

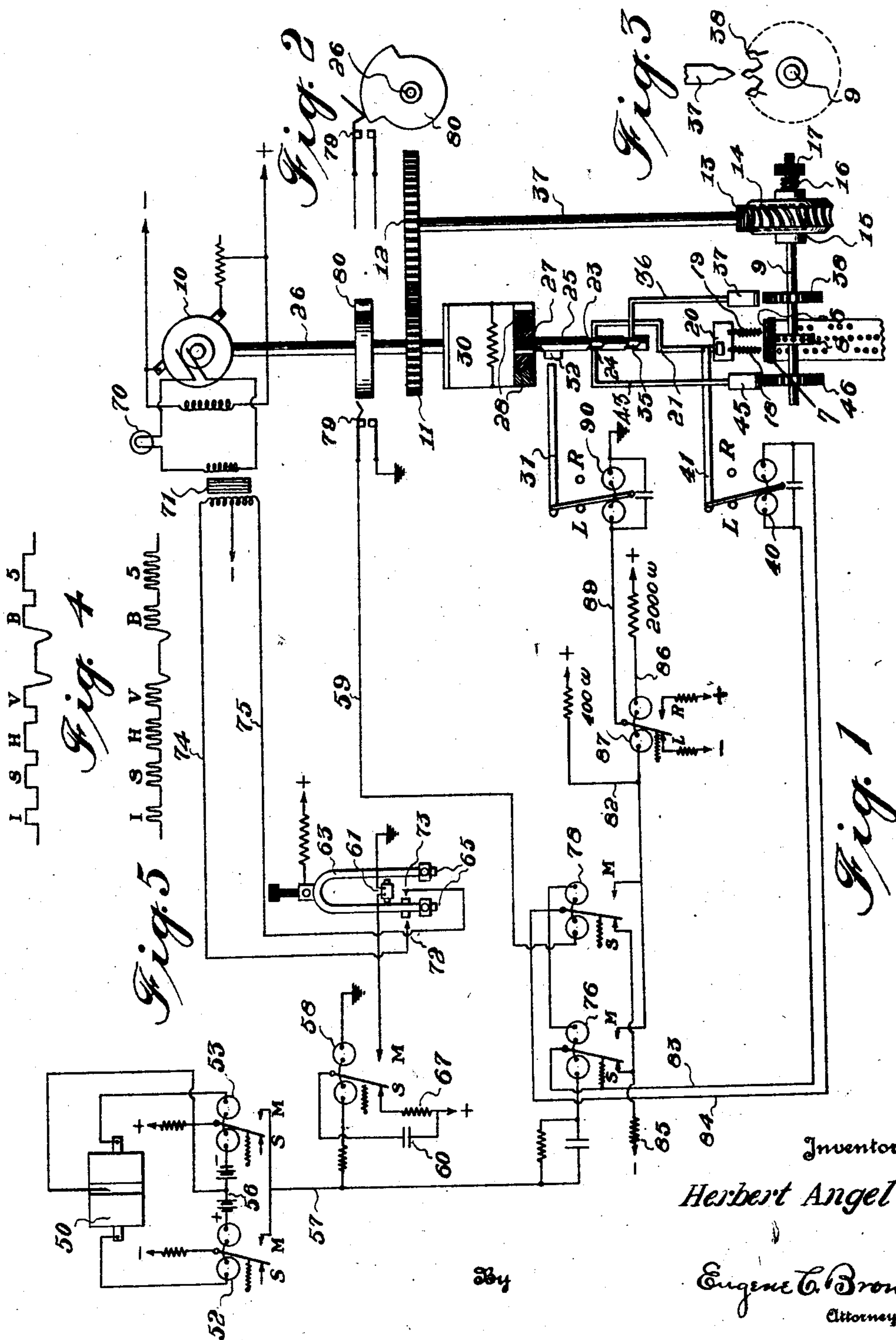
May 24, 1927.

1,629,466

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RECEIVING PERFORATOR

Filed July 21, 1925



Patented May 24, 1927.

1,629,466

UNITED STATES PATENT OFFICE.

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RECEIVING PERFORATOR.

Application filed July 21, 1925. Serial No. 45,002.

This invention relates to automatic telegraph receiving apparatus and particularly to the type of receivers used in ocean cable operation which record the messages or signals in the form of perforations in a tape.

The object of this invention is to increase the efficiency and reliability of apparatus of this type and to enable the apparatus to operate at greater speed with accuracy.

Receiving perforators as at present developed are not reliable and will not record the code signals accurately when connected to the receiving circuit of an ocean cable. This is due mainly to the fact that the signals are received at the end of an ocean cable in the form of "block" signals, wherein the successive unit impulses of like sign are merged into a single prolonged impulse having a length or period equal to the number of like unit impulses in the signal character. Owing to the necessary operation of the perforator mechanism, which stops the tape for an instant each time the punch is operated, it is evident that the driving motor must normally tend to rotate at a greater speed than that of the transmitter in order to compensate for the time consumed in the punching operations and yet must be corrected so that the resultant speed of the tape shall be in synchronism with the transmitter and the received signals. Heretofore there has been no means of applying a correction to maintain the perforator in accurate synchronism with the transmitted signals except at each received signal and as the "block" signals extend over a period of several unit impulses the perforator would advance beyond synchronous speed during the transmission of a single block signal. It has therefore been impossible heretofore to use receiving perforators on ocean cables which were operated according to the usual practice.

The purpose of my invention is to provide means for maintaining the perforator in exact synchronism with the transmitter and the received signals. To this end, I provide means for breaking up the "block" signals into separate impulses corresponding to the component unit impulses transmitted and cause each of these unit impulses to govern or control the perforator. In this manner it is impossible for the speed of the perforator to depart from synchronism with the transmitter or received signals and the

resulting perforated tape is an exact replica of the original tape at the transmitter station.

In the following description of my invention, I shall refer to the accompanying drawings, in which—Figure 1 is a diagrammatic illustration of one organization of apparatus and circuits embodying my invention; Figure 2 is a detailed view of the cam-actuated circuit controller for the impulse interpolating relays; Figure 3 is a detail view of the corrector wheel and its actuating dog; Figure 4 illustrates the "block" signals received on the cable relay; and Figure 5 shows the same signals broken up into their component unit impulses by the interpolating relays.

I have shown a perforating device P of a well known construction. The tape 6, which has been previously provided with a central row of feed holes, is moved over the punch block 7 by the tape feed wheel 8 carried by the shaft 9 which is driven by the motor 10, through the gears 11 and 12, the worm gear 13 and worm wheel 14. The punches 18 and 19, which punch the holes through the tape for the dot and dash impulses, respectively, of the code characters, are actuated by the hammer 20, carried by the punching shaft 21, having a head 23 moving in the cam-slot 24 in the drive shaft 25, whereby the hammer is reciprocated toward and from the punches. The hammer is shifted laterally over one or the other punch, depending upon whether the signal impulse represents a dot or a dash in the code character. The drive shaft 25 is connected to the motor shaft 26 through a friction clutch, represented by a disk 27 fast on the shaft 25 and friction shoes 28, secured to shaft 26 and held against the disk by a spring 30. The worm wheel 14 is permitted to slip on the shaft 9 being frictionally held against a collar 15 by the spring 16 held by a nut 17.

The driving motor 10 is maintained in exact synchronism with the signal impulses in the manner hereinafter described. When no signal impulse is received, the shaft 25 is driven through the friction clutch 27. As the shaft rotates the cam-slot 35 causes the rod 36 to descend, forcing the wedge 37 into the teeth of the wheel 38 and stopping the rotation of the tape feed shaft 9. Simultaneously the armature of the punch selector

magnet 40 moves the rod 41 and shifts the hammer 20 over the punch 18 or 19, depending upon whether the signal corresponds to a dot or a dash impulse. Immediately thereafter, the arm 21 is moved downwardly by the cam-slot 24 thereby causing the hammer to drive the selected punch through the tape 6. The further rotation of the shaft 25, causes the cam-slot 24 to move rod 43 downwardly thereby forcing the wedge 45 into the adjacent slot in the correcting wheel 46, just as the wedge 37 is withdrawn from the stop wheel 38, permitting the tape feeding shaft 9 to rotate. The slots in the correcting wheel 46 are so inclined that the entrance of the wedge 45 causes the wheel and the shaft to slip forward an amount equal to that which was lost while it was held by the stop wedge 37 during the operation of the punch.

The signals coming in over the ocean cable are received in the usual manner upon a drum relay 50, which actuates the local dot relay 52 or the dash relay 53 as the needle 51 is moved over to one side or the other of the drum in accordance with the polarity of the signals. The signals are received as "block" signals as indicated in Figure 4. Thus the letter I has a length equal to two unit impulses, the letter S being equal to three unit impulses and the letter H having a period of four unit impulses. It is evident that the recording apparatus must be maintained in exact synchronism with the incoming signals at all times in order to faithfully reproduce the signals. When a tape perforator is employed as the recorder, its speed must be governed with the greatest exactness as the slightest departure from synchronism causes a mutilation of the signal. While receiving perforators have been successfully used on land lines in which each unit impulse of a code character is transmitted and received, it has heretofore been impossible to use a perforator as a recorder on ocean cables because of the fact above stated that the signals are received in "block" form which does not permit a sufficient number of corrections to maintain the perforator in synchronism with the signal impulses. It has been found necessary to arrange the parts so that the speed of the perforator shaft shall be slightly faster than the speed of the distant transmitter. The shaft 25 of the perforator makes one rotation for each unit signal impulse and when this is corrected at every revolution, absolute synchronism and phase relation is maintained. If, on the other hand, correction can only be made once in several revolutions, the shaft will have an opportunity to gain speed to an extent sufficient to throw the perforator out of synchronism thereby rendering it an unreliable instrument.

To overcome the difficulties and defects

above pointed out, I have devised an organization for causing each impulse received over the cable to control and maintain the speed of a synchronous governor for the driving motor, thereby correcting any tendency of the motor to depart from synchronism; and for separating the "block" signals into their component unit impulses and causing the perforator to stop and punch the tape for every unit impulse. By this means the speed of the perforator is controlled during each unitary component of each "block" signal and hence any departure from absolute synchronism with the received signals is absolutely prevented. I have thus made possible the use of a receiving perforator on ocean cables. The tapes which have been perforated at the receiving end of a cable may be used in a tape transmitter to repeat messages into another cable or line, so that messages may be repeated from one cable to another automatically and without manual control. This not only eliminates errors due to mistakes of an operator but greatly increases the capacity for handling traffic over the cables.

Referring to the accompanying diagram, if a "block" signal is received which causes the needle of the cable relay 50 to move onto the left hand conducting portion of the drum, a circuit is closed from the local battery 56 through the coils of the dot relay 52, causing its tongue or armature to move over against its marking contact M. A circuit is thereby closed from minus battery through the tongue of relay 52, conductor 57, and fork control relay 58 to ground. As the tongue of relay 58 moves over against its marking contact M, a current flows from plus battery charging condenser 60 and energizing magnet 61, which exerts a quick pull on the tines of the tuning fork or vibratory reed 63. This tuning fork or reed has been previously set into vibration and the weights 65 have been adjusted along the tines of the fork until they vibrate in synchronism with the distant transmitter or unit signal impulses received over the cable. After the fork has been set into vibration it will continue to vibrate at fixed rate for a considerable period. When the marking impulses received over the cable energize the fork magnet 61, the fork is not only given an impulse to maintain its vibrations but the impulse either assists or retards the natural vibration to thereby correct any departure in phase from exact synchronism if any exists. The synchronous vibration of the fork is thus established and corrected directly by the signal impulses. Upon the deenergization of the relay 58, its tongue moves back to its spacing contact S and the condenser is discharged through resistance 67.

The motor 10 which drives the shaft of the perforator P, is operated from a direct

current source and is of the constant speed type. The rheostat in circuit with the armature is adjusted until the speed is substantially synchronous with the speed of the signal transmission, which can be determined by the flashes of the lamp 70. The motor is provided with a winding and slip rings by which an alternating current may be taken off and connected to the secondary winding of a transformer 71. The primary winding is connected to contacts 72 and 73, which are alternately engaged by the contacts carried by one of the fork tines. The middle or neutral point of the primary winding is connected to minus battery. As the fork alternately engages the contacts 72 and 73, a current flows from plus battery through fork 63, through conductor 74 or 75, and through one half or the other half of the transformer primary to minus battery. Thus the vibrations of the fork alternately send current through the two halves of the transformer primary and this in turn produces an alternating current in the secondary winding which is connected through the slip rings with the alternating current winding on the armature of motor 10. When the direct current side of the motor armature is adjusted to a speed approximately synchronous with the frequency of the alternating current induced by the impulses from the fork circuit, the latter induced currents will pull the motor, into exact synchronism with the vibrations of the fork and thereafter operate it as a synchronous motor, the latter operating substantially as a rotary converter. The speed of the motor is thus under the direct control of the signal impulses received over the cable. It is obvious that an impulse motor controlled by a vibrating fork may be used as a driving means, but the motor and method of control just described has the advantage of being self-starting.

I have previously explained the necessity for separating the "block" signals into their component unit impulses before introducing them into the magnet which controls the stopping of the perforator shaft. For this purpose I connect the conductor 57 (which carries the "block" signals from the dot and dash relays 52 and 53), to the coils of the polar interpolating relays 76 and 78 and through conductor 59 to a pair of circuit breaking contacts 79 controlled by a cam 80 on the motor shaft. As the cam makes one revolution during a unit signal period, the circuit through the interpolating relays 76 and 78 will be broken after each unit impulse and consequently the tongues of these relays will move between their S and M contacts during the transmission of each "block" as many times as there are unit impulse periods in the "block" signal. Thus if the "block" signal for the letter H is transmitted

over the conductor 57, the circuit through the interpolating relays 76 and 78 and the conductor 59, will be broken four times at the contacts 79 by the cam 80, since the latter will make four revolutions during that period. Hence the prolonged impulse for the letter H shown in Figure 4, is broken up into four short impulses shown in Figure 5. In order to separate these four unit impulses from each other, the cam 80 is so constructed (see Fig. 2) that the circuit is broken at the contacts 79 for a certain proportion of the unit period.

If the received signal corresponds with a dot code character, the polar relay 76 will be actuated and its tongue will move over against its marking contact M, thereby closing a circuit from plus battery through conductor 82, tongue and M contact of relay 76, conductor 83, punch selector magnet 40, conductor 84, tongue and S contact of relay 78, and conductor 85 to minus battery. Thereupon the armature of magnet 40 moves to its left hand stop L, and causing the link 41 to shift the hammer 20 into alinement with the dot punch 18. When a signal is received corresponding to a dash code character, the polar relay 78 will be actuated and the current from plus battery will flow over conductor 84 and through the coils of magnet 40 in the opposite direction, thereby causing its armature to swing over against its R stop and the hammer 20 will then be shifted into alinement with the dash punch 19.

Simultaneously with the action of the punch magnet 40, the release indent relay 87 was operated which is in a shunt circuit with conductor 82 and therefore in series with punch magnet 40. The tongue of relay 87 normally rests against its left hand contact L, thus closing a circuit from minus battery through conductor 89 and the coils of detent magnet 90, which holds its armature against its right hand stop R and causes the free end of the arm 31 to engage the detent 32 and stop the rotation of the perforator shaft 25. When a signal impulse is received which actuates either of the relays 76 or 78, a circuit is closed through relay 87, causing its tongue to move over to its right hand contact R. This sends a current from plus battery through magnet 90 which moves the arm 31 to release the detent and permit the rotation of the perforator shaft. It will be observed that the relay 87 and detent magnet 90 are actuated with every actuation of either of the interpolating relays 76 and 78 and hence the arm 31 will engage the detent 32 after every unit signal impulse,—comprised in the "block" signal. Accordingly the detent 32 will be engaged by the arm 31 to stop the rotation of the perforator shaft three times during the reception of the code letter S, four times

during the reception of the code letter H and five times during the reception of the figure 5 as will be apparent from Figure 5.

I have illustrated and described one arrangement of apparatus for carrying out my method of operating a recording tape perforator at the receiving end of an ocean cable but it will be evident to telegraph engineers and those familiar with the construction and operation of telegraph systems that other apparatus may be used in association with the cable relay for separating the "block" signals into their component unit impulses such as the regenerative rotary repeaters disclosed in the patent to Foll No. 1,535,073 and in the application of Peterman, Serial Number 557,048, filed April 28, 1922. I intend, therefore to cover in my claims such other arrangements as may be considered within the scope of my invention.

I claim:

1. The method of recording telegraph code characters, received as "block" signals at the receiving end of an ocean cable upon a motor driven tape perforator, which comprises separating the "block" signals into their several component unit impulses, transmitting said unit impulses in sequence to the tape perforator and causing the received signals to control the speed of the driving motor to thereby maintain the perforator in synchronism with the signals.

2. An organization for recording telegraph code characters received from a cable in the form of "block" signals, comprising a cable relay for receiving the signals in "block" form, means for separating said "block" signals into their component unit impulses, a tape perforating mechanism provided with automatically operating punching devices and punch selecting means, means for driving said mechanism at a substantially uniform speed, and means actuated by said unit impulses for momentarily arresting said mechanism after each impulse, and simultaneously operating said selecting means.

3. In an organization as set forth in claim 2, means controlled by the received signals

for maintaining said driving means in synchronism with the speed of transmission of said signals.

4. Apparatus for receiving and recording telegraph signals from an ocean cable, comprising a cable relay actuated by the "block" signals received from the cable, a tape perforator provided with punch selecting means and with a stop device, a continuously operating motor for driving said perforator, means for separating said "block" signals into their component unit impulses, and means for causing said unit impulses to actuate said selecting means and said stop device.

5. Apparatus for receiving and recording telegraph signals from an ocean cable, comprising a cable relay actuated by the "block" signals received from the cable, a tape perforator provided with punch selecting means and with a stop device, a continuously operating motor for driving said perforator, means for controlling the speed of said motor by said received signals, means for separating said "block" signals into their component unit impulses, and means for causing said unit impulses to actuate said selecting means and said stop device.

6. In an apparatus as set forth in claim 4, a member having a natural period of motion, and electromagnetic means associated therewith and controlled by the received signal impulses for controlling the speed of said motor.

7. Apparatus for receiving and recording telegraph signals from an ocean cable, comprising a cable relay actuated by the "block" signals received from the cable, a tape perforator provided with punch selecting means, a continuously operating motor for driving said perforator, means for controlling the speed of said motor by said received signals, means for separating said "block" signals into their component unit impulses, and means for causing said unit impulses to actuate said selecting means.

In testimony whereof I affix my signature.

HERBERT ANGEL.