April 18, 1939. E. E. KLEINSCHMIDT ET AL 2,154,512

FACSIMILE PRINTING TELEGRAPH SYSTEM AND APPARATUS

Original Filed Aug. 14, 1930 3 Sheets-Sheet 1

FIG. 1

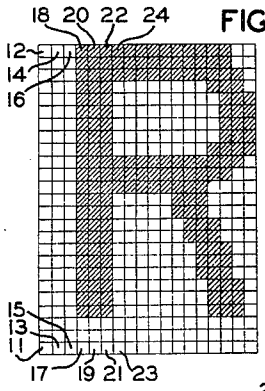
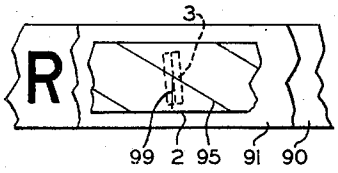


FIG. 7



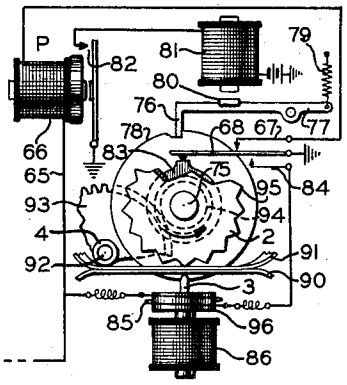


FIG. 3

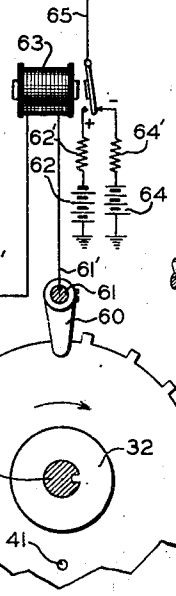


FIG. 2

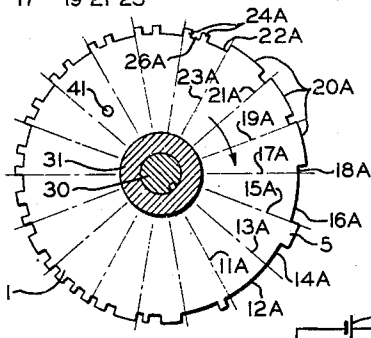


FIG. 5

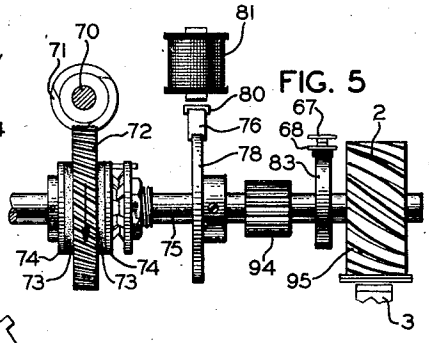
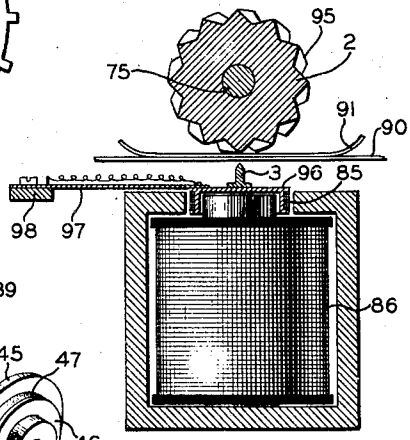


FIG. 6



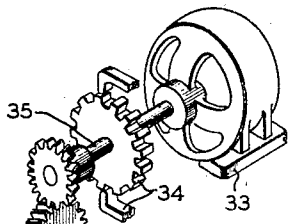
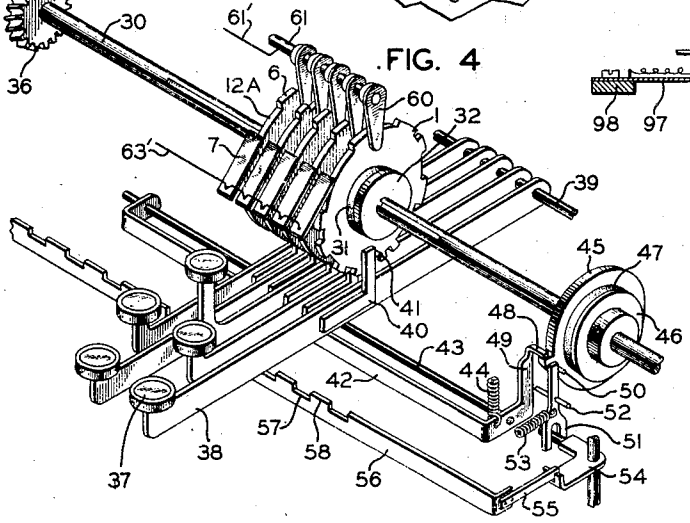


FIG. 4



EDWARD E. KLEINSCHMIDT
EDWARD F. KLEINSCHMIDT
INVENTORS

BY H. B. Whitfield

ATTORNEY

April 18, 1939. E. E. KLEINSCHMIDT ET AL 2,154,512

FACSIMILE PRINTING TELEGRAPH SYSTEM AND APPARATUS

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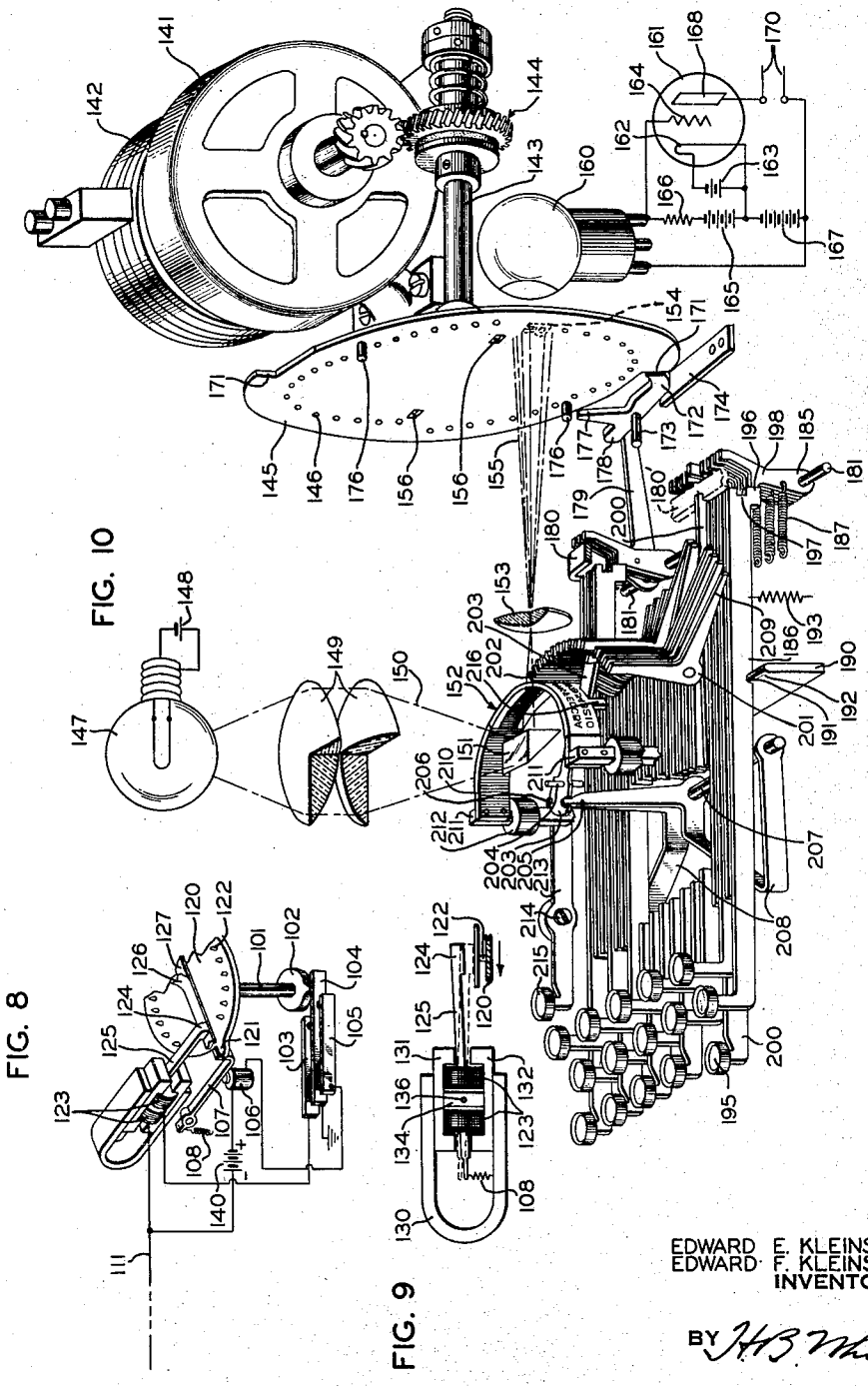

FIG. 10

FIG. 8

FIG. 9

EDWARD E. KLEINSCHMIDT
EDWARD F. KLEINSCHMIDT
INVENTORS

BY H. B. Whitfield
ATTORNEY

April 18, 1939. E. E. KLEINSCHMIDT ET AL 2,154,512

FACSIMILE PRINTING TELEGRAPH SYSTEM AND APPARATUS

Original Filed Aug. 14, 1930 3 Sheets-Sheet 3

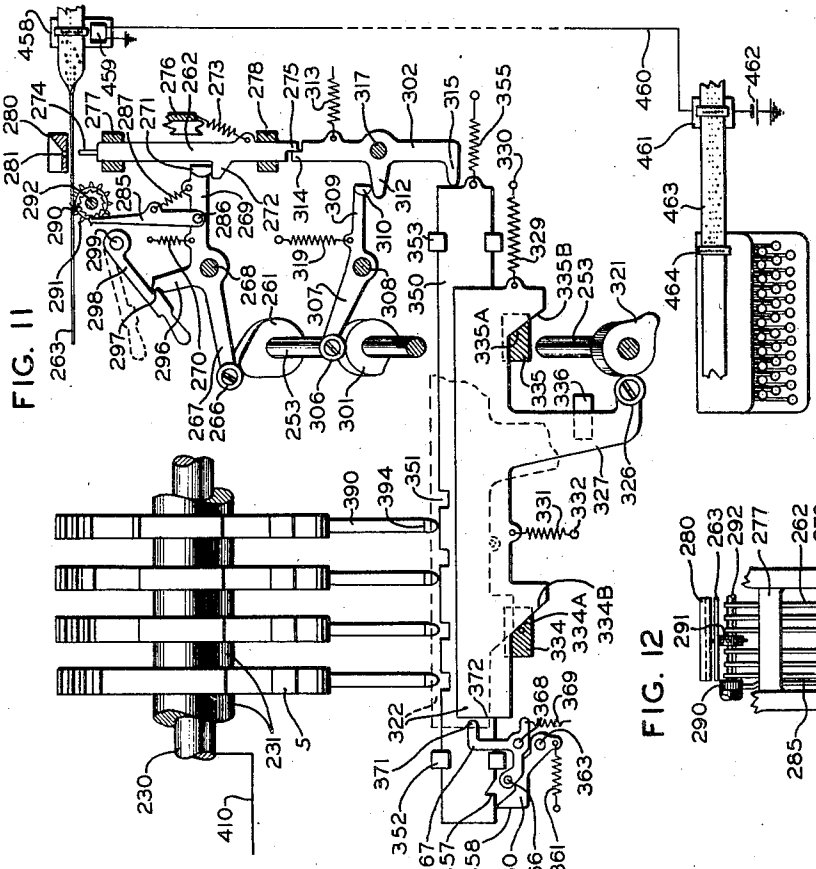

FIG. 11

FIG. 12

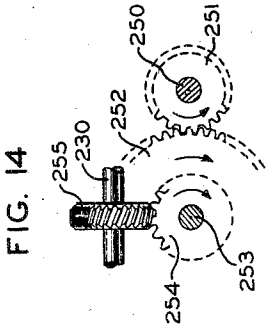

FIG. 14

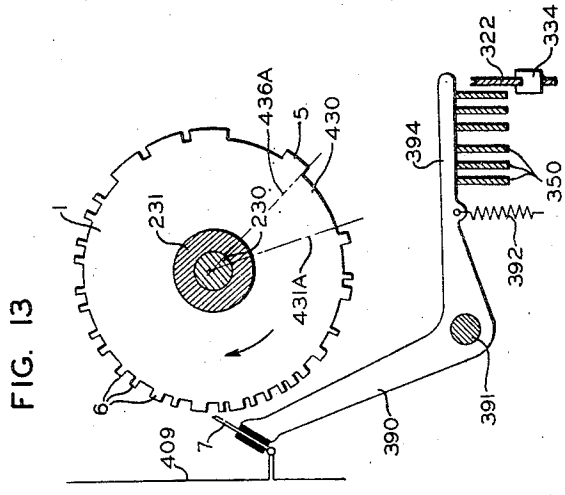

FIG. 13

INVENTORS
EDWARD E. KLEINSCHMIDT
EDWARD F. KLEINSCHMIDT
BY
H. B. Whitfield
ATTORNEY

Patented Apr. 18, 1939 2,154,512

UNITED STATES PATENT OFFICE

2,154,512

FACSIMILE PRINTING TELEGRAPH SYSTEM AND APPARATUS

Edward E. Kleinschmidt and Edward F. Kleinschmidt, Highland Park, Ill., assignors to Teletype Corporation, Chicago, Ill., a corporation of Delaware

Original application August 14, 1930, Serial No. 475,264, now Patent No. 2,046,328, dated July 7, 1936. Divided and this application April 29, 1935, Serial No. 18,813

18 Claims. (Cl. 178—69.5)

This invention pertains to printing telegraph systems and more particularly to facsimile telegraph systems and apparatus in which signal codes representing scanning analyses of letters and other characters are transmitted code by code or character by character to form a directly legible printed line of characters, and in which successive characters occupy approximately equal lineal units of space in the line.

This application is a division of copending application Serial No. 475,264 filed August 14, 1930, now Patent No. 2,046,328, granted July 7, 1936.

An object of the present invention is to provide a simple, efficient, and reliable facsimile printing telegraph apparatus wherein special control or synchronizing impulses are transmitted over the communication circuit between successive code groups of signals representing characters.

A further object is to provide a facsimile printing receiver with means for starting and stopping the recording mechanism and the record tape between printing of successive groups of code signals representing a character.

The above and further objects are attained by providing mechanism operating in response to a start or synchronizing signal for causing the recording device and tape advancing device of a receiver to be operated according to the start-stop principle.

Spaces between characters and between words are produced by a momentary suspension of signals of facsimileing nature and by sending a start signal followed by an interval of suspension of facsimileing signals during the then ensuing code or character time period during which interval the tape driving means effects a movement of the tape for a distance equivalent to the advancement for the printing of one character respectively.

A better understanding of the invention may be had from the following description, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 shows an arrangement of a character for scanning;

Fig. 2 shows a telegraphic transmitter disc embodying thereupon a scanning code according to Fig. 1;

Fig. 3 illustrates a telegraphic system utilizing transmitter discs such as shown in Fig. 2;

Fig. 4 shows details of the transmitter shown in Fig. 3 with a continuously operated driving motor;

Fig. 5 shows a side view with detail and assembly of start-stop members of the receiving printer illustrated in Fig. 3;

Fig. 6 is a sectional view of the receiver of Fig. 3;

Fig. 7 discloses the method of reproducing the character of Fig. 1 by the receiving printer shown in Fig. 3;

Fig. 8 illustrates an alternative type of receiver;

Fig. 9 is a sectional view of the receiver of Fig. 8;

Fig. 10 shows an alternative type of keyboard transmitter;

Fig. 11 shows a side view of elemental parts of a transmitter adapted for regular cyclic transmission of code signals, according to the requirements of this invention;

Fig. 12 shows a fragmentary front end view of parts of the structure of Fig. 11;

Fig. 13 shows a fragmentary rear end view of the structure of Fig. 11, and

Fig. 14 shows a detail of Fig. 11.

In general, the system of the present invention comprises a transmitter, Fig. 3, whose design may vary widely in mechanical detail and arrangement of its constituent members, each complete transmitter comprising, in part, a set of facsimile code members or subtransmitters as illustrated by disc 1, Figs. 2, 3, and 4. The transmitter cooperates over a communication circuit with a receiving printer comprising printing members 2 and 3, Figs. 3, 5, and 6, and a tape driving member 4, Fig. 3, all of which are held inert by start-stop control devices during periods when transmission is not being actively effected.

Code transmitter discs 1 each embody a lug 5 for generating a starting signal over a transmission circuit and are further designed according to a novel method of prescanning in which characters or symbols to be transmitted are divided into any desirable number of small transmitter unit areas and in which the several unit areas thus created are assigned in order of scanning to the periphery of a disc 1, either the dark areas or the light areas of a character being represented by high arcuate surfaces 6 to engage a brush 7 in the transmitter, Figs. 3 and 4, to send an electrical code signal over the communication circuit representing a dark or light area according to the method of receiving and recording adopted in the receiving printer.

As an example, a prescanning of the letter "R" together with the area of space between the letter and the preceding letter is shown in Figs. 1 and 2. The total area of the letter, together with spaces

between letters, shown at the left in the figure, and space for variation in vertical location of the printed letter on its record tape, shown at the bottom in Fig. 1, is divided into 450 small unit areas arranged in eighteen vertical strips of twenty-five unit areas each. As shown in Fig. 2, disc-edge arcs corresponding to the eighteen vertical strips respectively are laid off in eighteen angular sectors on the code disc 1, and each angular sector is divided into twenty-five angular units each corresponding to a small unit area of an identified vertical strip. The code disc periphery is then executed by recessing the corresponding disc unit sections of each sector where the respective scanning unit areas are light, thus producing raised surfaces 6 where the scanning units are dark. A blank interval is left below and/or above each letter or character, shown in Fig. 1 as three lower horizontal blank rows. Prescanning or generation of the code begins with unit area 11 in Fig. 1 and progresses vertically to area 12. Since all of the unit areas in this strip are white, the twenty-five units of the first sector of disc 1 between radii 11A and 13A of Fig. 2 are recessed, forming a portion 12A of a continuous low-radius arc. Prescanning then proceeds beginning with unit area 13 and ending with unit area 14 of the second vertical strip. All areas of the second strip being white, the second sector 14A of the code disc is also recessed, except that lug 5 for generating a starting signal is retained. Prescanning then proceeds beginning with area 15 and ending with area 16, Fig. 1, resulting in the third recessed sector 16A, Fig. 2, between radii 15A and 17A. Prescanning proceeds from unit area 17 to unit area 18 then 19 to 20 and 21 to 22, completing in three sectors respectively three groups of twenty-two black unit areas each preceded by three white unit areas resulting in corresponding raised arcs 20A, each preceded by a recessed arc 18A for the next three sectors as shown in Fig. 2. Prescanning proceeds in like manner from area 23 to area 24 for the seventh sector, giving thirteen white unit areas for recessed arc 22A of disc 1, then three black unit areas for first arc 24A, six white unit areas corresponding to recessed arc 26A, and three black unit areas for final arc 24A of the seventh sector of disc 1. In this manner prescanning proceeds through the remaining eleven strips of Fig. 1 to complete the periphery of code disc 1 of Fig. 2.

In like manner each other code disc is developed to represent one of the other desired characters. Every letter or character to be transmitted is preceded by the desired space between it and the preceding letter so that every code disc comprises a letter space and character code. The first three sectors of each disc are allotted to transmission of the letter space and starting signal impulse, thereby providing a depressed facsimile spacing arc 12A, 14A, and 16A, extending from radius 11A to radius 17A of Fig. 2 on each disc and modified by the lug 5 for generating the starting impulse. The code discs are then sleeved on shaft 30, Figs. 2, 3, and 4, with friction rings 31, Figs. 2 and 4, and feathered washers 32, Figs. 3 and 4, in such manner that adjacent code transmitter discs 1 are alternated with feathered washers 32 and are separated from the washers by friction rings 31. Spring means are provided to press the friction rings, transmitter discs and washers mounted upon shaft 30 together to provide a sufficient driving friction whereby a released transmitter disc 1 will be driven by shaft 30 and will turn with shaft 30 while restrained discs 1 will remain inert, shaft 30 and washers 32 being permitted to turn continuously by overcoming the friction of rings 31 against the surfaces of the associated transmitter discs 1.

The further structure of the transmitter, Fig. 4, comprises a motor 33 and a speed regulator of phonic type 34, which jointly turn the power shaft 35 at a uniform regulated speed. Through gears 36 a uniform rotation is communicated to shaft 30 which carried discs 1.

A controlling keyboard consists of a plurality of keys 37 upon key bars 38, mounted upon a common pivot rod 39 and each having a stop lug 40 projecting into the path of a pin 41, Figs. 2, 3, and 4, carried by and individually associated with each transmitter disc 1. Pins 41 engage the stop lugs 40 and stop all of the transmitter discs 1, all of the transmitter discs then having their spacing segments 12A in alignment. Key bars 38 are urged upward into position to engage pin 41 and stop all discs 1 by universal bar 42, pivoted upon rod 43, and urged by spring 44. The universal bar 42 serves to supply a spring tension to the key bars 38 and also when operated serves to release a key bar lock for all of the key bars of the keyboard. The lock comprises a cam disc 45 between a pair of friction clutch discs 46, of which but one is visible in the perspective view, fixed to shaft 30 and supplied with friction rings 47, spring-pressed to produce a friction drive whereby cam 45 will be driven by shaft 30 when released for rotation. The cam is controlled by a finger 48 upon an arm 49 of universal bar 42 and carries a pin 50 which controls a rocking yoke 51 pivoted at 52 and tensioned by spring 53. Within the yoke 51 is located one arm of a pivoted bell crank 54 whose other end is forked and spans a flat spring 55 attached to a sliding notched bar 56 which in normal position has a notch 57 under every key bar 38 and which in shifted position has a lug 58 under every key bar 38.

Each transmitting disc 1 has an individual brush 60, all brushes 60 being carried by a common shaft 61 and electrically connected thereto, and further connected electrically through shaft 61 to a conductor 61' and also individual code-sensing brush 7, which is of spring material to engage the higher arcs and to follow the minor irregularities of the higher arcs of its associated transmitter disc 1 and being positioned not to engage the lower arcs of its associated disc. Brushes 7 are connected by a common transmission conductor 63' and are positioned with their code-sensing ends over the low arcs 12A of the associated code transmitter discs 1 so that when no code disc 1 is being operated, there will be no connection between transmitting conductor 63' and conductor 61', as clearly shown in Fig. 3.

Transmission conductor 63' is connected through a source of current 60', Fig. 3, to relay 63 whose armature is connected to conductor 65, which extends to a receiving printer at a remote station where it is connected to prepare a normally closed receiving path through winding of polar relay 66, contact 67, and switch spring 68 to ground.

The receiving printer, Figs. 3, 5, and 6, comprises a power shaft 70, Fig. 5, driven by a motor and phonic type speed regulator in the manner shown in connection with power shaft 35, Fig. 4. Gear wheel 71 drives gear wheel 72 continuously and thus through a friction clutch comprising friction rings 73 and friction discs 74 impresses a torque upon operating start-stop shaft 75, Figs. 3, 5, and 6, the shaft 75 being held by stop dog 76,

Figs. 3 and 5, pivoted at 77 for engagement with stop cam 78 under tension of spring 79. Stop dog 76 carries armature 80 of start magnet 81, whose winding is connected in circuit with the armature contact 82 of slow-to-release relay 66. A start-stop switching cam 83 controls switch spring 68 to engage contact 67 when switch cam 83 and shaft 75 are in normal or stop position, and permits switch spring 68 to engage its alternative contact 84 when switch cam 83 and shaft 75 are out of normal position. Contact 84 is connected through armature winding 85 of receiver magnet 86, Figs. 3 and 6, to communication circuit conductor 65.

A recording tape 90 and an inking ribbon 91 are drawn by tape drive roller 4 and pass between spiral edges 95 of printing wheel 2 and the edge of a straight knife edge printing element 3. Tape drive wheel 4 is attached to shaft 92 and to gear wheel 93 which meshes with gear wheel 94, Figs. 3 and 5, fixed upon start-stop shaft 75, whereby tape 90 is driven only during time periods when shaft 75 is operating. The dimensions of gears and type drive wheel 4 are so proportioned that one revolution of shaft 75 and gear 94 will drive tape 90 a distance for recording the only of successive letters in a word.

Printing wheel 2 turns with start-stop shaft 75 to which it is rigidly fixed and therefore turns only in periods when the tape is being advanced. During one revolution of shaft 75 the straight printing element 3 presses recording tape 90 and ink ribbon 91 against the moving edges 95 of printing wheel 2 and produces marks by transfer of ink from ribbon 91 to tape 90 in such manner that a legible character is produced, as will be explained in connection with the description of Fig. 7.

In Fig. 6, an enlarged sectional view with detail of printing elements is shown. Magnet 86 provides a polar magnetic field for winding 85 of its vibrating armature cup 96 which is supported by a flat spring 97 upon an anchorage 98. The tension in flat spring 97 is set to withdraw cup 96 and printing edge 3 from tape 90 or to release the pressure between edge 3 and the spiral edges 95 of wheel 2 to such an extent that the wheel 2 when turning does not cause ribbon 91 to mark tape 90. When current passes through winding 85 of armature cup 96, the polarity of the magnetic field of magnet 86 is such as to repel winding 85 and its cup 96 and knife edge 3 to press knife edge 3 against tape 90 with such force that the turning of the printing wheel 2 will cause ribbon 91 to yield ink upon the surface of tape 90. Since the edges 95 of printing wheel 2 are spiral, each edge 95 as it turns will traverse the length of knife edge 3 and thus will produce a line 99, Fig. 7, upon the record tape 90. When this line reaches the end of the knife edge 3, corresponding to the top of a recorded character, the operating spiral edge 95 will leave the knife edge 3, but at or about that instant the succeeding spiral edge 95 will engage that end of the knife edge 3 identified with the bottom of a recorded character and will begin the tracing of a second record line upon the tape 90. By reason of the movement of the tape 90, the second line will be at the side of the first line but so close that successive lines will merge by coincidence or overlapping of their edges or will appear to merge when viewed in ordinary reading. By retaining the knife edge 3 against the tape 90 through a complete cycle of rotation on wheel 2, a solid black area would be produced upon tape 90. By withdrawing knife edge 3 from tape 90 in code manner, desired parts of the indicated black area may be omitted from printing, permitting to be printed only such fractional markings in each traced line as jointly will constitute a legible character. Printing thus is effected of any desired character, the method being the same for all characters and the characters being distinguished one from the other by the code manner in which the knife edge 3 is operated, its operation being controlled by the manner of the code cutting of a single operating disc 1 in the transmitter. All other transmitter discs in the transmitter are held inert by the stop dogs 40 on their associated key bars 38.

Operation of transmitter

It is presumed that all parts are at rest in the positions shown, with shaft 30 and shaft 70 running at regulated speeds and through their friction clutches supplying power to the several restrained parts; namely, transmitter discs 1, cam disc 45, and start-stop shaft 75. Transmission takes place character by character, which is accomplished by operating keys 37 key after key. The keyboard is of the type known as a bound keyboard in which operation of one key 37 disengages lug 40 from pin 41 to release a disc 1 and also operates universal bar 42 to result in operation of sliding bar 56 which locks all other keys similar to 37 against operation until the transmission indicated by the operated key has been effected. Accordingly, the operator at the transmitter shown in Fig. 4 depresses a key 37 which depresses key bar 38, rotating upon pivot shaft 39, and withdraws lug 40 from the path of stop pin 41 and releases an associated transmitter disc 1 which then rotates by power of motor 33 through shaft 30, feathered washers 32, and the friction of friction discs 31. The local transmission circuit 61', 63' has been open, as shown in Fig. 3, between brush 7 and disc 1, so that transmitter disc 1, now in rotation, first connects brush 60 to brush 7 through disc 1 by engagement of lug 5 with brush 7, thus generating a starting impulse in local circuit 61', 63' and in communication circuit 65 from battery 62 through resistor 62', front contact and armature of relay 63, line conductor 65, winding of polar relay 66, and switch members 67, 68 to ground. Subsequently the facsimile code lugs 6 comprising the high arcs of the facsimile code transmitter disc 1 are caused to engage the code-sensing brush 7 in their designed order and transmit to the transmission line impulses corresponding in length and in timing to the high arcs 6 and therefore corresponding to the dark unit areas of the analysis of the character as disclosed in Fig. 1. At the end of the cycle, key 37 and key bar 38 having been released by the operator, stop pin 41 engages lug 40, and transmitter disc 1 comes to rest in its normal position as shown with open circuit between disc 1 and brush 7 and therefore with open circuit in the local transmission circuit 61', 63'. The downward movement of key bar 38 has released transmitter disc 1 as described and also has engaged universal bar 42 and has rotated that bar upon its pivots on shaft 43 against tension of spring 44, thereby rotating arm 49 counterclockwise, as viewed in Fig. 4, and removing finger 48 from the path of the cam 45, whereupon cam 45 starts simultaneously with transmitter disc 1 being driven by its friction clutch 46 and 47, and immediately the cam pin 50 moves away from the

rocking yoke 51, permitting yoke 51 under power of spring 53 to rock upon its pivot 52 and to rotate bell crank 54 and to flex the flat spring 55 attached to sliding notched bar 56, thus urging notched bar 56 against the side of key bar 38, after which release of key 37 by the operator's finger permits key bar 38 to rise under tension of spring 44 transmitted through universal bar 42 so that key bar 38 clears the engaging lug of notched bar 56 and permits flat spring 55 to shift notched bar 56 lengthwise, thus bringing a lug 58 under every key bar 38 and thus locking every key bar 38 against operation. At the completion of one revolution of shaft 30, the operated disc 1 will cause its stop pin 41 to engage lug 40 to stop the disc and at the same time cam 45 will engage finger 48 which will stop the cam. Immediately prior to the engagement of cam 45 with finger 48, the cam pin 50 carried by cam 45 will engage rocking yoke 51 and rotate the yoke upon its pivot 52, thus rotating bell crank 54 to move flat spring 55, and as there is no restraining influence affecting the sliding notched bar 56, the bar 56 moves with spring 55 and bell crank 54 to remove all lugs 58 from their positions under all key bars 38 and to position notches 57 under all key bars 38 so that all key bars are unlocked in readiness for the operation of any one of them to transmit a succeeding character. Should the key bar of the next character be depressed instantly upon unlocking, another transmitted disc 1 will start but between the transmission of the last facsimileing impulse from the preceding transmitter disc 1 and the transmission of the first facsimileing impulse from the subsequently operating transmitter disc 1, there will intervene the time interval caused by the passing of the low radius arm 12A which will produce in the printed record a space between the successive letters. In this space there will be generated a starting impulse by engagement of starting lug 5 with brush 7, the effect of which will be described in connection with the description of the receiving printer immediately to follow. Since all feed brushes 60 are connected electrically to conductor 61' and all code-sensing brushes 7 are connected directly to conductor 63', it follows that any transmitter disc 1 will produce through relay 63 code impulses from sources 62 and 64 in the transmission circuit 65, each transmitter disc 1 producing a starting signal and a space between characters which are uniform for all discs and each disc further producing facsimileing signals which are variant, each disc from all the others, in the timing and arrangement of the facsimileing signals produced by high arcs 6 on the individual transmitter discs.

Should the operator desire to transmit signal impulses indicating a space between words, a key 37 would be depressed which will release a transmitter disc 1 having a starting lug 5 and having no other high arc. The result upon the transmission line 65 will be to transmit a starting signal generated by contact of lug 5 with brush 7 and accompanied by a locking of the keyboard by cam 45, as described, so that no other key 37 may be depressed until the blank or spacing disc 1 has completed its revolution. However, the starting impulse generated by lug 5 will not be followed by any facsimileing code impulses whatever so that the ultimate effect is to indicate proposed transmission of a facsimileing signal and then not to send any signal other than holding the transmission conductor 65 ineffective during a desired time interval. The effect in the receiver printer will be described in the description of the printer.

Operation of receiving printer

In response to signals received from the transmitter described above, the receiving printer, Figs. 3, 5, 6, and 7, operates in response to the starting impulse generated by lug 5. The starting impulse is received while the switching cam 83 is in its normal stop position and is holding the switching member 68 in engagement with its contact 67. The starting impulse, therefore, passes from transmission conductor 65 through relay 66 and contacts 67 and 68 and thence to ground, energizing relay 66 which by its slow-to-release armature contact 82 energizes starting magnet 81, which attracts its armature 80 to lift the stop dog 76 free of the notch of stop disc 78, thereby permitting the start-stop shaft 75 to rotate. The first effect of the rotation of start-stop shaft 75 is to cause switching cam 83 to move its lug away from switch member 68, thus permitting switch member 68 by its inherent spring tension to abandon its contact 67 and to engage its contact 84 and thus to prepare a path from transmission conductor 65 through the winding 85 of the armature cup 96 and contacts 84 and 68 to ground, the prepared path being effective in response to facsimile signals to operate the printing element 3 into cooperation with printing element 2 through the interpositioned tapes 90 and 91. The second effect of the starting of the start-stop shaft 75 is to rotate shaft 92 by power derived from shaft 75 through gears 93 and 94 and thus to rotate tape drive wheel 4 to draw tape 90 and ribbon 91 at a regulated speed between printing members 2 and 3. The third effect of rotation of the start-stop shaft 75 is to rotate the printing drum 2 with its spiral edges 95 continuously to provide for the cooperation of the spiral edges 95 with the straight edge 3 to effect printing in accordance with the method of scanning disclosed in Fig. 1 in response to signals controlled by the high arcs of the now operating transmitter disc 1. In response to facsimileing impulses received from transmission conductor 65, the straight edge 3 is operated to press tape 90 and ink ribbon 91 against spiral edges 95 in code manner to produce fractional marks so located as to combine to form a letter identified by the identify of the operating code disc 1. At the end of the group of facsimileing signals, first the straight edge 3 ceases operating by reason of cessation of facsimileing signal impulses, then the lug of switching cam 83 passes under the engagement point of switching member 68 and lifts switching member 68 from contact 84 into engagement with contact 67, then the notch of stop disc 78 being under the end of stop lug 76 engages stop lug 76 with its vertical side and effects the stopping of the start-stop shaft 75, the stopping of the tape drive wheel 4 also being thus effected and the cycle of facsimile printing of one character being thus concluded.

Should the transmitted intelligence be that of indicating a space between words, only the starting impulse would have been received upon winding of relay 66 and not upon winding 85, straight edge 3 would have remained withdrawn from pressure against tape 90 throughout the entire cycle of revolution of printing wheel drum 2 and tape driving wheel 4 with the result that a measured amount of tape 90 equal to the amount required for printing a character would have

been drawn past the point of printing but without imprinting any marking thereon, thus effecting a blank space in the tape equivalent to the lineal dimension of one printed character.

The speed of shaft 75 is adjusted to be slightly faster than the speed of transmitter shaft 30 and is corrected from time to time by dog 76 in engagement with stop disc 78. Should any such engagement produce a greater delay than is theoretically necessary, then in the following revolution or revolutions of shaft 75 and disc 78, the notch of disc 78 will be in delayed arrival, the starting impulse may have passed, relay 66 will have been energized and may be retaining its slow-to-release armature, magnet 81 will be already energized, and dog 76 will be in lifted condition, permitting the notch in disc 78 to pass without stopping shaft 75. Difference in speeds of shafts 75 and 30 may be made very small and shaft 75 may run normally without correction when controlled by an automatic transmitter, being stopped for correction only when its accumulated error becomes large enough to permit disc 78 to engage dog 76 before magnet 81 has become fully energized.

Modified start-stop receiver

An alternative form of receiver is shown in Fig. 8 with details in Fig. 9. Power shaft 101, cam 102, cam switch spring 104 and contacts 103, 105, starting magnet 106, stop dog 107, stop spring 108, and line conductor 111 correspond to similar elements in Fig. 3 labeled respectively 75, 83, 68, 84, 67, 81, 76, 79 and 65, all of which will be understood from prior description herein, and the receiver illustrated in Fig. 8 may be substituted for the receiver illustrated in Fig. 3, and may be operated under control of the transmitter illustrated in Fig. 3 over line conductor 65.

Power shaft 101, Fig. 8, it will be understood is the power shaft of a start-stop receiver and therefore is rotated through a friction clutch similar to 72, 73, 74 in Fig. 5.

Shaft 101 carries scanning disc 120 having an integral stop lug 121 and corresponding respectively to wheel 2 and disc 78, Fig. 3. Disc 120 carries a plurality of scanning points 122 arranged in a true circular arc and projecting from the disc. Polar line magnet 123 has an armature 125 with printing platen 124 at the end thereof which is just above the scanning points and which has a movement toward and from the points. Between points 122 and armature platen 124 are record tape 127 and pigment tape 126. Detail of polar magnet 123 is shown in Fig. 9 in which a horseshoe permanent magnet 130 has pole pieces 131 and 132 of U-shape, and between the pole pieces are positioned solenoid coils 123 and pivot block 134. Armature 125 is pivoted at 136 in block 134 and extends through the two coils 123 and is normally held with its platen end 124 away from disc 120 by spring 108 secured thereto adjacent to the opposite end.

Battery 140 is connected in a starting circuit from line conductor 111 in series with start magnet 106 and switch contacts 105 and 104 to ground, its polarity being such as to augment current from battery 62 received when contact 104 is in engagement with contact 105. A facsimileing circuit in the receiver of Fig. 8 extends from line conductor 111 through polar line magnets 123 and switch springs 103 and 104 to ground.

In operation of the receiving device of Fig. 8 when used in connection with the transmitter of Fig. 3, scanning disc 120 is held against the power of its friction clutch by stop dog 107. The potential of battery 140 opposes the potential of battery 64 and current does not flow. A starting current impulse, for example, transmitted from relay 63 in response to contact of arc 5 and brush 7, Fig. 3, will pass from earth through battery 62, resistance 62', front contact and armature of local relay 63, line conductor 111, Fig. 8, battery 140, start magnet 106, contact 105, and spring 104 to ground, cam 102 being in its stop position and holding contacts 104 and 105 engaged and batteries 62 and 140 being of assisting polarity and connected to operate with their potentials added. Start magnet 106 energizes and operates stop dog 107 to release scanning disc 120 after which printing is effected as follows: Each marking condition from brush 7, Fig. 3, produces energization of relay 63 which generates a current through battery 62, which passes through conductor 111, Fig. 8, corresponding to conductor 65, Fig. 3, solenoids 123, switch contact 103, and switch tongue 104 to ground. Each such impulse moves armature 125 to rotate clockwise about its pivot 136 and to press its printing end 124 against tapes 126 and 127, thereby pressing the tapes together and against a scanning point 122. The scanning points being in motion, it follows that a line of arcuate form will be drawn upon tape 127 by transfer of pigment from tape 126, and it will be understood further that the nature of the code signals which draw printing platen 124 against the tapes are such in time and nature that the resultant accumulation of marks upon tape 127 will constitute a record thereon which will be the character telegraphed by the transmitter.

Armature platen 124 is lifted from scanning points 122 by electromagnetic power given to the armature by battery 64 which is included in the line circuit by sending relay 63 when not charged by a marking impulse from brush 7; that is to say, when brush 7 is indicating a spacing impulse by transmitting no current to energize relay 63. During such spacing intervals battery 140 is removed from the circuit since cam 102 is rotating in its facsimileing angles so that tongue 104 does not engage contact 105 but engages contact 103 instead. Therefore a spacing impulse from battery 64, Fig. 3, passes by conductor 111, Fig. 8, through solenoids 123, contact 103 and spring 104 to ground. This reverse current through polar relay 123 pulls its armature 125 into spacing position so that printing platen 124 does not compress tapes 126 and 127 against revolving points 122. Spring 108 is not strong enough to interfere with movements of armature 125 when controlled by solenoids 123, but merely holds platen 124 out of operating contact with the printing tape when the receiver is not in use.

Modified transmitter

Where the start-stop system of transmission is used, the code signals for the several characters may be sent at irregular intervals by a manual device and yet may appear always in suitable form and position upon the tape because the tape stops between receipt of successive characters.

An optical scanning transmitting device suitable for transmission of this nature is shown in Fig. 10, which is a broken perspective to show the parts more clearly. Motor 141 whose speed is regulated by governor 142 drives shaft 143 through friction clutch 144 which may be of any desired construction. Upon shaft 143 is mount-

ed scanning disc 145 having two series of scanning holes 146 through which a pencil of light may pass from lamp 147. Lamp 147 is connected to a source of current 148 and is located in the axis of an optical condenser system 149 which may concentrate rays of the lamp into a beam 150 reflected by prism 151 through a type mask or stencil 152 and thence through a lens 153 to project a character image in light as shown at 154 upon rotating disc 145.

The type mask 152 comprises an opaque member having the characters cut therethrough, similar to a stencil sheet, whereby light rays passing through an opening formed by a stenciled character will project the character on disc 145. Holes 146 in two series are of any suitable number in each series for effective scanning and the distance between holes is equal to or slightly greater than the height of the character 154, and the radial distances of the holes from the axis of shaft 143 are variant so that the most distant hole of each series when turned by the disc will traverse the distant edge of a character and the hole of each series nearest the axis will traverse the nearer edge of the same character, the intervening holes traversing intervening lines equally distant from each other in the body of the character.

A further spaced pencil of light 155 and larger holes 156 in the disc 145 which intercept the pencil 155 are provided adjacent the beginning of each series of holes 146 to transmit a starting impulse of light to a photo-electric cell 160 positioned in back of disc 145. Holes 156 are positioned to align with pencil of light 155 prior to the first hole 146 of each series coming into alignment with light image pencil 154 so that each scanning operation is preceded by a starting signal. Following each series of holes 146 is a blank section of disc 145 which intercepts both pencils 154 and 155 in normal position and imposes a stop signaling condition on the transmission circuit.

Photo-electric cell 160 is positioned behind disc 145 and is associated with thermionic valve 161 which has a filament 162, a heating source 163, a grid 164 with polarizing path containing battery 165 and resistor 166, a grid control path containing battery 167 and photocell 160, and finally has an output circuit including battery 167 and plate 168 and including for transmission purposes two wires 170 which may extend directly to a recording receiver or to a line channel or to modulating devices of a radio system. While scanning holes shown in Fig. 10 are arranged in two sets each occupying one-half of the complete disc and each set of holes with its starting impulse opening 156 serving to completely scan a character, it will be obvious that one set of scanning holes may occupy 360 degrees of the disc or any portion thereof.

Scanning disc 145 has two notches 171 in the rim thereof which are engaged by latch 172 pivoted to the frame at 173 and urged by a spring 174 also fixed to the frame. Pins 176 carried by scanning disc 145 are positioned to strike a tail 177 of latch 172. Operating arm 178 of latch 172 is adapted to be engaged by arm 179 which is an integral extension of universal bar 180 pivoted upon shaft 181. It will be understood that a stop notch 171 and stop pin 176 are provided for each set of scanning holes and are correctly positioned to function in a manner to be described. Universal bar 180 is shown unoperated at the portion labeled 180 and is shown operated in the dash-dot line position of the same bar labeled 180'. A number of latches 185 equal in number to the number of keylevers 186 are pivoted also with bar 180 upon shaft 181 and each of them has its individual spring 187 which draws it toward universal bar 180. Keylevers 186 are pivotally mounted upon universal support 190, each keylever having a notch 191 which surrounds pivot edge 192 of support 190, and each lever is under tension of its individual spring 193. Each lever 186 is provided at its front end with a finger piece 195 and at its back end with a lug 196 and a notch 197. Lugs 196 are engaged by shoulders 198 of latches 185, and notches 197 may receive the edge of the universal bar 180 when a keylever is depressed at its front end and elevated at its back end about pivot 192, as is shown in the case of the lever 200.

A plurality of bell crank levers 201 are pivoted in an arc; one lever for each keylever 186. Upper ends 202 of bell cranks 201 form a circular arc within which moves the type mask actuator 203 pivoted to the frame at 204, and engaged by one or the other of two operating fingers 205 and 206. The two operating fingers are pivoted on the shaft 207 and each has a power receiving bail 208 which passes under a number of keylevers 186. Each of the bell crank levers 201 has its horizontal end 209 in engagement with the upper edge of one of the keylevers 186.

Projection mask or type stencil slide 152 slides upon a guide 210 of circular arc form and of open central section to permit beam 150 to pass therethrough. Guide 210 is supported upon two sliding posts 211 for sliding vertically in fixed guides 212 when urged upward by shift lever 213 pivoted to the receiver frame at 214 and operated by manual key 215. Two downwardly projecting fingers 216 form a fork through which oscillatory actuator 203 projects, whereby oscillatory movement of member 203 will shift mask 152 along guide 210. It will be understood that mask 152 has a double row of characters and the lever 213 operates the shift whereby the lower set of characters, such as figures, may be transmitted in the upper position of mask 152.

Operation of transmitter of Fig. 10

With motor 141 running at regulated speed and with all parts at rest by reason of engagement of latch 172 with one notch 171 of scanning disc 145, and with friction clutch members slipping, a finger piece or key 195 may be depressed to operate a keylever as shown in the drawing at keylever 200. Before depression of the key, universal bar 180 is in the position shown in full lines at 180 and all latches 185 are held back by engagement of all shoulders 198 with all of lugs 196. In this position, a stop signaling condition is imposed on conductors 170, as above pointed out, due to interception of pencils 154 and 155 by a blank section or stop section of disc 145.

When keylever 200 is depressed at its front end, the back end will rise until its lug 196 moves out of the path of shoulder 198 of its cooperating latch 185 by which time notch 197 of the operated keylever 200 will be high enough to receive the edge of universal bar 180. Released latch 185 will be urged by its individual spring 187 and will move its shoulder 198 under lug 196 of keylever 200, at the same time engaging and moving universal bar 180 into notch 197 of keylever 200. Thus keylever 200 will be locked against return, and counterclockwise movement of universal bar 180

about its pivot 181 will occur due to pressure of released latch 185, and will move its integral extension arm 179 and lift arm 178 to rotate latch 172 upon pivot 173, which at the same time will withdraw the latch from notch 171 of disc 145 and will move tail 177 into the path of pins 126 of disc 145.

Depression of a keylever such as 200 will rotate one or the other power bail 208, depending upon which side of the machine the keylever 200 is positioned. Rotation of any power bail 208 will move its operating finger 205 or 206 to the left and, due to engagement of fingers 205, 206, with pivoted type mask actuator 203 which controls mask 152, the type mask actuator will be rotated about its pivot 204 until its free end engages the operated bell crank lever 201. When keylever 200 is operated, upward movement of its rear end raises end 209 of its individual bell crank lever 201, so that the oscillatory movement of mask 152 is stopped when the stenciled character therein corresponding to the operated keylever aligns with ray 150.

The disc 145 will assume its full speed when released and will transmit signals to the line conductors 170 as follows: First, hole 156 aligns with pencil 155 to allow this pencil to pass to photoelectric cell 160, which immediately will vary the current in the circuit of resistance 166, which will vary the difference of potential existing between filament 162 and grid 164, and thus produce a signal current in output conductors 170. This is a starting impulse for the receiving station and may serve to start a receiver such as shown in Fig. 3 or 8. A series of holes 146 now will scan the image of character 154 thrown on disc 145 from the bottom to the top of the character and successively from the beginning to the end of the character, the character being inverted in its projection upon the disc 145. The scanning of the selected character will result in transmission of a suitable series of marking and spacing conditions of the type transmitted by code discs 1, Fig. 4, for similar characters, each preceded by a start condition followed by a stop condition.

When a key in the right-hand half of the keyboard is depressed, bail 208 on this side of the keyboard will be depressed, operating finger 205 will move toward the left as viewed in the drawing, and operating member 203 will be rotated upon fixed pivot 204, thus carrying mask 152 along its guide 210 toward the right-hand end of the guide until member 203 engages the upper end of the operated bell crank 201. Back end of the keylever 200 when rising has engaged back end 209 of one of its associated bell cranks 201 and by the lifting of the back end has advanced front end 202 of that bell crank into the path of operating member 203. When operating member 203 stops against the operated bell crank, the mask 152 will be in proper position to project upon the scanning disc 145 that character 154 which corresponds to the finger piece 195 on the keylever 200.

At the conclusion of a half revolution of scanning disc 145, a pin 176 will strike tail 177 of latch 172 and will operate the latch to operate arm 179 to overcome spring 187 and thus to restore universal bar 180 from its operated position 180' to its unoperated position. Latch 172 when operated by pin 176 will be in position to engage the corresponding notch 171 to stop scanning disc 145, and universal bail 180 when thus operated will release keylever 200 which will be returned by its spring 193, it being presumed that the keyboard operator has removed his finger from finger piece 195. Scanning disc 145 will then come to rest in the position shown in Fig. 10 with beams 154 and 155 intercepted by the blank or stop signal section of the disc, and a stop signaling condition will be imposed upon the transmission circuit. Should key 215 be held down while key 195 is operated, the figure or shift character will be projected at the point 154.

Should the operated key be in the left half of the keyboard, operating finger 206 instead of 205 would be effective upon operating member 203.

It will accordingly be seen that output of signals on wires 170 produced by scanning with a circular arc is of the nature of direct current which is interrupted in a code manner and which is particularly suitable for a recording receiver according to Fig. 8 which records by scanning with a circular arc.

Continuous cyclic transmitter

In this type of transmitter, code discs 1 are fixed on shaft 230, Fig. 11, with spacing rings 231, and the further structure of the transmitter, Figs. 11, 12, 13, and 14, comprises motor driven shaft 250 carrying pinion 251 which meshes with gear 252 on power shaft 253 of Fig. 11. Shaft 253 carries spiral gear 254 which meshes in the spiral gear 255 on shaft 230 and thus drives transverse shaft 230 of the transmitter of Fig. 11 at the same angular speed as cam shaft 253.

Referring to Fig. 11, a code transmitter is driven by a power cam shaft 253 which carries three cams. A first cam 261 controls the action of feeler bars 262 of which there are six in the device as shown, the feeler bars 262 being sufficient in number to detect all of the code holes in control tape 263. Apparatus herein illustrated is adapted to use a six-hole cross-perforated tape, although the device may be arranged to be controlled from any desired form of tape. Cam 261 engages roller 266 on cam follower 267 pivoted at 268 to the transmitter frame. Cam follower 267 is under tension of spring 270 and has arm 269 with transverse flange 271 which engages six lugs 272 on the six feeler bars 262. Each feeler bar 262 is provided with an individual spring 273 urging it upward, with a tape testing pin 274 and with a stop lug 275. Springs 273 extend to the center frame at 276 and the six feeler bars operate freely in slide guides 277 and 278 fixed in the frame. Tape guide 280 is perforated at 281 opposite each tape testing pin 274.

Arm 269 carries pawl 285 attached pivotally at 286 and under tension of spring 287 which draws the pawl against the teeth of ratchet 290. The ratchet 290 and tape feed sprocket wheel 291 are fixed to shaft 292 which is journaled in the frame. Pins on feed wheel 291 engage feed holes in tape 263 in well-known manner to feed the tape in operation.

Follower 267 has a stop tooth 296 engageable by tooth 297 in a manually controlled lever 298 pivoted at 299 to the frame of the transmitter. With shaft 253 and cam 261 in operation and with lever 298 in the full line position shown, follower 267 is held from movement as cam 261 rotates and operation of the transmitter is prevented. With lever 298 moved to the dotted line position shown, follower 267 is freed for movement under influence of spring 270 and cam 261, and transmitting operations may proceed under control of tape 263.

A second cam 301 carried by shaft 253 controls the action of transfer levers 302 which are equal in number to the tape feeler bars 262 and are

controlled thereby. Cam 301 engages roller 306 on cam follower 307 pivoted at 308 to the frame. Cam follower 307 has an arm 309 with transverse flange 310 which engages six lugs 312 on the six transfer levers 302. Each lever 302 is provided with individual spring 313, with a testing finger 314 and with a power lug 315. Springs 313 are secured to the transmitter frame and the six transfer levers are pivotally mounted for independent movement upon a common pivot shaft 317 fixed in the frame. Cam follower 307 is under tension of spring 319 secured to the frame.

A third cam 321 carried by shaft 253 engages roller 326 on cam follower arm 327 formed integrally with bail 322. Bail 322 is under tension of two springs, spring 329 attached to the frame at 330 and spring 331 attached to the frame at 332. Bail 322 operates freely in longitudinal and vertical directions in slide guides 334, 335, and 336 fixed to the transmitter frame. Guides 334 and 335 are provided with inclined cam surfaces 334A and 335A which are engaged by inclined edges 334B and 335B respectively of bail 322. As cam 321 rotates, the cooperation of cam 321, surfaces 334A, 334B, edges 335A, 335B, and springs 329, 331 shifts bail 322 into and out of its dotted line position, the shift being made momentarily and once for each rotation of shaft 253.

Six permutation bars 350 provided with selecting notches 351 slide in slotted guides 352 and 353 fixed to the transmitter frame. Each bar 350 is provided with an individual spring 355 secured to the frame. Each bar 350 is individual to and controlled by each of the six transfer levers 302, and springs 355 draw the six bars 350 severally against the lugs 315 which determine the normal position of rest of the bars, the normal position of levers 302 and lugs 315 being determined by springs 313 and by the flange 310 of follower 307, whose position is determined by engagement of roller 306 and cam 301.

Each bar 350 has a locking notch 357 adapted to be engaged by point 358 of a latch 360 of which there are six individual to six bars 350. Secured to each latch 360 is a spring 361 attached also to the transmitter frame. The six latches 360 are pivotally mounted upon a common pivot 363 fixed in the frame and are crossed by a striker pin 366 carried by a restoring bell crank 367 pivotally mounted at 368 upon the frame and under tension of spring 369 attached to the frame. Bell crank 367 rotates on its pivot 368, and extension 371 thereof at all times slidably engages end 372 of selector bail 322. Notches 351 of bars 350 are preferably arranged in a manner similar to the permutation code bars commonly used in type printing telegraphs and are preferably arranged to operate under control of permutation code perforations in tape 263.

Referring to Fig. 13 in connection with Fig. 11, a series of bell cranks 390, one for each character to be transmitted, are pivotally mounted upon a common pivot shaft 391. Each bell crank 390 has an individual spring 392 secured to the frame which springs urge arms 394 of bell cranks 390 into engagement with the six permutation bars 350, thus conditioning the bell cranks to be selectively controlled by sets of aligned notches 351 of bars 350 in accordance with control perforations in tape 263.

Each bell crank 390 carries an insulated brush 7. The brushes 7 contact severally with code discs 1, one for each character or signal to be transmitted, all rigidly secured to shaft 230 and spaced apart by collars 231. Each code disc 1 has associated with it an individual brush 7 with its operating member 390.

All the brushes 7 are connected to a common wire 409 and all code discs 1 are connected electrically through shaft 230 and through the transmitter frame to a common wire 410. Each code disc has a high radius or contact surface 6 at each point where a signal is to be transmitted. Contact surfaces 6 are arranged on each code disc in such manner as to transmit the desired signals.

Controlling tape 263, Fig. 5, may be perforated in any well-known manner with successive rows of perforations arranged in controlling combinations in accordance with a six-unit permutation code and with one or more rows of feed holes to be engaged by the pin on the tape feed wheel 291 of the transmitter.

For purposes of remote control, a magnetically controlled reperforator 458 controlled by signal selector magnet 459 is utilized. Selector magnet 459 is connected in line 460 which is in turn controlled by a six-unit permutation code tape transmitter 461 of any desired construction and which controls the transmission of code impulses to line 460 from battery 462 in accordance with perforations in control tape 463 formed in keyboard perforator 464 of any desired construction. As the receiving perforator 458 produces a duplicate of the tape 463 adjacent to the transmitting mechanism 260, it will be obvious that the keyboard perforator 464 and tape 463 may be utilized directly to control the transmitter 260 in place of the reproduced tape 263 if desired.

Operation of transmitter

To start transmission, the shafts 253 and 230 being in rotation and perforated tape 263 being in position in guide 280, manual lever 298 is lifted when apex of cam 261 is under roller 266, thus releasing cam follower 267. Notch 297 of lever 298 and detent 296 of cam follower 267 are so shaped that under the action of spring 270 the raising of lever 298 is prevented until roller 266 is on the peak of cam 261, thereby insuring initiation of transmission at the beginning of a cycle. With cam 261 in the position shown in Fig. 11, discs 1 will be in the position shown in Fig. 13 and cam roller 268 will be lowered during approximately 120° of angle of rotation of shaft 253. Rotation of cam 261 allows spring 270 to rotate cam follower 267 counterclockwise about its pivot 268 to lift flange 271 out of engagement with the six lugs 272 on tape feeler bars 262 which rise under influence of spring 273. When feeler bars 262 rise, should any feeler pins 274 register with any holes in tape 263, said pins will pass through said holes and each feeler bar 262 will rise to remove its stop lug 275 from the path of finger 314 on corresponding transfer lever 302. Accordingly, feeler bars 262 will be positioned in a code combination in accordance with the controlling permutation code perforations.

Rotation of shaft 253 for approximately 110° from the zero position shown in Fig. 11 carries cam 321 into engagement with roller 326 to shift follower 327 and selector bail 322, thus moving said bail to dotted position. Vertical movement of the selector bail 322 causes it to engage arms 394 of all bell cranks 390 to raise the members clear of permutation bars 350 to permit setting of the bars immediately after the last transmit-

ting arcs of all discs 1 have passed their respective brushes 7.

Movement to the left of bail 322 causes rotation of bell crank 367 about its pivot 368 which causes striker pin 366 carried thereby to engage and to depress all latches 360. This releases all operated permutation bars 350 and allows them to return to their right-hand position under action of their individual springs 355. Further rotation of shaft 253 to about 120° from zero angle next causes the low portion of transfer cam 301 to pass under roller 306, thus allowing spring 319 to rotate cam follower 307 counterclockwise lifting flange 310 out of engagement with lugs 312 to release the six transfer levers 302. At this point in the cycle of operations feeler bars 262 have assumed their selective positions in accordance with the code for the character to be transmitted and transfer levers 302 will be positioned accordingly. The transfer levers associated with the feeler bars 262 which are raised due to perforations in tape 263 are free to rotate clockwise under influence of their individual springs 313 which maintain lugs 312 in engagement with flange 310. Others of said transfer levers are retained in the position shown in Fig. 11 due to lugs 275 or feeler bars 262 contacting with lugs 314 on the transfer levers to prevent rotation of the transfer levers.

The transfer levers assume positions in accordance with the code for the character to be transmitted at or just after restoration of bars 350, and due to the engagement of lugs 315 of these transfer levers with the ends of permutation bars 350, said bars will be forced to assume a position in accordance with the code for the character to be transmitted.

Code bars 350 engaged by transfer levers 302 which are free to rotate clockwise will be forced to the left, thereby to align slots 351 under one bar 394 of bell cranks 390. Movement of permutation bars 350 to the left in Fig. 11 aligns notches 357 in said moved bars with tips 358 of latches 360. When shaft 253 has rotated to say 140°, cam 321 will release roller 326 and bail 322 will return to its normal lowered position under influence of its springs 329 and 331. As bail 322 is lowered, latches 360 engage the notches of operated bars 350 and bell crank 390, selected in accordance with the code of the character to be transmitted, will fall into the aligned notches of the code bars 350 and will move the brush 7 thereon into engagement with one of the discs 1. Cam 301 restores transfer lever 307 and transfer levers 302 after cam 321 allows bail 322 to be lowered and after bars 350 are locked in their new positions.

The selected brush 7 approaches its individual disc at or immediately before the radius marked 436A in Fig. 13. The time interval in which all discs 1 rotate their arcs 330 from radius 431A to radius 436A through the contact point of their brushes 7 provides a transmission interval during which the movement of the receiving tape effects a space between consecutive characters, during which also a brush 7 which has been utilized for the completed character may be lifted and a brush selected to be utilized for the succeeding character may be brought into transmitting position. As the rotation of shaft 230 continues through its facsimileing angle of 300°, the selected character will be transmitted by signals similar to signals produced by direct scanning and during that transmission an overlap action will occur in the selecting mechanism of the transmitter. Transfer levers 302 will be restored by cam 301, feeler bars 262 will be restored by cam 261, and tape 263 will be advanced by rotation of sprocket wheeel 291 and shaft 292 produced by movement of pawl 285 as arm 269 is lowered by cam 261. The transmitting mechanism thus is positioned for its next cycle of selection, which begins immediately as cam 261 lowers its follower 267, and the selection is completed in readiness for transfer to a predetermined bell crank 390 during the next interval while the low radius arcs 230 are passing brushes 7.

Although the invention has been described in connection with a specific form thereof, it will be understood that it has further applications and is not intended to be limited in scope by the embodiment shown herein for illustration.

What is claimed is:

1. In a telegraph system, a signal channel, means to transmit over said channel a group of signals individual to each character which are composed of a plurality of scanning lines, means to transmit a single momentary starting signal preceding each group of signals for each complete character, a recorder normally inert, means responsive to said starting signal for rendering said recorder effective for recording of one complete chaacter, and means in said recorder responsive to the group of signals individual to the character for effecting recording thereof during the period such recorder is rendered effective by said starting signal.

2. In a telegraph system, a signal channel, means to transmit over said channel a group of signals individual to each character which are composed of a plurality of scanning lines, each group of signals including marking and spacing signals of equal duration, means to transmit a single momentary starting signal preceding each group of signals for each complete character, a recorder normally inert, means responsive to said starting signal for rendering said recorder effective for recording of one complete character, and means in said recorder responsive to the group of signals individual to the character for effecting recording thereof during the period such recorder is rendered effective by said starting signal.

3. In a printing telegraph system for the transmission of intelligence composed of a series of symbols each symbol composed of a plurality of scanning lines accompanied by an inter-symbol space interval, a signal channel, a driven printing receiver connected thereto, a transmitter having means responsive to the selection of each symbol to transmit over said channel a space interval and marking and spacing conditions of facsimileing impulses representing a plurality of scanning lines individual to the selected symbol, recording means in said receiver for recording a symbol in form of a plurality of scanning lines between succeeding inter-symbol space intervals, and start-stop means for synchronizing the phase of the receiver only during reception of the space interval.

4. In a facsimile telegraph system for the transmission of intelligence composed of a series of symbols each symbol composed of a plurality of scanning lines, a signal channel, a transmitter having a plurality of transmitting elements each having means for transmitting over said channel a series of marking and spacing impulses corresponding to the light and dark areas of a scanned symbol, means in said transmitter for transmitting a single momentary start impulse for each said series of impulses and prior to all of the

signal impulses of the series for each symbol, a receiver connected to said channel and provided with a driven printing mechanism to facsimile successively the plurality of scanning lines constituting a transmitted symbol, and start-stop means for said printing mechanism actuated by said start impulses from said transmitter once for each transmitted symbol.

5. In a facsimile telegraph system for the transmission of a series of individual symbols, physical embodiments of each of said symbols, a signal channel, a signal generating scanning device connected to said channel, means to bring any one of said embodiments of symbols into operative relation with said scanning device, a recording device connected to said channel, means to start both of said devices at the beginning of each signal representing a single symbol, means in said recording device and independent of signals generated by said scanning device to continue said recording device in operation for a time period sufficient to record completely a maximum one of said symbols, and automatic means to stop both devices at the end of each of said symbols.

6. In a facsimile telegraph system, physical embodiments of symbols of a series, a normally stationary scanning device, selective means for positioning fixedly one of said embodiments of symbols for scanning by said device, latch means for retaining said selective means and said embodiments fixed in selecting position, means for initiating rotary operation of said scanning device by the operation of said selective means, and means for stopping said scanning device and releasing said latch means at the completion of scanning of a selected symbol.

7. In a printing telegraph system, a transmitter having means to transmit a start impulse followed by a series of signal impulses for each character, a receiver having a driven printing mechanism and normally engaged stop means therefor, starting means therefor operable by a start impulse, and means for continuously maintaining said stop means disengaged when said transmitter and receiver are in synchronism.

8. In a telegraph system, a signal channel, means to transmit over said channel a group of character signals individual to a character, means to transmit a single starting impulse invariably preceding each said character group of signals, and means connected to said channel to record the character signal by signal directly as the individual signals of the character group are received, and a starting magnet for said last mentioned means rendered effective solely in response to said single starting impulse.

9. In a facsimile telegraph system for the transmission of intelligence composed of a series of a series of symbols each symbol composed of a plurality of scanning lines, a signal channel, a transmitter having a plurality of transmitting elements each having means for transmitting over said channel a single group of marking and spacing character impulses corresponding to the light and dark areas of a complete scanned symbol, means in said transmitter for transmitting a single start impulse prior to the said group of symbol impulses for each complete symbol, a receiver connected to said channel and provided with a driven printing mechanism to facsimile successive scanning lines of a transmitted symbol, and start-stop means for said printed mechanism actuated once per complete group of symbol signals by said start impulses in an inter-symbol time period between successive groups of symbol impulses, one start impulse for each group of symbol impulses from said transmitter.

10. In a facsimile telegraph system, a signal channel, means for transmitting over said channel groups of electrically contiguous facsimile signals in successive cycles each cycle corresponding to a plurality of scanning lines comprising the light and dark areas of a complete scanned character, and means for transmitting also over said channel a single recorder-start condition restricted to the time elapsing between two successive groups of said contiguous facsimile signals.

11. In a telegraph system, a signalling channel, a rotary transmitter to transmit over said channel successive groups of facsimileing signals each of said groups representing a plurality of scanning lines of a symbol and to transmit over said channel accompanying each of said groups of facsimileing signals groups of non-facsimileing synchronizing signals in number fewer than the number of said scanning lines, a receiver connected to said channel, a facsimile printer in said receiver, synchronizing means in said receiver, a synchronized rotary cam in said receiver, and channel-circuit switching means in said receiver controlled by said cam to connect said channel to said facsimile printer during receipt of said facsimileing signals and to connect said channel to said synchronizing means during receipt of said synchronizing signals.

12. In a telegraph system, a signalling channel, a rotary transmitter to transmit over said channel facsimileing signals representing a plurality of successive scanning lines of an image during a part of a revolution and a single stop-start signal during the remainder of said revolution, a receiver connected to said channel, recording means in said receiver, stop-start means in said receiver, and a cam-controlled switch in said receiver to connect said channel to said recording means during receipt of said facsimileing signals and to connect said channel to said synchronizing means during receipt of said stop-start signal.

13. In a telegraph system, a signalling channel, means to transmit over said channel successive groups of facsimileing signals representing a plurality of successive scanning lines, each group of signals individual to a character, each group of signals including marking and spacing signals and all groups being of equal duration, means to transmit over said channel accompanying each said group of facsimileing signals a group of non-facsimileing signals fewer in number than the number of said scanning lines during a spacing period representing a blank record space between recorded characters, a receiver connected to said channel, recording means in said receiver, synchronizing means in said receiver, and channel-circuit switching means in said receiver to connect said channel to said recording means during said duration of receipt of said facsimileing signals and to connect said channel to said synchronizing means during said spacing period.

14. The method of synchronizing facsimile transmitters and receivers which comprises transmitting scanning signals representing consecutive scanning lines of an integral message, and transmitting also synchronizing signals interspersed with said scanning signals, the number of said synchronizing signals being smaller than the number of said scanning lines.

15. In a facsimile telegraph system, means for transmitting facsimileing signals representative of successive scanning lines, means for transmitting automatically synchronizing signals inter-

spersed among said facsimileing signals, the number of said synchronizing signals being smaller than the number of said scanning lines, and means for effecting a synchronized facsimile record in response to said facsimile signals.

16. In a facsimile telegraph system, means for transmitting facsimile scanning signals of marking electrical characteristic representing successive scanning lines in a complete message, means for transmitting further signals of marking electrical characteristic interspersed with said facsimile scanning signals fewer in number than said scanning lines, facsimileing means responsive selectively to said facsimile scanning signals, and synchronizing means responsive selectively to some of said further signals.

17. The method of operating a facsimile telegraph system which comprises transmitting facsimile signals representing successive scanning lines of a complete message, transmitting a synchronizing signal following the facsimile signals for a plurality of successive scanning lines, and synchronizing said system by utilizing synchronizing signals fewer in number than the number of said scanning lines.

18. In a facsimile telegraph system, means for transmitting facsimile signals representing successive scanning lines of a complete message, means for transmitting synchronizing signals interspersed with said facsimile signals, recording means for recording said facsimile signals, and synchronizing means responsive to synchronizing signals and effective to synchronize said recording means in response to synchronizing signals fewer in number than the number of scanning lines.

EDWARD E. KLEINSCHMIDT.
EDWARD F. KLEINSCHMIDT.