratchet wheel 264 we provide a gear 265 in mesh with a rack 12 rigidly mounted upon the front of the paper carriage and longitudinally reciprocable therewith a pawl 266 is pivoted at 267 upon the upper face of the gear 265 as is also a leaf spring 268 which engages with the pawl 266 to resiliently press it toward meshing position with the ratchet wheel 264. This arrangement permits relative rotation of the gear pinion 259, with respect to the gear 265, in but one direction. By virtue of this arrangement the pinion 259 is caused to rotate in one direction,

when the gear 265 is rotated, but upon opposite rotation of the gear 265 no rotation of the pinion will occur.

Therefore when the carriage to which is secured the rack 12 is moved in a spacing direction both trains of gears meshed with the pinion 259 are driven thereby but when the carriage is returned to start the printing of a new line there will be no driving of the pinion 259 and the trains of gears in mesh therewith. To more positively prevent improper rotation of the trains of gears upon a return movement of the carriage, because of possible frictional effect in the escapement comprising the pawl 266 and ratchet wheel 264, we provide an additional spring press pawl 269 to prevent rotation of one of the gears in one of the trains, here shown as the gear 263.

The above arrangement is provided for the purpose of preventing rotation of the ribbon spools 241 and 242 during the return movement of the carriage and to provide for a step by step rotation of the ribbon spools as commonly required in typewriting apparatus during spacing movements of the carriage, and upon spacing movements that spool whose driving pinion 245 or 246 is in mesh with the intermediate trains of gears driven by the pinion 259, it will be rotated to wind the ribbon 161 upon it.

Parallel to the shafts 250 and 251 are provided the shafts 272 and 273 which are journaled at each end to the main frame 40. Attached to the lower end of the shafts 272 and 273 in proximity of the fixed bearings 271 are a pair of short lever arms 280 and 281. Carried by the upper end of each of the shafts 272 and 273 are arms 276 and 277 having rollers journaled in the outer ends. These rollers 278 and 279 bear upon the ribbon rolls 241 and 242. The rollers are held in engagement with the ribbon rolls by means of coil springs 274 and 275 substantially about the upper part of the shafts 272 and 273. The springs are secured at one end 38 and 39 to the main frame and are coiled about the shafts and are secured to the opposite end of the roller arms 276 and 277. The shafts 272 and 273 being parallel to the shafts 250 and 251 and the arms 276 and 277 being of suitable length, the rollers carried by the arms 276 and 277 will swing toward the center of the ribbon spools, and are caused to follow the ribbon during the winding and unwinding of the ribbon spools on or off by the action of the springs 274 and 275. As shown the ribbon rollers are supplied with the maximum and minimum diameter of ribbon rolls thereon. Ribbon roller 241 is at the minimum diameter and ribbon roller 242 is at the maximum diameter. It will be seen that any change in the diameter of the ribbon on the rolls will exert varying movements upon the arms 276 and 277 which in turn cause the shafts 272 and 273 to be rotated, transmitting a pivotal movement to the lever arms 280 and 281.

Carried by the plate 254, and in close relation with the gears 257 and 258, are two pawl members 282 and 283. The pawls are normally held in operative position against the stop pins 284 and 285 by the spring action exerted by the flat springs 286 and 287 secured to the plate 254. The pawls are pivoted to the plate 254 the outer ends being shaped so as to provide a lug on one side thereof to be engaged by the short arms 280 and 281 while the opposite side of the pawls are provided with a sharp tooth. The outer end of the pawls terminate in a projection on which the springs 286 and 287 exert their force to retain the pawls in inoperative position.

As shown the plate 254 is in its maximum left hand position relative to its support. In this position the tooth on the pawl 282 is disposed in substantial radial alignment with the center of the gear 257, while the pawl 283 in its shifted position is left of the radial center of the gear 258. If the gear 257 is rotated by the carriage, and in the direction of the arrow, and if the pawl 282 is pushed against its spring and into engagement with the gear 257 this gear will draw the pawl along with it until a time is reached when the pawl is released. The pawl being attached to the plate 254 it too will be moved in the direction of the arrow by the active gear until the pawl is released.

Engagement of the pawl with the gear wheel is brought about by the roller arm 276 contacting with the ribbon spools 241, so that when the diameter of the ribbon on the roll reaches a predetermined minimum the roller arm will transmit a rotary motion to the short lever arm 280 so as to abut against the lug 36 on the pawl 282. The rotary motion to the short arm is transmitted by the shaft 272 herebefore described in detail. The same operation is effected by the ribbon roll 242 and roller arm 277 on the pawl 283 when the ribbon has been exhausted to the minimum from the ribbon roll 242.

Heretofore we described the engagement of the pawl and the gear whereby the plate is shifted in the same direction as the gear is rotated. Inasmuch as the plate and pawl move more rapidly than the lever arms 276 and 277 the pawls are carried away from the gears 257 and 258 by the force exerted by the springs 286 and 287 when the short arms are moved away from the pawls, and the pawls are accordingly returned to inoperative position against the stop pins 284 and 285.

To overcome any friction between the pawl and the gear wheel we have provided a means to cause disengagement. Preferably the means provided consists of a pawl 290 pivoted to the main frame of the machine and held in one of two notches 238 and 239 provided on one side of the plate 254, by the force exerted by the spring 289 supported on the main frame of the machine. It will be seen that shifting the plate 254 in either direction by the gears 257 or 258 lifts the pawl 290 from one notch in the plate and the spring forces the same into the other notch. In this manner the plate 254 is held in position until the ribbon is exhausted from one of the ribbon rolls. It will also be seen that any friction between the pawls and the gears while in engagement with each other, will be overcome by the snap action of the pawl 290 in entering one of the notches on the plate 254. In this way the plate is carried ahead faster than the speed of the gear thereby allowing the pawls 282 and 283 to return to inoperative position.

When the plate 254 is shifted to the left the gears 246 and 258 are in mesh while gears 245 and 257 are separated, likewise the shifting of the plate 254 to the right will cause gears 245 and 257 to mesh, while gears 246 and 258 are disengaged. From the foregoing it is evident that as the gear trains herebefore described, are rotated by the carriage rack, and the gears 245 and 246, when either is in engagement with the train gears, the ribbon rolls will be rotated in one direction or the other, depending upon which of the gears referred to are meshed, thereby causing the unwinding of the ribbon from the free ribbon roll and winding the ribbon on the driven roll. It will be noted that, although one ribbon roll is

termed a free ribbon roll, the roller arms **276** and **277** act as brakes by virtue of the tension exerted on the roller arms by the springs **274** and **275**.

The winding and unwinding operation of the ribbon spools takes place in either direction until a time when the ribbon on the free ribbon roll reaches a predetermined diameter, at which times, the reversing mechanism herebefore described automatically shifts the gears **245** and **246**.

A side view of the printing apparatus is best shown in Figs. 5A and 6A and will be hereinafter more fully described.

The ribbon is guided through a pair of guide slots provided in the ribbon elevator **35** and in the upper portion thereof. These guides are supported by a pair of parallel arms **305** at **306** which are pivoted at one end **304** to the main frame of the machine. The ribbon elevator **35** also comprises a curved armature arm **307** fastened together by spacing studs **308**. Carried by the elevator **35** and above these studs are two small rolls **294** adapted to rotate on a vertical axis to reduce the friction between the ribbon and the guide slots as the ribbon passes the type wheel.

In normal position the elevator used is in such a position as to leave the top of the ribbon slightly below the point of contact with the paper **33** which receives the printed characters. When the elevator member **35** is raised upward against the stop pin **296** the ribbon will be carried upward in direct alignment with the characters on the typewheel **71**. Thus a clear vision at all times may be had by the operator, except when the printing operation is taking place. The elevator member **35** is forced upward into printing engagement by the action of the printing hammer arm, **297** armature arm **307**, and magnet **300**, which will be hereinafter described more in detail.

Disposed below the elevator **35**, substantially at right angles thereto is a curved armature arm **307** pivotally supported on a shaft **308** and adapted to support on its outer end a magnetic pole piece **299**. Upon the end of the armature **307** is pivoted the printing hammer **297**. Disposed below and in alignment with the pole piece **299** is an operating magnet **300** supported on the main frame in such a way that the energizing of the same attracts the pole piece **299** downward rocking the armature **307** causing the printing hammer **297** to be swung upward on its pivot **34** to effect the printing on the paper **33**.

The printing hammer is composed of two L-shaped pieces **302** one of which appears in the drawings joined at the ends of their long arms and secured to the hammer head **297** in any well known manner. The shorter arms of the L-shaped members **302** have bearings **303** adapted to support a roller **301** journaled to freely rotate therein. The long arms of the member **302** normally rest on the shaft **308**, adjacent the hammer head **297**. A screw **309** is also provided to limit the downward movement of the armature and hammer, and is preferably adjustable to vary the movement of the armature arm **307**.

The action of the above in the elevation of the ribbon and printing hammer is as follows: When the magnet **300** is energized the armature pole piece **399** is drawn downward raising the curved end of the armature and the hammer. If the operation were slow and the elevator relatively heavy, the roller **301** journaled in the short end of the arm **303** of the hammer, would be forced under the spacing stud **293** and the hammer would be raised up and against the paper at a point below the proper printing position, and the ribbon would not have been raised.

The above described operation of the combined units is effected by the speed of operation, and the relative positioning of the different cooperative parts. The arms of the hammer unit are set at such an angle from the vertical and the hammer is made of such a weight, that a certain resistance to the movement thereof around the pivot **306** results. The angular relationship of the roller **301** to the spacing stud **293** is substantially 45 degrees which tends to cause an upward thrust on the elevator **35**.

Cooperating with the previously mentioned factors is the elevator which should be so proportioned in weight as to offer a certain resistance to the raising of the hammer. When its function is completed, the quick movement of the armature **307** by the magnet **300**, is resisted by the angle and weight of the hammer and the angular relation of the roller **301** and the stud **293**. The force resulting from this reaction is all applied to the stud **293**, accordingly the elevator **35** will be raised to a position governed by the stop **296**. At the end of this movement the relation of the roller **301** to the stud **293** is such as to cause the roller to travel under the stud **293** causing the upwardly swinging action of the hammer on its pivot toward the typewheel **71**.

As the hammer is raised and rotated around its pivot the angle between the roller and the stud gradually decreases until a point is reached where the movement of the roller is in a horizontal plane. At this point the roller will ride under the stud while the hammer will continue its arcuate movement until it strikes the type wheel **71**.

It will be seen that the action of the roller and the stud forces practically all of the power to initially lift the ribbon elevator. The hammer is then started slowly in its travel toward the typewheel, the speed being increased until the roller leaves the stud and the hammer completes its stroke. In this way the ribbon is raised up in front of the type wheel while the printing hammer is caused to strike the ribbon forcing it against the paper causing the type wheel to impress a character on the paper.

The relative positions of the various parts of the units just described are best shown in Figures 5 and 5A.

The ribbon and the printing mechanism is preferably located centrally and in front of the paper carriage. The ribbon elevator **35** and the armature **307** spanning the paper roll **152** on the carriage brings the ribbon and the hammer in close proximity of the typewheel as will be seen by reference to Figure 5A.

The control of the electric circuit to the magnets **300** will be hereinafter fully described.

Motor and line switch

Included in the machine is a mechanism for the switching on and off, of the motor, the switching of the line circuit to the sending, receiving and stopped condition, and a time limiting or time delay action for stopping the machine automatically after a predetermined time period has elapsed. This unit is power driven with the exception of the two manually operated buttons provided at the right and is controlled by the buttons, the two magnets and paper carriage.

The power employed to drive the machine is preferably an electric motor. Suitable switches are provided to start and stop the motor at times

desired so that the machine does not operate continuously but is always under the control of the operator who may be at any machine of the system. The motor switch heretofore referred to is of the toggle type, and the switch blade is operated in one direction by the motor and is returned by a spring. We have arranged preferably two L-shaped levers 310 and 311 which are supported on a common pivot 312, one of these members extending upwardly and to the right while the other member extends upwardly but horizontally in the opposite direction. The L-shaped lever 310 is provided on its lower end with an insulator portion upon which is fastened a contact plate 313. When in the operative position shown the contact plate 313 engages two fingers 314 completing an electrical circuit through the fingers 314 to the motor.

The right hand portion of the L-shaped lever 311 is tapered downwardly to insure engagement with the armature 315. Disposed at equal distances between the ends of the L-shaped levers 310 and 311 are preferably pins 316 and 317 which support a spring 318 in its stretched position. The function of the lever 311 is to raise the spring 318 upwardly until it passes above the pivot 312. This action will give to the lever 310 a snapping upward movement and if the lever 311 is lowered so that the spring 318 passes below the pivot stud 312, the L-shaped lever 310 will be snapped down into contact with the fingers 314 again.

The vertical section of the L-shaped lever 311 extends above the periphery of the gear 319. Carried on the face of the gear 319 is a pin 320 which is carried around as the gear 319 is rotated in the direction of the arrow and which is capable of striking the L-shaped lever 311 and moving the same to the left until the pin passes over the end of the L-shaped lever 311. As the pin 320 moves the L-shaped lever 311 to the left, the horizontal section of the L-shaped lever 311 will be raised on its pivot 312 above the armature 315. The end of the bevel portion of the L-shaped lever 311 then passes into the notch in the armature 315 and the armature 315 will be drawn over by the spring 321 and caused to pass under the lever 311 locking the same in this position. Simultaneously the pin 320 on the gear 319 passes the point of contact with the L-shaped lever 311. This operation opens the motor switch and it is locked by the armature 315.

Carried by the main frame of the machine and the L-shaped lever 311 is a spring 322 which is secured to the L-shaped lever near its bevel end. The function of the spring 322 is adapted to draw the L-shaped lever 311 downwardly when it is released by the armature 315.

The armature 315 is operated by energizing the magnet 323. When the armature is moved to the right it will release the L-shaped lever 311 which will be drawn downwardly by the spring thereby closing the switch. The movement of the L-shaped lever 310 in opening and closing the switch also operates the contacts 324 through the insulating stud 325. In opening the switch only the L-shaped lever 310 operates a horizontal bar 326. The function of the bar 326 will be hereinafter more fully described.

Associated with and driven by the motor is a gear 327 and a train of gears, 328, 329, 330, 331, and 332, the ratio of these gears being such as to give a predetermined reduction in speed between gears 328 and 332. The driving gear 327 being engaged directly with the gear 328, any operation caused by the gear 328 will be fairly fast relatively to the speed of the gear 327 and any function caused by gear 332 will be much slower depending upon the gear train ratio selected for a definite interval of time.

Disposed directly in front of and below the axis of the gears 328 and 332 are two gears 319 and 333 all of equal size. These gears are intermittently meshed with the two driving gears 334 and 335 and are driven when so meshed by the companion gears 328 and 332. As the three sets of gears referred to above operate in a similar manner their locking and releasing operations are alike. The functions of gears 328, 319, and 334 will now be described.

Gears 328 and 319 are mounted on parallel axes of rotation, each facing the other with a slight clearance between them so that when the gear 334 is brought into mesh with the two gears 328 and 319, by swinging on the pivot 336, the lower gear 319 is driven by the upper gear 328 through the gear 334 as best shown in Fig. 7A. It will be seen that gear 319 receives an intermittent rotary motion by being meshed or unmeshed with the gear 334. Relative spacing of the gears 328 and 319 is important in this operation. It will be seen that if the gears were in alignment and the gear 334 was in engagement with the gears 328 and 319 the angle of the teeth on these gears when in contact with each other, and when power is applied to gear 328, and a load applied to gear 319 the idler gear 334 would be forced out of engagement with the other gears 328 and 319. Should the centers of the gears 328 and 329 be spaced a given distance apart the angles of the teeth on the gears, relative to each other, would be in opposite order and the idler 334 would be drawn closer between the gears 319 and 328 and ultimately locked in this position while power was applied to gear 328 and a load maintained on gear 319.

Any action of this kind by the gears 328, 319, and 334 is overcome by spacing the driving and the driven gears in such a manner as to bring the angles of contact between the teeth of the gears and of the idler into substantially parallel planes. This results in the idler gear when released meshing with the gears 328 and 319, and remaining in meshed position until the load is removed or the gears unmeshed. The difference in the angle of contact of the gear teeth is substantially zero and the slight locking which takes place is not to such an extent as to render the separation of the gears difficult.

When the gear 334 is meshed with gears 328 and 319, it is necessary that the idler gear become properly meshed with both the gears 319 and 328. This action is assured by placing the arc through which the center of the gear 334 travels at such position that the gear 334 will always contact with the driving gear 328 first which will draw the idler gear 334 into mesh with the driven gear 319. Gear 334 is loosely journaled in the upper end of a bell crank lever 337 which is pivoted to the main frame at 336 and swung to the left by a spring 338 and in the opposite direction by a pin 339 carried on the bar 326.

The bell crank lever 337 is beveled at the end of the horizontal section which is engaged by the armature 340. The armature normally holds the bell crank lever 337 in a position disengaging gears 334 from gears 328 and 319. Should the lever 337 be released by the armature 340 at a time when the motor switch is closed and gear 328 is being rotated the spring 338 on the bell

crank lever 337 will bring the gear 334 into mesh with the gears 328 and 319. Gear 319 will now be rotated in the direction of the arrow, carrying the pin 320 around into contact with the upper end of lever 311. Continued rotation of gear 319 will open and lock the motor switch as heretofore described and simultaneously the vertical section of the lever 310 strikes a pin on bar 326 shifting the bar to the right. This movement of the bar 326 by means of the bell crank lever 337 disengages the gear 334 from its companion gears. Bell crank lever 337 will be locked in this position by the armature 340 and the spring 341. In this manner the motor switch can be closed by energizing magnet 323 and is opened by energizing magnet 342.

Referring more particularly to the time limiting feature for the opening of the switch which functions substantially the same as the motor switch proper, in regard to intermittent drive by the gear train, through the idler gear 335 and gears 332 and 333. The idler gear 335 is carried on a vertically disposed lever 343 which is pivoted at its lower end 44 to the machine frame and extends upward in line with the fixed rack 200 on the paper carriage 151. The lever 343 retains the gear 335 in engagement with gears 332 and 333 by the action spring 346 during the time it is not in contact with the rack 200, or shifted to the right by the pin 347 on the bar 326. The engagement of gear 335 in mesh with gears 332 and 333 slowly rotates gear 333 at this end of the gear train at a reduced speed in the direction of the arrow.

Upon the face of gear 333 a stud 348 is carried which is held against a stop lever 349 by means of preferably the spiral spring 350, one end of which is attached to the pin 348 in the gear wheel 333 while the other end is secured to the stationary bearing 351 upon which the gear 333 rotates. It will be seen that should the gear 333 be turned in a clockwise direction and released, it will be returned to its normal position with the pin 348 against the stop lever 394 by the spring 350. Rotation of the gear 333 far enough, will cause the pin 348 on this gear 333 to strike the upper end of lever 352, pivoted at its center to the main frame of the machine, thereby contacting its lower end to operate the armature lever 340 to the right.

Operation of the armature 340 by the lever 352, will release bell crank lever 337 thereby opening the motor switch as heretofore described. With the operation of the switch lever 310, the bar 326 is shifted to the right and the pin 347 in the bar 326, to the left of lever 343, will shift lever 343 and, in turn the gear 335 out of engagement with its associated gears. As soon as gear 335 is released from gear 332, gear 333 will be returned by the spring 350 to normal position, and gear 335 will be held out of engagement with gears 332 and 333 as long as the motor switch is open. It will be re-engaged with gears 332 and 333 the moment the switch is closed provided the paper carriage is not in the starting position.

Each time the paper carriage is returned to starting position by the motor, the rack 200 will strike the lever 343 and dis-engage the gear 335 from gears 332 and 333 allowing the gear 333 to return to normal position. The motor has now been started by the operation of the motor switch and consequently the switch member 310 will release bar 326 and the spring 353 will move the bar 326 to the left. The lever 343 is then released by the pin 347 in the bar 326 and the gears 332, 333 and 335 are meshed and slowly rotate the gear 333.

Assuming that the rotation of gear 333 will bring the pin 348 into contact with the member 352, thereby opening the motor switch at the end of, a five minute period of time for example, if return of the paper carriage does not take place during this time, and the machine will be automatically stopped. However, if carriage is returned to its starting position at any time during this five minute period of time, the carriage will strike the lever 343; the gear 333 will be returned again to its normal position. There is preferably a five minute interval of time between the last operation of the carriage, the starting of the machine, and the moment when the machine will be automatically stopped. The machine will continue to run, if the printing is not stopped, for a greater period of time than that for which the time limit mechanism is set. The interval of time for which the automatic operation of the motor switch is set can be varied by changing the distance between the pin 348 and the stop lever 349.

Any suitable means may be provided to mount the pin 348 so that its position may be adjustably varied by minute amounts. A parallel motion is given the bar 326 by pivotally supporting it on preferably two links 354 and 355 at each of its ends. These links are pivoted upon the frame of the machine. Mounted upon the same pivot journaled with link 354 is a hooked pawl 356 with three extension arms, the lower arm being turned at its extremity at substantial right angles to and in alignment with the link 354 and the end of the upper arm being in co-operative relation with the button 357. Both the bar 326 and the pawl 356 are operated in one direction by the spring 353. When the bar 326 is moved to the right, the link 354 will raise the hooked end of pawl 356. The pawl 356 can also be operated by the button 357 without rocking the bar 326.

Stopping the motor will shift the bar 326 to a right hand position accordingly releasing gears 334 and 335, and raising the hook on the pawl 356 above and clear of the upwardly central projecting contact 358 in the group 359. The right hand contacts in this group will be closed and the left hand contacts will be opened. As described in another part of the specification, closing the left hand contacts of group 359, completes the line circuit through magnet 323 and the line battery. Energization of magnet 323 by the line battery operates the motor switch.

The contacts of group 359 are operated by the starting button 360, which, when pressed into engagement with the long contact spring 358 will bring the end of the spring in engagement with the hooked end of the pawl 356 and simultaneously with the moment of contact between the springs, the motor switch will operate to allow the hook on the pawl 356 to drop and hold the contacts in position shown in 8A while the start button 360 is released.

The contacts are held in this position as long as the machine is operating as the transmitting machine. This position is also maintained until the contacts 359 are released by manually actuating the transfer button 357 which connects the machine for receiving only, or when the motor switch is operated by other means as mentioned otherwise. Figure 7A is a side view of the idlers 334 and 335 and their companion gears. A full detailed description of operation of the complete unit in co-operation with the rest of the machine

has been given in another portion of the specification.

Line circuit and operation

The two line circuits are best shown in diagrammatic views Figs. 8 and 8A. Fig. 8 has one line relay which energizes a secondary circuit of the machine when sending and receiving, while Fig. 8A has a separate line relay for sending and for receiving which will be hereinafter more fully described. The use of two relays is advisable in cases where there is considerable leakage in the circuit between two machines, as the individual relays can be adjusted to suit the condition under which they would function when used for one operation only.

The source of current is preferably at the transmitting end of the system. The relay at this end is subjected to varying operating characteristics different from that of the receiving relay at the opposite end of the line.

Only in cases of extreme line leakage is the circuit of Fig. 8A necessary. The operation is the same in both circuits with the exception of the dividing of the incoming and outgoing impulses between relays **361** and **362** in Fig. 8A. At **363** and **364** is represented the line terminals of the machines when they are connected. Dotted lines representing line circuit conductors **701** and **702** interconnecting the circuits of Fig. 8 and Fig. 8A, indicate how two machines comprising transmitting and receiving elements may be interconnected by line conductors. Either of the machines may be of the two-relay (Fig. 8A) or one line relay (Fig. 8) type.

The transmitting and receiving circuit is completed through the two machines. When a machine is not in use, the circuit can be traced as follows; from terminal **363**, through conductor **365**, motor switch magnet **323**, conductor **368**, contacts **324** and **367**, conductors **369** and **370**, contacts **359** and **358** and then from conductor **373** to terminal **364**. This is the normal circuit when the machine is idle. Should current now be supplied to terminals **363** and **364** from another machine, the trip magnet **323** of the motor switch will be energized, the insulator portion **325** of the motor switch will reverse contacts **313**, **367**, and **324**. Reversing the contacts of group A will complete the circuit for receiving, from conductor **365** through conductor **376**, contacts **313** and **367**, conductor **368**, line relay **361** and conductors **377** and **370**, as heretofore described.

The contact group A short circuits the line relay **361** and closes the circuit through trip magnet **323** when normal, and the reversal of the group A by the motor switch short circuits trip magnet **323** and closes the circuit through the line relay **361**. When current is supplied to the terminals at this time, the line relay **361** will be operated by the received impulses and will close a local circuit in the machine.

Reviewing the foregoing when the machine is idle, trip magnet **323** is connected into the line circuit, and an incoming impulse will cause the trip magnet to release the motor switch, starting the motor and the machine; the switch **367** will cause reversal of the contact group A, short circuiting the trip magnet **323** and finally connecting into the circuit line relay **361**.

The resistance of magnet **323** and relay **361** being the same and switching arrangement makes it possible to change from one function to another without any change in the loop resistance of the line circuit, and two or more machines can be switched in or out of the line circuit without a change in the value of the line resistance.

The line circuit and its equipment, as just described, applies to the machine acting as a receiving machine and being controlled at one end of a circuit by a transmitting machine at the other end of the circuit. At the transmitting end, the circuit through the machine, when in operation, differs from that of the receiver because the transmitter unit must be included in the circuit. The setup and operation of the circuit and apparatus in the transmitting machine follows, when two machines are connected together, but idle, the line complete through the trip magnets **323** of each machine. When it is desired that the machines be started, current is supplied to the line momentarily to operate the motor switch trip magnets **323**. This is accomplished by the operator pressing the start button **360** which must be operated to its limit of movement thereby opening contacts **358** and **359** and closing **372**, **358**, and **379**.

The line circuit is now complete in both machines from terminal **363** through conductor **365**, trip magnet **323**, conductors **380** and **368**, contacts **367** and **313**, conductors **369** and **395**, line battery, conductors **391** and **392**, contacts **372** and **358** through conductor **373** to terminal **364**. The current from the battery **374** will operate the trip magnets of both machines and, the motors will be started.

In the receiving machine, only the reverse operation of the contact group A will occur when the motor switch operates, but at the transmitting machine, together with the operation of the contact group A, the pawl **356** releases the hooked end so as to overlap the upper end of contact **358**. When the pressure is removed from the button **360** the spring contact **358** will engage the pawl **356**, opening contacts **372** and **379** but keeping contacts **379** and **358** closed. The contacts **372** and **379** when closed, short circuit the open contacts **132** on the key transmitter completing the line circuit through the battery, but when the button is released and the pawl **356** engages the contact spring **358**, as shown in Fig. 8A, the transmitter contacts **132** will be connected in the line, from terminal **363** through conductors **365** and **376**, contacts **367** and **324**, conductor **368**, relay **361**, conductor **395**, battery **374**, conductors **391** and **396** to the transmitter contacts **132**, from contacts **132** through conductor **397**, contacts **379** and **358** and conductor **373** to terminal **364**.

In the manner set forth the line relay is the same both for the sending and the receiving machine, but the transmitter contacts and line battery are connected into the line circuit at the transmitting machine. When two complete machines are connected to a line, either machine can be set up as a transmitter or receiver depending upon which of the machines the starting button **360** is pressed. The transfer button, **357** makes possible the quick change in the line circuit from transmitting to receiving while the machines are running. When the machines are in operation but the transmitter keys of the sending machine are not being operated, the transmitter contacts **132** remain open thus opening the line circuit. If while a message is being received from the transmitting machine should the receiving operater desire to stop the transmission of the message, the starting button **360** is pressed. This, through its contact group B opens the line circuit at the contacts **359** and **358**, at the receiving machine. This stops all transmission over

the line and indicates to the transmitting operator to set his or her machine for receiving.

This is accomplished by operating the transfer button 357 which trips the pawl 356 and allows contacts 358 and 359 to complete the circuit from terminals 364 to the relay 361.

Manipulation of buttons 360 and 357 allows for transmitting correspondence over a line in either direction at will. As stated heretofore, circuits in Figs. 8 and 8A are similar except as to the relay 361 which is reversed with respect to conductor 395 as shown in Fig. 8A. The relay 362 being added to the conductor 398 in the circuit of Fig. 8A. In this arrangement, relay 361 is short circuited and relay 362 operates in the transmitter circuit when sending, and when receiving, relay 361 is connected in the line circuit and relay 362 is connected in the open transmitter circuit. The machine is stopped by sending a particular series of impulses over the line circuit by the transmitter which operates magnet 342 (Fig. 7), indirectly causing the motor switch to open. In Fig. 8A, the contacts or relays 361 and 362 are preferably placed in multiple.

The opening of the motor switch, through the insulator 325 reverses the contact at "A" and releases the pawl 356 causing reversal of contact "B". It is apparent that the opening of the motor switch puts the line circuit and apparatus in its normal or inoperative position ready for the starting impulse at the desired time.

Machine circuit and operation

The circuit of the complete machine is preferably divided into three divisions viz; the line circuit that has heretofore been described, the first secondary circuit that is controlled directly by the contacts of the line relay, and the second local circuit that is controlled by the contacts of the slow release relay and the cam or armature operated contact groups. The first secondary circuit is best shown in Figure 9, in heavy lines and designated circuit "A". The other circuit is shown in light lines and designated circuit "B".

The power supply for the local magnets is received from the generator 407 coupled to and driven by the motor, not shown, which has been heretofore mentioned as the source of driving power for the machine. The line relay through the conductors 400 and 401 receives the impulses set up by the transmitter, and through the energizing of the armature 403 to swing contact 85 into closed or opened position with relation to the second circuit through the magnets 88, 87 and 114 and the generator 407 in unison therewith.

Magnet 88 oscillates finger 79 on long impulses only. Relay magnet 114 is rendered slow-releasing by short circuiting one or more turns of its winding, or otherwise, and functions to keep the second local circuit open during the reception of a series of impulses.

The second circuit can be traced from the line relay contact 63 through conductor 413 circuit "A" to conductors 408 and 409 where it is divided into a multiple circuit through magnets 88 and 87. Conductor 410 connects magnet 88 and the slow release relay 114 through conductor 411, generator 407 and conductor 412 to armature 403 of the line relay. A combination of impulses from the transmitter to the line relay 402 will set up a like series of impulses in the local circuit, all impulses operating magnet 87 and allowing the typewheel to advance one division for each impulse. All long impulses will operate magnet 88 which shifts the escape finger 79 and rotates the typewheel 71 the same or a greater number of divisions than does the magnet 87, and also controls the channel position of the typewheel 71.

Relay 114 is also affected by all the impulses, but due to its slow release action it will remain operated during the reception of a series of impulses keeping the second local circuit open during this period and stopping the printing or other functions. During the time when no impulses are being received, cam 109 keeps the armature 113 in operative position, opening the second local circuit through contacts 112. The foregoing action saves time and the operation is more positive. The armature 113 is always in the operated position when the first impulse of any series energizes magnet 114 and it is only necessary that the armature be held in this position during the first impulse by cam 109, the remainder of the series holding armature in attracted position through magnet 114.

Cam 109 only engages the armature arm 113 at the first division of the typewheel 71 and the first impulse of any series moves the cam 109 ahead of armature 113, during the remainder of the revolution and until the typewheel is returned to the first division, the armature 113 is free to drop back and close its contacts 112 when not attracted by magnet 114.

In this manner the second local circuit is held open at contacts 112 when no printing is being performed through the cam 109 and during the reception of impulses by magnet 114 but soon after the last impulse is over the armature 113 closes the second circuit through contacts 112 and the printing and restoring take place.

In the embodiment of our invention herein described, the proper operation of the magnets is thus largely dependent upon the speed at which they may be actuated or released, and in this connection it is well to note that the magnet 87 is fact in actuation and responds to all impulses, while the magnet 88 is slow in actuation and quick in releasing and responds only to the long impulses. The magnet 88 is in series with the slow relay magnet 114, whose armature may also be operated mechanically by cam 109, and is slow releasing when magnetically operated. Due to the mechanical construction of the armature 84 and the retarding effect of the slow relay magnet 114 in series with magnet 88, it responds only to prolonged impulses through magnet 88 and releases quickly when the current is cut off.

When no impulses are being received, the armature of relay 114 is held up by cam 109, and the first impulse disengages the cam and frees the armature, the armature still remaining in that position as long as the impulse, or series of impulses continues, All other magnets are made to operate or release as rapidly as is possible.

The sequence of operation of the several magnets is as follows: the closing of the line relay contact will send impulses through magnet 87 and slow relay 114 and magnet 88. If the impulses be short, magnet 87 will only operate and if long, magnets 87 and 88 will operate in the sequence. The slow relay will hold its contact open during the series of impulses. The operation of magnet 87 will only advance the typewheel one division for each impulse and the operation of magnets 88 and 87 together will advance the wheel one or more divisions per impulse. In any case that the operation of both magnets advances the wheel only one division

the magnet 88 will shift the wheel along the shaft 72 to the second or third channel.

At the end of a series of impulses the slow relay will close its contact and operate the other magnets as follows: if the wheel is stopped on the first division the relay contact will close a circuit through magnets 89 and 104, magnet 89 allowing the wheel to complete its revolution to normal position and magnet 104 will shift the wheel to the first channel or normal position. Should the wheel be stopped on the second or any division from second to fifteenth, inclusive, the relay will close the printing magnet (300) circuit which in turn will close the circuit to magnets 89 and 104 restoring magnets 89 and 104 as on the first divisions. Should the wheel be stopped on the 16th division it will close a circuit through either the carriage return magnet 196 or stop magnet 342 depending upon the position of the typewheel with respect to its channel.

The restoring magnets are operated directly from the relay on the functional divisions, first division spacing and sixteenth division carriage return and stop. The relay operates the printing magnet which in turn operates the restoring magnets on the intermediate divisions.

In order that exact synchronism of speeds of the motors at descending and receiving stations may not be required, in the practical operation of our improved system, we rotate the shaft 72 of the receiving mechanism at such a higher speed that we rotate the shaft 130 of the transmitting mechanism so that even though the speeds of each of the motors at the descending and receiving stations vary within the commercial limits, at all times the speed of rotation at the receiving station will be in excess of that at the descending station, the pawl and escape wheel mechanisms herein described so operating that slippage of the clutch, Fig. 2, compensates for the difference in speeds in the effect produced upon the type wheel rotation.

Clearer understanding of the function of the escapement can be best seen by assuming that magnet 87 operates just ahead of magnet 88 on the longer impulses. All impulses whether long or short, through magnet 87 oscillate the fingers 78 and 79, once for every impulse allowing the escapewheel 75 and the typewheel 71 to advance one division for each impulse.

Should a long impulse be received the magnet 88 will shift finger 79 in line with escapewheel 76 having a lesser number of teeth than the wheel 75. When a tooth on wheel 76 adjoins one on wheel 75, which is true for the first two teeth of wheels 75 and 76 for each of the first two impulses the finger 79 will have been engaged even if shifted and the wheels will be advanced but one division. As the first two teeth are engaged by finger 79, both wheels 75 and 76 will be advanced but one division on the first two impulses of any series, whether the impulses be long or short. Now should the third or following impulses be for a longer period, the finger 79 will be shifted to the wheel 76 by magnet 88 and the magnet 87 will lift finger 79 into engagement with wheel 76 whereby all the wheels will be advanced until the finger 79 comes into contact with a following tooth which may be several divisions ahead.

It should be understood that at certain times an impulse slightly longer than that required to advance the wheels one division will allow the wheels a free rotation for several divisions. With a short combination of impulses any one of several characters on the typewheel can be brought to the printing position. The first two impulses of any series does not advance the wheel but one division each, any movement of the armature 84 on the first two impulses will cause the shifting of the typewheel to the second or third channel and the selection of a character in any channel is accomplished thereby.

A view showing one combination of escapewheel is best shown in Figure 10. The first vertical column represents wheel 76, the second wheel 75 and the third wheel 77. The horizontal divisions are the teeth on the respective wheels. It will be seen from this that finger 78 operates in column 2B when selecting and in column 3D when restoring the wheels to normal position, and finger 79 operates in column 2B on the short impulses and in column 1C on the long impulses, it is obvious how any character on the typewheel can be brought to the printing position with a certain combination of impulses and restored to its normal position by the operation of magnet 89.

After the selection of a character on the typewheel the printing takes place and then the wheel is restored to its normal position with respect to its further rotation to the first division and to its shifting to the first channel. The printing is accomplished by magnet 300 (Figs. 5 and 9) which operate the swinging contact 415 on its pivot. Magnet 104 restores the type wheel to its first channel position and magnet 89 sets the escapement for the return of the typewheel to its first division and operates contact group 416. The cam 107 actuates the contact group 110 on the first, second, and last divisions of the wheels and stops the operation of the printing hammer during this time these positions being used for other functions of the machine. Now as division 1 is the normal position of the typewheel and all circuits are open, one impulse either long or short, advances the wheels to the second division and cam 109 will release armature 113. At the end of the impulse, armature 113 closes contacts 112 completing the typewheel restoring circuit from contact 112 through conductor 418, contacts 419 and 420, and conductor 421 where it is led into magnets 104 and 89, thence through conductors 422, 423 and 424 to generator 407 and conductors 412 and 425 to armature 113.

Magnets 104 and 89 now return the wheel to normal channel and division respectively; the rotating shaft 72, Fig. 1, operating the cam 107, Figs. 1 and 9, to cause engagement of contacts 427 and 428 which occurs immediately following the opening of contacts 431 and 432 by movement of the armature 83, thereby keeping the printing magnet 300, controlled by the contact 432 inoperative and spacing the paper carriage one division by means of the armature 83, Figs. 9 and 1, and the escapement 41, Fig. 1.

The transmitter cam adapted to close the line for one impulse is connected to the space bar of the key board and spacing of the carriage occurs each time the space bar is depressed. When a character has been selected between the second and last division of the typewheel 71, cam 107 opens contacts between 419 and 420 and closes contacts between the 427 and 428. The printing circuit has now been closed from contact 112, through conductor 430, contacts 431 and 432, conductors 434 and 435, printing magnet 300, conductor 436, contacts 427 and 428, conductor

437, generator 407, conductors 412 and 425 to armature 113.

This energizes the printing magnet 300 which operates the printing hammer 297, closing contacts 415 and completing the restoring circuit from contact 112, through conductors 430 and 438 to contacts 415, conductors 439 and 421 to magnets 89 and 104; through conductors 422, 423 and 424 to generator 407, conductors 412 and 425 to armature 113. Magnet 104 shifts the typewheel to the first channel and magnet 89 allows the typewheel to rotate to the first division opening the printing circuit at contacts 431 and 432. Simultaneously contacts 431 and 433 are closed, short circuiting contact 415 so that magnets 104 and 89 remain energized after the printing magnet is cut out, and until the restoring operation is complete.

The foregoing describes all operations, except of the last division 16 of the typewheel, which division is utilized for the carriage returning, and the motor stopping functions. The carriage returning and stop functions are controlled by cam 108, Figs. 1 and 9, which closes contacts 111 at the last division position of the typewheel, contacts 440 which are operated by the typewheel lever arm 93 and contacts 431 and 432 operated by the armature 83. The non-printing position of the typewheel is maintained by cam 107 and contacts 110.

A carriage return and a stop key is provided on the transmitter and when the stop key is depressed, the impulses sent out will bring the typewheel 71 around to the last division in the first channel and the carriage return key brings the wheel to the last division but in the second channel. Pressing the stop key brings the wheel to a position where cam 108 closes contacts 111 and arm 93 holding contacts 441 and 442 closed. Upon completion of a series of impulses, armature 113 closes the circuit from contacts 112 through conductor 430 to contacts 431 and 432 to conductor 444, contacts 111, contacts 441 and 442, magnet 342, conductors 445 and 424, generator 407, conductors 412 and 425 to armature arm 113.

The above circuit described causes magnet 342 to operate armature 340 and the motor switch, at the same time the restoring circuit is closed through contact 112, conductor 418, contacts 419 and 420, conductors 421, 446, and 447, magnets 104 and 89, conductor 422, 423, and 424, generator 407, conductors 412 and 425 to armature 113.

Armature 83 opens contacts 431 and 432 cutting off the magnet 342 allowing the typewheel 71 to restore to its normal position and advancing the paper carriage one division. The operation of the carriage return key will also bring the typewheel to the last division and in the second channel so that the wheel shifts to the second channel and armature arm 93 opens the contacts 441 and 442 closing contacts 442 and 443. The armature 113 is now released and a circuit will be established as just described, except from conductor 448 to contacts 442 and 443 through conductor 449, carriage return magnet 196 (Figs. 6 and 9) and conductor 451 to conductor 424.

Carriage return magnet 196 is now energized and attracts its armature 193 which engages the carriage return clutch. As heretofore stated, when the carriage 151 reaches the extreme limit of movement in the spacing direction, it automatically trips the carriage return clutch through a suitable mechanical means, or it can be accomplished through contact 202. When a circuit is completed between contact 454 and conductor 449, as shown by the dotted line 455 (Fig. 9), each time the carriage rack 200 closes contact 202 a circuit will be established through carriage return magnet 196 from one side of generator 407 through conductors 412 and 456, contacts 452, 453 and 454, conductors 455 and 449, carriage return magnet 196, conductors 451 and 424 to the opposite side of the generator 407.

The carriage return clutch, after being operated, by momentarily closing the contact 202 as required, remains engaged until the carriage reaches the end of its travel where the clutch is released. A signal is provided to indicate when the end of the printing space is near at hand. Preferably lamp 457 as the indicator, is used, the current being supplied by the generator 407 through contacts 452 and 453. These contacts can be so adjusted that the rack 200 on the paper carriage will close them preferably five or six spaced from the end of the carriage travel so that the lamp will light notifying the operator of the approach of the carriage near the end of its travel. It will be seen that because of the lamp signal, splitting of words through the functioning of the carriage return arrangement will be avoided. The same sequence of operation occurs for all characters printed and every mechanical function of the machine.

Escapewheel and typewheel chart

The chart of the peripheries of the escapewheels and the typewheel is shown in a single plane in Fig. 10. The relation of the teeth on the three wheels 76, 75, and 77, and their relation to the character and functional points on the typewheel are best shown in that figure.

The vertical columns 76, 75, and 77 are schematic views of the escapewheels best shown in Fig. 1, and the horizontal columns are the teeth on the wheels. Vertical columns 1, 2, and 3 are a similar view of the three circumferentially disposed channels of the typewheel, the horizontal columns are the character and functional points on the wheel. The chart shows a 17 division, 3 channel typewheel having 47 printing and functioning positions.

The direction of rotation is shown by the arrow, the normal division 460 is at the bottom of the Figure 10. The escapefinger 78 (Fig. 1) rests at division 460 in column 75. Inasmuch as the fingers 78 and 79 operate as a unit on escapewheel 75, the position of these fingers can be traced in column 75 of the chart, one division for each short impulse in any series. If finger 78 actuates escapewheel 75, and finger 79 actuates escapewheel 76, the position of the fingers can then be traced in column 76. When finger 78 is engaging escapewheel 77, the finger movement can be followed to the single tooth in column 77 in the normal starting division 460.

Assuming that the finger 78 moves up to the following tooth in the column 75, for each short impulse, and up one tooth in column 76 for each long impulse imparted thereto, it is obvious how any particular division can be reached with a combination of long and short impulses, in less time than that required with a long series of short impulses.

Referring now to vertical columns 1, 2, and 3 of Fig. 10, which as stated heretofore, are the three rows of characters around the periphery of the typewheel (called channels), and the three horizontal positions (called a division), it will be seen that each division of the escapewheels co-

incides with three positions on the typewheel. The selection of a division on the escapewheels has reference to any one of the three horizontally disposed points on the typewheel, and the horizontal, or channel selection is gained through the first two impulses of any series. If the first, and second impulses be short, the typewheel will remain fixed in the first channel, and can be traced up the vertical column 1, and if the first impulse is a short one and the second a long impulse, the wheel will shift to the second channel, which can be traced in vertical column 2. However, if the first two impulses are long ones, the wheel will be shifted to the third channel and should be traced in vertical column 3.

For example, suppose that the point 465 on the typewheel chart is a desired character. It is in the second channel and tenth division of the wheel. The transmitter code for that character could be, one short, two long and two short impulses (– — — — –). Tracing this by the light line in columns 75 and 76 the first short impulse would reach the second division in column 75, the second being a long impulse would move to the third division and the third being a long impulse would move to 461 in column 76 while the short fourth and fifth impulses would move in divisions 462 and 463 in column 75.

This co-operation of units would then bring the typewheel around from the division 460 to division 463 which is occupied by three printing characters. As the typewheel is shifted one channel as in this case, for each long impulse of the first two of any series, the typewheel would be shifted to the second channel by the long second impulse. The point 465 would be reached as indicated in columns 1 and 2.

Should the first impulses in this series be short division 463 in the first column would have been reached and, likewise division 463 in the third column would have been reached had the series started with two long impulses. With wheels constructed as shown, any one of 47 points referred to on the typewheel can be reached with a combination of six impulses.

In the restoring operation the finger 78 when shifted to escapewheel 77 will be engaged by the tooth in that wheel which is division 1, and the typewheel will have been returned to starting position. The typewheel makes one complete revolution for each printing, or other function and is stopped at the point selected just long enough for such function to occur. The printing and operating functions can be distributed over the typewheel to suit any particular requirements by arranging the cam code wheel and the keys of the transmitter accordingly. It should be noted that more than one impulse code can be used for the selection of any operating point on the typewheel, except the one in the division 464, channel 77, which is a blank and cannot be reached by any combination.

Referring now to Fig. 2 of the drawings we have illustrated a fragmentary view of one type of clutch which may be employed to drive the shaft 72 from the source of power. The clutch comprises a cylindrical sleeve 82 keyed in any suitable manner to one end of the shaft 72 and is adapted to internally receive a driven drum 510. The drum 510 is keyed or fastened in any suitable manner to the driving shaft 92, at 522, and is on the same axis of rotation as the sleeve 82. It will be seen that the shafts 72 and 92 can be frictionally connected.

Loosely carried by the drum 510 are preferably a pair of friction shoes 511 and 512. The shoes are composed of a cylindrical metallic shell adapted to receive and retain felt, or the like, faces 513 and 525 in extended position beyond the metallic shell portion of the shoe. These shoes are retained in frictional engagement with the internal periphery of the sleeve 82 by the force exerted on them by the springs 514 and 515 disposed in any convenient manner on the shaft 92 and extending inwardly to engage the inner side of the friction shoes 511 and 512 and force them outwardly into frictional engagement with the cylindrical sleeve 82 thereby connecting the drive shaft 92 with the driven shaft 72.

The springs 514 and 515 are capable of having the tension applied to the shoes 511 and 512 adjusted preferably through the agency of a wedge member 517 disposed on the drive shaft 92 in any suitable manner. It will be seen that by shifting the wedge member 517 to the right forcing the inturned ends of the springs outwardly accordingly increasing the outward pressure of the spring arms 514 and 515 on the friction shoes 511 and 512. Therefore by shifting the wedge member 517 to the left the tension of the springs 514 and 515 is decreased and the frictional engagement between the shoes 511 and 512 with the sleeve 82 is proportionately decreased.

Referring now to Fig. 4, of the drawings, the action of the cam wheels 127 on the drive shaft 128 can be more clearly understood by reading the description of this figure with Fig. 3. The cam 127 and the slotted disk 126 are suitably combined on a sleeve as a unit and rotatably disposed on shaft 128. Disposed adjacent to each unit is a ratchet wheel 124 and on the same vertical plane with pawl 125. The pawl 125 is pivotally mounted on disk 126 and is engaged with the ratchet wheel 124 when the pawl 125 is released by the action of the escape fingers 122 and 123, intermittently rotating the cam unit as hereinbefore more fully described. It follows that rotation of the cam 127 transmits a vertical oscillation to contact fingers 129 through the rollers journaled in the fingers 129 adapted to ride upon the periphery of the cam wheel 127.

Referring particularly to Figs. 5*a* and 6*a* of the drawings, it will be noted that we have provided a structure whereby the printing mechanism may be elevated above and overhang the paper and paper carriage to make possible clear vision of the printed matter upon a movable supply of paper.

It will be noted also that the paper roll 152, the guiding rollers 156, 157, and guides 160 are so related to the direction of winding of the paper on the roll 152 and position of the type wheel 71 that the paper 33 as it emerges past the type wheel will, by virtue of the natural "curl" imparted to the paper by winding it upon the roll 152, effect a tilting or deflection of the paper over the top of the type wheel 71, and prevent the end of the paper again being received within the rolls or struck by the printing hammer and will feed out to a suitable receptacle or intermediate cutting mechanism not shown.

Having thus described our invention as embodied in a particular electromagnetic system and as particularly applied to printing telegraph mechanisms and systems, we are aware that numerous and extensive departures may be made from the embodiment herein illustrated and described and we appreciate that our invention may be advantageously employed in electromagnetic mechanisms other than printing telegraph systems and mechanisms and we particularly contemplate the

employment of the selective mechanism of this invention wherever it is desired to move a selector element in a step by step manner and particularly where the same is movable in two dimensions.

Subject matter illustrated and described but not claimed herein may be claimed in divisional application Serial No. 490,466, filed October 22, 1930 for Improvements in typewriters.

We claim:

1. In a printing telegraph mechanism, in combination a typewheel having a plurality of annular rows of printing type characters, the characters of the different rows being in transverse alignment, a shaft rotatively carrying said wheel, a plurality of escape ratchet wheels on the shaft rotatable with the wheel, a pair of escape fingers, driving means for the shaft, clutch means to communicate motion from said driving means to said shaft, each finger adapted to be moved into contact with a selected one of the wheels to restrain the said shaft from rotating, a plurality of magnets adapted to selectively control the movements of said escape fingers, and means responsive to current impulses through said magnets to move a selected finger to contact with a selected escapewheel.

2. In a printing telegraph mechanism, in combination a typewheel, a plurality of escape wheels rotatable therewith, each of the escape wheels having a different number of escape teeth thereon, a pair of escape fingers having pawl ends normally disposed on opposite sides of the escape wheels, electromagnetic selection mechanism adapted to selectively position the escape fingers in desired lateral alignment with selected wheels, means to deflect the fingers into engagement with selected wheels, said typewheel having a plurality of annular rows of printing characters disposed about its peripheral face, said escape fingers and wheels adapted for selective engagement to stop the typewheel in a desired rotative printing position, and selective means adapted to displace the typewheel longitudinally to position the typewheel in desired longitudinally adjusted printing position to select a row of printing characters.

3. In a printing telegraph mechanism, in combination a typewheel, a plurality of escape wheels rotatable therewith, a pair of escape fingers, each having a pawl end, said pawls interchangeably engageable with the wheels, said fingers being laterally displaceable to effect selection of a particular wheel to be engaged by the pawl of the finger, said wheels having different numbers of teeth, means to rotate said typewheel and wheels, said typewheel and wheels adapted to be stopped whenever contact is had between a pawl of one of the fingers and a tooth of one of the wheels, means to selectively laterally displace the fingers, and means operable to effect engagement of a selected one of said fingers with a selected one of said wheels to stop the typewheel at a desired point in its rotation.

4. In a printing telegraph system, in combination a printing hammer, a typewheel, an electromagnet for actuating said printing hammer, means for rotating the typewheel, comprising a driving shaft and a friction clutch, a spring for shifting the typewheel longitudinally, an escapement mechanism effective to accomplish a step by step longitudinal releasing movement thereof under the impelling influence of said spring, an electromagnet for actuating the escape mechanism, means for preventing the actuation of the escape mechanism by the magnet, and means rotatable with the type wheel to bar operation of said last named means, during a portion only of the period of rotation of the type wheel.

5. In a printing telegraph system, a printing telegraph mechanism, means to effect starting and stopping of the typewriter mechanism therefor comprising two main gears and a pinion, the gears being larger than the pinion and one of said gears being a driving gear, the other being a driven gear and the pinion adapted for communication of rotary motion from the driving to the driven gear, said gears being disposed relatively eccentrically and rotated in closely adjacent parallel planes, said pinion having teeth of sufficient width to bridge both of the main gears and to enable it to be simultaneously meshed with the teeth of both said gears, and a mounting for the pinion comprising a laterally shiftable arm, said pinion pivoted on the arm and movable thereby into and out of mesh with the two gears, the parts being relatively so disposed and of such relative sizes, that when the pinion carried on its support is moved into mesh with the gears, in the meshing movement the pinion will first engage the driving gear and subsequently engage alike the two gears, the direction of rotation of the driving gear being in such a direction as to tend to draw the pinion into mesh with the driven gear, the axes of the two driving gears being disposed sufficiently close together relative to the diameters of said gears and the size of the pinion, that the pinion will not be susceptible of movement toward a line extending between said gear axes sufficiently to effect locking engagement of the pinion with the driving and driven gears.

6. In a printing telegraph system, a type selecting mechanism therefor comprising a pair of escapement fingers, three escapement wheels and means to differentially operate each of the escapement fingers relative to one of the wheels and another of said wheels common to the two fingers, a shaft for rotatably supporting said wheels, a typewheel having three rows of type characters on its peripheral surface and rotatably carried by the said shaft.

7. In a printing telegraph mechanism, a typewheel, said typewheel having a row of spaced printing characters disposed around its outer surface, driving means for the typewheel, electromagnetic positioning means for the typewheel comprising a plurality of electromagnetically actuatable armatures, each having characteristically different rates of rapidity of actuation and retraction, said electromagnetic positioning means adapted upon the reception of short current impulses to effect actuation of a rapidly actuatable armature, escapement means actuatable responsive to movement of said rapidly actuatable armature to effect rotation of the typewheel, by said driving means, through an angle corresponding to the spacing of contiguous type characters on its periphery, said positioning means adapted upon the reception of longer current impulses to effect actuation of a less rapidly actuatable armature, and controlling means for said escapement means operative responsive to actuation of said last named armature to effect rotation of the typewheel by said driving means through an angle corresponding to the spacing between non-contiguous characters on its periphery.

8. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for

the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels.

9. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels, and means operable under the control of said electromagnetic means for selectively shifting the typewheel longitudinally to position one of the plurality of rows of printing type characters for printing purposes.

10. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels, said electromagnetic means comprising a pair of relatively slow actuatable electromagnets, each adapted, when operated, to move a different one of said fingers to engagement with a different one of the two escape wheels having the fewer number of teeth and a third electromagnet actuatable to selectively determine which of the pawls shall operably engage the selected wheel.

11. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels, said electromagnetic means comprising a pair of relatively slow actuatable electromagnets, each adapted, when operated, to move a different one of said fingers to engagement with a different one of the pair of escape wheels having the fewer number of teeth and a third electromagnet actuatable to selectively determine which of the pawls shall operably engage the selected wheel, and retractile means for returning each of the said pawls to a position adjacent the wheel with the greatest number of teeth, one of said pawls being adapted thereupon to engage said wheel.

12. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of tele-

graphic current impulses for selectively moving the pawls to engagement with selected escape wheels, said electromagnetic positioning means comprising an electromagnet having an armature responsive to move only upon the reception of a prolonged current impulse through its winding, said electromagnet upon each actuation thereof adapted to shift the typewheel longitudinally to position a different row of type characters for printing purposes.

13. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels, said electromagnetic positioning means comprising an electromagnet having an armature responsive to move only upon the reception of a prolonged current impulse through its winding, said electromagnet upon each actuation thereof adapted to shift the typewheel longitudinally to position a different row of type characters for printing purposes, and means for preventing actuation of the said escape means upon a preliminary movement of the said armature responsive to a preliminary impulse of current passing through its actuating magnet winding.

14. In a selecting mechanism for printing telegraph typewheel characters, in combination a typewheel having three rows of type disposed around its peripheral surface, a driving shaft for the typewheel, said typewheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of telegraphic current impulses for selectively moving the pawls to engagement with selected escape wheels, said electromagnetic positioning means comprising an electromagnet having an armature responsive to move only upon the reception of a prolonged current impulse through its winding, said electromagnet upon each actuation thereof adapted to shift the typewheel longitudinally to position a different row of type characters for printing purposes, a spring tending to shift the typewheel longitudinally in one direction and an electromagnet adapted to move the escape wheel in the other direction.

15. In a selecting mechanism in combination a ratchet pawl, a plurality of ratchet wheels, each having a set of ratchet teeth adapted to be engaged by the pawl and disposed laterally of each other, means for shifting the pawl laterally to select one of the wheels, and means adapted to effect a step-by-step rotary motion of the selected wheel comprising means for reciprocating the ratchet pawl to intermittently engage the ratchet teeth.

16. In a selecting mechanism in combination a pair of ratchet pawls, a plurality of movable elements, each element having a set of ratchet teeth adapted to be intermittently engaged by the said pawls to effect a step-by-step movement of the engaged elements, said elements disposed laterally of each other, and means for differentially shifting the ratchet pawls laterally for engagement with different selected ones of said sets of teeth, and means for reciprocating the ratchet pawls to make intermittent controlling engagement with the ratchet teeth.

17. In a selecting mechanism in combination a pair of ratchet pawls, a plurality of movable elements, each element having a set of ratchet teeth adapted to be intermittently engaged by the said pawls to effect a step-by-step movement of the engaged elements, said elements disposed laterally of each other, and means for differentially shifting the ratchet pawls laterally for engagement with different selected ones of said sets of teeth, and means for reciprocating the ratchet pawls to make intermittent controlling engagement with the ratchet teeth, and a linkage between the pawls whereby, when one of the pawls is swung into engagement with one of the sets of teeth, the other pawl will be swung out of engagement with any other set of ratchet teeth.

18. In a printing telegraph system, a type selecting mechanism therefor comprising a pair of escapement fingers, three escapement wheels and means to differentially operate each of the escapement fingers relative to one of the wheels and another of said wheels common to the two fingers, a shaft for rotatably supporting said wheels, a typewheel having three rows of type characters on its peripheral surface and rotatably carried by the said shaft, means adapted to effect longitudinal shifting of the type wheel to an extent equal to the spacing between the rows of type characters, step by step, responsive to successive impulses imparted to the said shifting means, and means responsive to the predetermined rotation of the type wheel to disable the said typewheel shifting means.

19. In a selective mechanism a rotatable element, step by step mechanism adapted to operate responsive to impulses imparted to it to rotatably advance the said element, shifting means responsive to step by step impulses imparted to the shifting means to laterally shift the said rotatable element, and controlling means responsive to a predetermined rotation of the said element to disable the said lateral shifting means, said

disabling means comprising a cam rotatable with the said rotatable element.

20. In a printing telegraph system in combination a laterally shiftable, rotatable type wheel, printing mechanism therefor, electromagnetic means for laterally shifting and rotating the type wheel, an electrical relay armature responsive to impulses received over a telegraphic line to actuate the said electromagnetic means, and means comprising a cam operable with the type wheel engageable with the armature of the relay to hold the armature in a given operative position while the type wheel is in a given rotative position.

21. In a telegraph typewriter mechanism, a motor therefor, means responsive to the reception of a first current impulse over the telegraph line to initiate the operation of the motor, means independent of energization of the said impulse responsive means for maintaining operation of the motor, and means operable only after the expiration of a predetermined interval following the cessation of current impulses received over said telegraph line, to open the motor circuit.

22. In a telegraph typewriter mechanism, a motor therefor, means responsive to the reception of a first current impulse over the telegraph line to initiate the operation of the motor, and means operable only after the expiration of a predetermined interval following the cessation of current impulses received over said telegraph line, to open the motor circuit, and means responsive to the reception of a series of current impulses of a particular character, adapted to open the motor circuit, prior to the operation of the first named circuit opening means.

23. In a telegraph typewriter mechanism, a motor therefor, means responsive to the reception of a first current impulse over the telegraph line to initiate the operation of the motor, means independent of energization of the said impulse responsive means for maintaining operation of the motor, and means operated by the rotation of the motor only after the expiration of a predetermined interval following the cessation of current impulses received over said telegraph line to open the motor circuit.

24. In a printing telegraph system, a printing telegraph mechanism, means to effect starting and stopping of the typewriter mechanism therefor comprising two main gears and a pinion, the gears being larger than the pinion and one of said gears being a driving gear, the other being a driven gear and the pinion adapted for communication of rotary motion from the driving to the driven gear, said gears being disposed relatively eccentrically and rotated in closely adjacent parallel planes, said pinion having teeth of sufficient width to bridge both of the main gears and to enable it to be simultaneously meshed with the teeth of both said gears, and a mounting for the pinion comprising a laterally shiftable arm, said pinion pivoted on the arm and movable thereby into and out of mesh with the two gears, the parts being relatively so disposed and of such relative sizes, that when the pinion carried on its support is moved into mesh with the gears, in the meshing movement the pinion will first engage the driving gear and subsequently engage alike the two gears, the direction of rotation of the driving gear being in such a direction as to tend to draw the pinion into mesh with the driven gear, the axes of the two driving gears being disposed sufficiently close together relative to the diameters of said gears and the size of the pinion, that the pinion will not be susceptible of movement toward a line extending between said gear axes sufficiently to effect locking engagement of the pinion with the driving and driven gears, means responsive to the reception of a train of telegraphic impulses of a particular character adapted to move the pinion into contact with the gears, an electric motor for driving the said driving gear, an electric circuit for said motor, an electric switch for said circuit, and means associated with said driving gear operable upon a predetermined rotative movement thereof, adapted to effect opening of the switch.

25. In a printing telegraph mechanism in combination with the line circuit therefor, a pair of line electromagnets, a driving electric motor, one electromagnet adapted to effect the starting of the motor, the other adapted to control the selecting and motor stopping, and means responsive to the starting of the motor to disable the first named electromagnet and to effect the association of the second electromagnet with the line circuit.

26. In a printing telegraph mechanism in combination with the line circuit therefor, a pair of line electromagnets, a driving electric motor, one electromagnet adapted to effect the starting of the motor, the other adapted to control the selecting and motor stopping, and means responsive to the starting of the motor to disable the first named electromagnet and to effect the association of the second electromagnet with the line circuit, and means operated under the control of the second electromagnet adapted to effect the opening of the motor circuit, and to disassociate the second electromagnet with the line circuit, and to disable the second disabling means.

27. In a printing telegraph system in combination a pair of printing telegraph machines, a line circuit interconnecting the machines, each comprising an operating motor, one of the machines comprising a receiving mechanism and a transmitting mechanism, transmitting and receiving circuits for the said transmitting and receiving mechanisms, a "start" and a "break" typewriter key at said machine, an electric switch operable by the "start" key when depressed, latching means for the electric switch, the "start" key adapted, when depressed, to operate the electric switch to effect the transmission of current over the line circuit to the distant machine and to effect the starting of the motors of both machines, means at each machine responsive to the starting of its motor adapted to effect continuous operation thereof independently of the position of said switch, the "break" key when operated adapted to disassociate the transmitting circuits from the line circuit and to associate the receiving circuits therewith, and discontinue the transmission of current to the distant machine over the line circuit.

28. In a printing telegraph system, a line circuit, a selecting mechanism, an electric motor, motor switching mechanism, printing mechanism, said mechanisms being so related that they may be operated individually, and means operating subsequent to any operation of any of the said mechanisms adapted to condition any and all of the other mechanisms for immediate succeeding operations.

29. In a telegraph typewriter system, in combination a sending station and a receiving station and a telegraph line interconnecting said stations, a source of current at the sending station, switching means thereat for supplying impulses of current from said source over said line

from the sending station to the receiving station, a telegraph typewriter mechanism at the receiving station, a motor for said mechanism, means responsive to the projection of a first impulse of current over the telegraph line from said source to initiate operation of the motor, means independent of energization of said impulse responsive means for maintaining operation of the motor, selecting and printing means for said mechanism operable responsive to a train of said current impulses to effect the printing of alphabetical and like characters according to the nature of different shorter series of said impulses of said train, timing means for discontinuing the operation of said motor after the expiration of a predetermined period of continuous operation of said timing means, and means periodically operable during a substantially continuous train of said impulses to reset the timing mechanism to starting position.

30. In a telegraph typewriter system, sending and receiving mechanisms therefor, a telegraph line interconnecting said mechanisms, a telegraph typewriter mechanism at a receiving station thereof, a motor therefor, means responsive to the reception of a first current impulse over the telegraph line to initiate the operation of the motor, means independent of energization of said impulse responsive means for maintaining operation of the motor, and means operable only after the expiration of a predetermined interval following the cessation of the last current impulse, to open the motor circuit, and a source of current at each sending station adapted to project current flows over said line only during sending periods.

31. In a printing telegraph mechanism, in combination a type wheel having a plurality of annular rows of printing type characters, the characters of the different rows being in transverse alignment, a shaft rotatively carrying said wheel, a plurality of escape ratchet wheels on the shaft rotatable with the said wheel, a plurality of escape fingers, driving means for the shaft, means for continuously applying torque from said driving means tending to rotate said shaft, the fingers adapted to be selectively moved out of and into contact with the wheels to permit and to arrest rotation of said shaft, a plurality of magnets adapted to selectively control the movements of said escape fingers, and means responsive to current impulses through said magnets to move a selected finger to contact with a selected escape wheel.

32. In a printing telegraph system, in combination a printing hammer, a type wheel, an electro-magnet for actuating said printing hammer, means for rotating the type wheel comprising a driving shaft and means for continuously applying torque to the shaft, a spring for shifting the type wheel longitudinally, and an escapement mechanism effective to accomplish a step-by-step longitudinal releasing movement thereof under the impelling influence of said spring, an electro-magnet for actuating the escape mechanism, means for preventing the actuation of the escape mechanism by the magnet, and means rotatable with the type wheel to bar operation of said last-named means, during a portion only of the period of rotation of the type wheel.

33. In a selecting mechanism for printing telegraph type wheel characters, in combination a type wheel having three rows of type disposed around its peripheral surface, a driving shaft for the type wheel, said type wheel being movable longitudinally, several escape wheels having a driving connection with the said shaft and rotatable therewith, one of said escape wheels having a plurality of escape teeth, at least as large in number as the largest number of type characters provided for use in any one of the rows of characters, a second of said escape wheels having a fewer number of spaced escape teeth, the third escape wheel having but a single tooth, a pair of fingers each comprising a pawl, each finger being so disposed and movable as to effect engagement by its respective pawl with a different one of said escape wheels, and shifting means for said fingers adapted to alternately effect engagement between either the pawl of the one finger or the pawl of the other finger with the other escape wheel, adapted to be engaged in common by both said pawls, and electromagnetic means operated responsively to the reception of current impulses of different descriptive character for selectively moving the pawls to engagement with selected escape wheels.

34. In a telegraph typewriter mechanism, comprising a multi-character type element adapted to be selectively positioned for printing in correspondence with current impulses transmitted thereto over an electric circuit from a distant impulse sending station, a motor for operating the mechanism, means for initiating operation of the motor, means independent of the operation initiating means for maintaining operation of the motor, and means operated by the rotation of the motor only after the expiration of a predetermined interval following the cessation of current impulses to open the motor circuit.

35. In a telegraph typewriter mechanism, comprising a multi-character type element adapted to be selectively positioned for printing in correspondence with current impulses transmitted thereto over an electric circuit from a distant impulse sending station, a motor for operating the mechanism, means for initiating operation of the motor, means independent of the operation initiating means for maintaining operation of the motor, and means operable only after the expiration of a predetermined interval following the cessation of current impulses to open the motor circuit.

36. In a printing telegraph system, a selective mechanism therefor, comprising a rotatable element, step by step mechanism adapted to operate responsive to impulses imparted to it to rotatably advance the said element, shifting means responsive to step by step impulses imparted to the shifting means to laterally shift the said rotatable element, and controlling means responsive to a predetermined rotation of the said element to disable the said lateral shifting means, said disabling means comprising a cam rotatable with the said rotatable element, said rotatable element carrying a type wheel thereby positioned to present a type character to a printing position.

37. In a printing telegraph mechanism, a selecting mechanism therefor, comprising in combination a ratchet pawl, a plurality of ratchet wheels, each having a set of ratchet teeth adapted to be engaged by the pawl and disposed laterally of each other, means for shifting the pawl laterally to select one of the wheels and means adapted to effect a step by step rotary motion of the selected wheel comprising means for reciprocating the ratchet pawl to intermittently engage the ratchet teeth, a printing wheel selec-

tively movable by selective operation of said wheels to position a desired type character in printing position and means subsequently operable to effect printing by said type character.

38. In a printing telegraph system, a type selecting mechanism therefor comprising a pair of escapement fingers, three escapement wheels and means to differentially operate each of the escapement fingers relative to one of the wheels and another of said wheels common to the two fingers, a shaft for rotatably supporting said wheels, a typewheel having three rows of type characters on its peripheral surface and rotatably carried by the said shaft, said mechanism effective to rotatably and longitudinally move said type wheel according to the combination of movements of said escapement fingers.

39. A printing telegraph mechanism comprising a type carrying element, means for rotating and longitudinally moving said element, operable under different combinations of long and short impulses to operatively position a printing character on said type wheel to adjusted position in two dimensions, said means comprising a motor and slipping clutch connection and electro-magnetically operated escape pawls for controlling the movements of said type carrying element.

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