

April 17, 1945.

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2,373,970

CONVERSION OF START STOP SIGNALS TO SYNCHRONOUS
TYPE SIGNALS AND VICE VERSA
Filed Nov. 26, 1942 2 Shee

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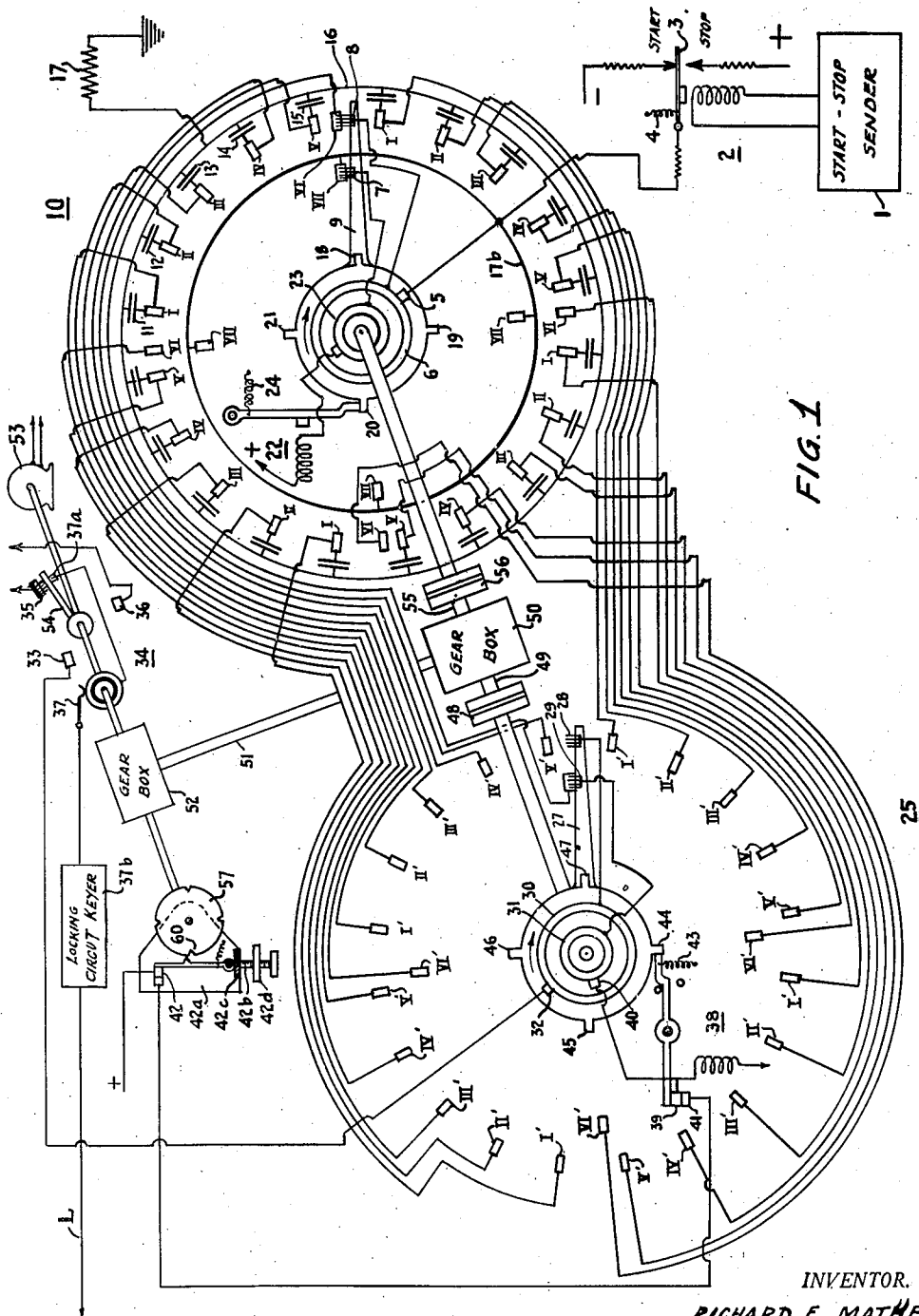


FIG. 1

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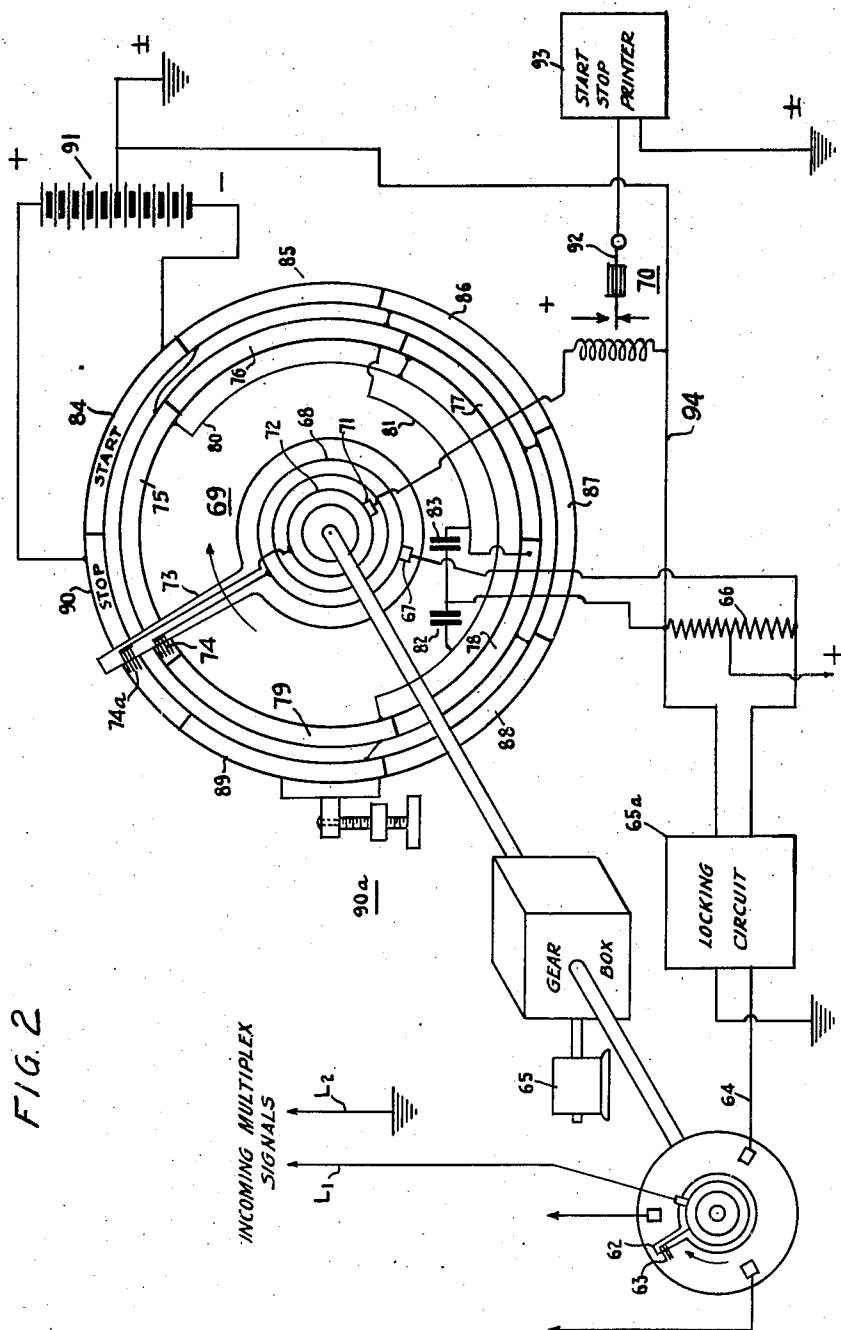


FIG. 2

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CONVERSION OF START STOP SIGNALS TO
SYNCHRONOUS TYPE SIGNALS AND VICE
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Application November 26, 1942, Serial No. 467,030

9 Claims. (Cl. 178—70)

This invention relates to electric telegraphs utilizing the Baudot code which, as is well known, has signal units of equal time-length.

There are two well-known methods of using this Baudot code. In one, the code characters follow each other with no intervening time space. This requires use of a commutator and brush arrangement, called a distributor, at both the transmitter and the receiver and means must be employed to keep the receiving distributor in synchronism and in phase with the transmitting distributor.

In the other method, two additional code units, in effect, are added to each code character. One is a start unit and the other a stop unit.

The first method is generally employed in multiplexing by combining several telegraph channels into one composite channel for transmission either by radio or by wire, though, of course, it is equally capable of use in single channel systems.

The second method is more generally used in single channel systems.

There are times when it is desirable to multiplex start-stop signals with synchronous signals and also to use start-stop printers for printing synchronous signals.

It is therefore an object of my invention to convert start-stop code signals into synchronous signals by eliminating the start-stop units of the code and storing the code units for synchronous transmission.

Another object of the invention is to convert synchronous type signals into start-stop signals by adding the starting and stopping units to each code character for operation of a start-stop printer.

Other objects will appear in the following description, reference being had to the drawings, in which:

Figure 1 is a diagrammatic illustration of apparatus for converting start-stop signals into synchronous type signals.

Figure 2 is a diagrammatic illustration of apparatus for converting synchronous type signals into start-stop signals.

Referring to the transmitting apparatus of Fig. 1, 1 is a block diagram indicating a start-stop printer, which is well known in the art. In the five unit start-stop printer there are seven signal positions. The first is the start position and the next five uniformly spaced positions are for code signaling purposes, either mark or space. The final, or seventh position, is the stop position. The output of the printer 1 passes into the coil of

relay 2, which when energized connects the relay tongue 3 to the minus terminal for start and space and to the positive terminal for mark and stop.

5 For purposes of illustration, the start-stop printer has been assumed to work with on-and-off current, though of course plus and minus current could also be used. The spring 4 pulls the tongue to the minus terminal in response to start and space signals (no current) and the magnet, when energized, pulls the tongue to the positive terminal for mark and stop signals. The tongue 3 is connected by means of a brush 5 to a slip ring 6, which is connected to brush 8 on a rotating arm 9 of a distributor arrangement indicated generally by 10. The distributor has four quadrants, each having five contacts I, II, III, IV, V, for the five mark or space signals, and a pair of auxiliary contacts VI, VII, through which the start and stop signals are transmitted, as will later be explained. Each contact I, II, III, IV, V is connected through condensers 11, 12, 13, 14 and 15 to a conductor 16, which is grounded through resistance 17, the ground being in this case the plus-minus terminal of the usual battery supply in a telegraph station. Contacts VI are connected as later described and contacts VII by conductor 17b.

30 As will be noted from the drawings, the brush 8 is adapted to sweep over the contacts I to V, inclusive, and VI in each quadrant. The brush 7 engages contact VII, only, in each quadrant. The rotating member of the distributor consists of a switch arm 9, carrying the brushes 7 and 8. The hub of arm 9 carries four stops 18, 19, 20 and 21, for engagement with the armature of the electromagnet 22. One terminal of the coil of magnet 22 is connected to the positive terminal of the battery supply and the other terminal is connected to the brush engaging slip ring 23, which is connected to the brush 7 engaging contacts VII. The armature of the magnet 22 is biased by a spring 24 to hold it in position to engage stops 18 to 21, inclusive. When the magnet is energized, the armature catch is held out of the path of the stops against the spring tension.

The contacts I to V of the distributor 10 are connected to similar contacts I', II', III', IV', V' of a second distributor, generally indicated at 25. There are four quadrants to this distributor and the contacts of the other three quadrants are likewise connected to similar contacts of similar quadrants in distributor 10. Distributor 25 also has auxiliary contacts VI' in each quadrant, con-

nected to corresponding contacts VI in distributor 10.

The distributor 25 has a contact arm 27 bearing two properly insulated brushes 28, 29 to engage the contacts I' to V', inclusive, and the contacts VI', respectively. The brush 28 is connected to a slip ring 30 and brush 29 is connected to slip ring 31. Brush 32 engaging slip ring 30 is connected to channel contact 33 of multiplex distributor 34. Contacts 35 and 36 of this multiplex distributor are connected to the two other channels of a three channel multiplex transmitting system, which for purposes of illustration we may assume to be connected to a tape transmitter or to some other signaling device, the character of which obviously will not affect the operation of the system being described. Brush 37 engages a slip ring connected to the rotating distributor brush 37a successively engaging channel contacts 33, 35 and 36. Brush 37 is connected to the outgoing line L through a locking circuit type keyer 37b of any desired type.

The coil of magnet 38 has one terminal connected to the minus terminal of the supply battery and the other terminal is connected to contact 39 on the armature of this magnet and to the brush 40 engaging slip ring 31. The other contact 41 of the magnet switch is connected through switch 42 to the positive terminal. The armature of magnet 38 is biased to open position of the switch by a suitable spring 43, in which position it is free of lugs 44, 45, 46 and 47. The other end of this armature, when the magnet is energized, is in position to be engaged by these four lugs. The arm 27 and its four stop lugs of distributor 25 are rotated through friction slip-clutch 48, shaft 49, gear box 50, shaft 51, gear box 52 and motor 53, so that the shaft 49 of the distributor 25 is run at a speed proportional to the speed of the multiplex distributor arm 54, which as shown is connected to the shaft of the motor 53.

Since, in a three channel system, the outgoing line L is assigned to one transmitting channel only once a revolution of the distributor brush arm, shaft 49 would rotate at such proportional speed that the arm 27 would move the angular distance between the adjacent two of contacts I', II', III', IV', and V', while the distributor arm makes one complete revolution. The shaft 55, however, runs at a slightly greater speed than the start-stop sender 1, as is standard printer practice. This shaft also runs at the same speed as, or slightly faster than, the shaft 49. Therefore, arm 27 cannot overtake arm 9 while both are rotating. It can catch up with it after a definite time, only when arm 9 has ceased rotating in response to the stop signal from the start-stop printer.

Shaft 55 drives the distributor arm 9 and stop lugs 18 to 21 at the same speed through friction slip-clutch 56, except of course when rotation is stopped by engagement of one of the lugs with the armature of magnet 22. Friction clutch 48 has a similar purpose in distributor 25 when the arm 27 is stopped by engagement of the armature of magnet 38 with one of the four lugs. However, as will be noted, the rotation of the arm of distributor 10 is stopped only when the magnet 22 is de-energized and the arm of distributor 25 is stopped only when the magnet 38 is energized. Also, magnet 22 is made slow-acting, while magnet 38 is made quick-acting, for reasons that will later be referred to.

Switch 42 is opened by a cam wheel 57 having

four cam notches equi-spaced around its periphery. This cam wheel rotates at a speed proportional to the speed of the arm and lugs of distributor 25 when they are not stopped by the armature of magnet 38, but this speed will be such that the switch 42 is opened once while the arm 27 is traveling through one of the quadrants. That is, the cam 57 and arm 27 have the same angular speed. The switch assembly 42a is mounted for adjustment around the periphery of the cam wheel 57. Screw 42b peened in the flange 42c (sectioned in Fig. 1) and threaded through stationary lug 42d permits adjustment of the time of opening of the switch 42.

The gear boxes 50 and 52 may be constructed in any way to secure the proportional speeds for operating the arms of distributors 10, 25 and switch 42.

The operation of the transmitting system of Fig. 1 may be described as follows:

Let it be supposed that the outgoing signals of the start-stop printer are to be multiplexed in with the signals of the two other channels. When the start signal is sent out from printer 1 (no current), spring 4 will cause tongue 3 to engage the minus terminal. This will close the circuit from the plus terminal through the coil of relay 22, brush and ring 23, brush 7, contact VII, conductor 17b and tongue 3 to the minus terminal. This will release the catch from its lug, 20 in this case, and the distributor arm 9 will immediately start rotating at the speed of shaft 55. The coil of magnet 22 is made so as to release in time for the brush 8 to pass over contact I substantially in the center of the first code signal pulse as it arrives from the start-stop printer 1. This may be either a space or a mark signal. In either case, condenser 11 will be charged, but its polarity for a mark will be the reverse for that of a space. The rotating arm of distributor 10 will be running at the same speed as, or very slightly faster than, the cam in the start-stop sender 1 and therefore the condensers 11, 12, 13, 14 and 15 will be charged with one polarity or the other by the mark or space signals sent out. When the arm 9 reaches contact VI, the stop signal (current) is sent out by the transmitter of start-stop sender 1. This stop signal is not sent out over the multiplex distributor, as it has no significance in a synchronous system, but it makes the tongue 3 positive and current will not flow through the coil of magnet 22, since both terminals are positive. The armature catch of magnet 22 therefore engages the next stop lug 19 by action of spring 24.

During the movement of the arm of distributor 10 through the quadrant as just described, condensers 11, 12, 13, 14 and 15 were charged with one polarity for mark signals and the other polarity for space signals. Let it be supposed that when the arm 9 was at some intermediate position in that quadrant, say with the brush 8 on contact IV, notch 60 on cam 57 opened the switch 42. This de-energized the magnet 38 and the spring 43 moved the armature catch away from the stop lug 44. Therefore, as the arm 9 of distributor 10 continued its rotation from contact IV in the quadrant, as already described, arm 27 of distributor 25 commenced its rotation. When the brush 28 was brought into position with contact I', condenser 11 discharged through contact I', brush 28, ring 30, brush 32, contact 33, distributor arm 54 and brush 37 to the locking circuit keyer and outgoing line L. Thus, rotating arm 27 passed the charge of the five condensers in each quadrant and the signals went out over the line L.

Since arm 27 of distributor 25 rotates at a speed proportional to that of multiplex arm 54, the distributor brush 37a always will be in engagement with the contact 33 when the brush 28 engages each of the contacts I' to V', inclusive, due to proper adjustment of screw 42b.

Soon after the stop signal was sent out by the start-stop printer 1, as already described, the start signal is transmitted. This places the tongue 3 in contact with the minus terminal and magnet 22 is energized by current passing from the positive terminal through the coil of magnet 22, brush and ring 23, brush 7, contact VII and tongue 3, to the minus terminal. The armature is therefore released from contact with the lug 19, which it engaged after movement through the first quadrant, and the arm 9 commences to rotate and successively charge the condensers in the second quadrant, after which the arm will be stopped as before when the stop signal is sent out. This will happen when the brush 8 is on contact VI of this quadrant and it will be thereafter started again by the start signal. The following distributor arm 27 will sweep over its contacts I' to V', inclusive, in successive quadrants, until it catches up with arm 9. Magnet 38 can never be energized to stop arm 27 from rotating unless brush 29 engages contact VI' when brush 8 is in engagement with contact VI in the same quadrant. Only at that time can current flow through the magnet 38, for positive potential is applied to the contact VI, with the tongue 3 in engagement with the positive terminal at relay 2, due to the stop signal. The energization of the stop relay causes the armature catch to engage one of the lugs 44, 45, 46 or 47 and stop the rotation of arm 27. Ordinarily, a number of revolutions of arm 27 will be completed before this occurs. When magnet 38 is energized in this way, the holding circuit is closed from the positive terminal through switch 42 and contacts 39 and 41, which are now closed. Soon thereafter the start signal (no current) is sent out by the start-stop printer and armature 9 again starts to rotate by energization of magnet 22. This, however, does not de-energize the coil of magnet 38, due to the holding circuit just referred to, and arm 27 of distributor 25 will remain at rest while distributor arm 9 proceeds to rotate and charge up condensers 11 to 15, inclusive, in the succeeding quadrant.

At some point cam 57 will bring a cam notch into position to open switch 42 and magnet 38 will be de-energized. This will start distributor arm 27 again on its rotation, after which it will again catch up with the distributor arm 9 and be stopped, as previously described.

While the distributor arm 27 is stopped by energization of magnet 38, no signals will be sent out to line L when the multiplex distributor arm 54 brings its brush into engagement with contact 33, but since this magnet is energized only when the brush 8 of distributor arm 9 is on contact VI, all five signal elements of a letter or other code character will have been transmitted and a code character cannot be mutilated.

In this way the distributor arm 27 will be stopped when it catches up with the distributor arm 9 and then will be held up for substantially a full quadrant while the start-stop signals are being sent out and stored in condensers 11 to 15, inclusive, to enable the distributor 10 to gain substantially a full quadrant on the distributor 25.

In Fig. 2 the receiving circuit is shown for receiving synchronous signals sent by either of the

three channels connected to contacts 33, 35 and 36 in Fig. 1 and converting them into start-stop signals so that they may be printed on a start-stop printer, but, of course, similar apparatus could be used to convert the signals of all three channels into start-stop signals.

In Fig. 2 the composite signals sent out by the synchronous distributor of Fig. 1 come in over lines L₁, L₂, the latter being grounded, and the multiplex distributor arm 62 carrying brush 63, separates the composite signals and sends each channel signal out over the three individual channel conductors, as is well known in the art. The channel 64 is the only one that will be considered and it will be assumed to receive the signals sent out by the start-stop printer from contact 33 on the transmitting distributor, though they equally could be the signals from any other channel.

The distributor arm 62 will be rotated in synchronism with the transmitter distributor by well-known means, generally indicated by motor 65, and synchronized and phased in well-known ways (not shown). The five start-stop code units sent out by the transmitter will be received in succession with no time separation between the end of one code character and the beginning of the next. Since these are to be used to operate a start-stop printer, means is provided for inserting start-stop signals in appropriate places in the cycle.

The five synchronous code units will be sent into a locking circuit 65a for regeneration of the signals. Such a locking circuit is well known in the art and is therefore indicated herein only in block diagram. Such a locking circuit is shown in detail in the patent to John W. Cox, No. 2,264,510, December 2, 1941, and the theory of operation is described therein. It will be sufficient to say herein that the terminals of the locking circuit produce a potential drop across resistance 66 of one polarity for marks and another polarity for spaces. The positive terminal of the supply voltage is connected to the midpoint in this resistance. One terminal of resistance 66 is connected to brush 67 contacting with slip ring 68 on a distributor generally indicated at 69. The other terminal of resistance 66 is connected through the coil of relay 70 to brush 71 engaging slip ring 72. Slip rings 68 and 72 are secured in any way to arm 73 of the distributor 69, which rotates at one-fifth the speed of the distributor arm 62. Distributor arm 73 carries brush 74, adapted to engage the five equally-spaced contacts 75, 76, 77, 78 and 79, when multiplex distributor brush 63 is on contact 64. The five contacts are shown virtually as segments of a circle, separated at the ends by strips of insulation, but in practice these segments would be shortened so that they would be one-half to one-fourth the angular length of the time signal, as is usual in telegraph distributors. Contact 75 is connected by a conductor 80 with contacts 77 and 79, while contact 76 is connected by conductor 81 with contact 78.

The upper end of resistance 65 is connected through condenser 82 to conductor 80 and through condenser 83 to conductor 81.

Distributor 69 has seven arcuate contacts 84, 85, 86, 87, 88, 89 and 90, shown as having substantially equal length and separated by strips of insulation at adjoining ends. These contacts are preferably arranged to be adjustable as a unit around the inner contacts 75 to 79, inclusive. This is indicated conventionally by the screw mechanism 90a. These contacts preferably would

be shortened in practice in the same way as contacts 75 to 79. Contact 84 constitutes the start contact and lags contact 75 in relation to the rotating arm 73, but overlaps such contact. This contact is connected to the minus terminal of the telegraph supply battery 91. Contact 85 is connected to the inner contact 75, contact 86 to the next inner contact 76, contact 87 to inner contact 77, contact 88 to inner contact 78, contact 89 to inner contact 79 and contact 90 to the positive terminal of battery 91.

The relay 70 is polarized because it has been assumed that the locking circuit 65a places alternate plus and minus potentials in resistance 66. Of course, on-and-off potentials could have been produced in this resistance by the locking circuit and in that case the relay would be non-polarized and biased to one position. The tongue 92 of the polarized relay 70 in one position engages with the positive terminal and in the other position with the other terminal that has no potential. The start-stop printer 93 has been assumed to work on on-and-off current, but it could equally well operate on plus and minus current, in which case the blank terminal of relay 70 would be connected to a minus potential. The tongue 92 of the relay is connected in the usual way to one terminal of the start-stop printer 93, the other terminal of this printer being grounded to the plus and minus terminal of battery 91.

The operation of the receiving circuit in Fig. 2 may be described as follows:

The incoming synchronous signals are separated by the distributor arm 62 in a well-known way and produce plus or minus potential drops in resistance 66 and these potentials will be produced in synchronism with the movement of the rotating distributor arm 73. When brush 74a on distributor arm 73 engages outer contact 90, current will flow from battery 91 through contact 90, brush 74a, slip ring 72, brush 71 and the coil of relay 70, back to the mid-terminal of the battery. This will throw the relay tongue 92 against the positive contact, which will produce a stop signal for the start-stop printer. The first code unit of a character will be received soon thereafter and will produce a potential in resistance 66 while the distributor brush 74 is on contact 75. This will produce current flow through brush 67, relay ring 68, brush 74, contact 75, conductor 80 and condenser 82 to the other terminal of the resistance. The polarity of the charge in condenser 82 will, of course, depend upon the character of the signal being received. If it is a mark, the condenser will be charged with one polarity, and if a space, an opposite polarity.

The brush 74a next engages contact 84 and current flows from the midpoint terminal of battery 91 to the lower end of the coil of relay 70, through brush 71, ring 72 and brush 74a to the minus terminal of the battery. This will energize relay 70 in an opposite direction and throw tongue 92 against the blank contact. This constitutes the start signal (no current) of the printer and the printer will start in a way well known in the art. Before the printer has reached the first code position, brush 74 of the distributor will have left contact 75 and engaged contact 76. This will produce charging current of either one polarity or the other from the lower terminal of resistance 66 through brush 67, ring 68, brush 74, contact 76, conductor 81 and condenser 83 to the other terminal of resistance 66. The first and second signals of the code character are now stored in condensers 82 and 83 before the distributor brush 74a engages outer contact 85. When contact 85

is engaged by the brush 74a, condenser 82 will discharge through conductor 80, contact 85, brush 74a, distributor ring 72, brush 71 and the coil of relay 70 back through conductor 84 to the other terminal of the condenser. The relay tongue 92 will then be positioned either against the positive contact or the blank contact, depending upon the polarity of the signals stored in this condenser. The tongue 92 stays in its operated position until moved to the opposite position, as well known in the art. While brush 74a has reached the middle of contact 85, the start-stop printer 93 will be in position for receiving the first code unit and will operate the first selector bar in one direction or the other.

When the distributor arm 73 passes off of inner contact 76, it will engage contact 77 and charge condenser 82 in a way already described. Slightly before this time, brush 74a will engage the outer contact 86 and permit the discharging of the second code unit stored in condenser 83 through the coil of relay 70. This will pass through conductor 81, contact 86, brush 74a, slip ring 72, brush 71, the coil of relay 70 and conductor 84 to the other terminal of the condenser. This will position the tongue 92 against either the positive contact or the blank contact, dependent upon the signal. The start-stop printer reaches the second code position when the brush 74a is in the middle of contact 86 and the second selector bar will be thus moved in response to either a mark or a space signal.

When the distributor arm moves the brush 74a onto outer contact 87, condenser 82 discharges through the coil of relay 70 and throws the tongue 92 onto the positive contact for a mark or onto the blank contact for a space. This is the stored signal of the third code unit and will cause the printer 93 to move the third selector bar when the third code position of the printer is reached.

As the distributor arm 73 continues to rotate, brush 74 engages contact 78 and the incoming fourth signal is stored in condenser 83. The distributor arm 73 next brings brush 74a onto outer contact 88 and the fourth signal unit just stored in condenser 83 discharges through the coil of relay 70 in position to cause the selection of the fourth selector bar in printer 93.

The distributor arm 73 then brings brush 74 into engagement with inner contact 79 and stores the fifth signal code unit in condenser 82 and when brush 74a engages the fifth contact 89, this condenser discharges through the coil of relay 70 to produce the movement of the fifth selector bar in the start-stop printer.

When the distributor brush 74a engages the outer contact 90, a stop signal is produced in the start-stop printer 93, as already described. The reception of one character and its printing has now been completed. The signal code units of the second character will be stored and cause the operation of the printer 93, in the way already described.

It usually will not be necessary to store the fourth and fifth code units in the condenser, as the brush 74a will usually be on the outer contacts 88 and 89 to permit the received signal current to pass directly through the coil of relay 70. However, it is preferable to connect all five contacts to condensers 82 and 83 and to interconnect the inner contacts with the outer ones, as described, so that the printer will operate either directly from the received signals or from such signals stored in the condensers, and it is

immaterial where one commences and the other leaves off.

I have shown one embodiment for converting start-stop signals at the transmitter into synchronous signals and for converting synchronous signals at the receiver into start-stop signals, but it will be apparent that various modifications may be used without departing from the spirit of the invention.

Having described my invention, what I claim is:

1. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, separate sets of independent storing devices for the code unit signals of a plurality of characters, means for conveying the code unit signals from said sender to the storing devices of one of said sets in succession, means for relaying the stored signals of one of said sets while signals are being stored in another of said sets in succession through the single channel in synchronism with its assignment to the outgoing channel, means for stopping the operation of the second-mentioned means upon its relaying all of the stored signals and restarting it upon the first-mentioned means storing additional code unit signals in another of said sets.

2. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, separate sets of independent condensers for storing the code unit signals of a plurality of characters, means for storing the code unit signals of a character in the condensers of one of said sets in succession, means for discharging said condensers in succession through the single channel in synchronism with its assignment to the composite channel while signals are being stored in the condensers of another of said sets, means for stopping the operation of the second-mentioned means upon the discharging of all of the charged condensers.

3. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, separate sets of contacts and connected storing devices for the code unit signals of a plurality of characters, a switch arm connected to said sender and moving over said contacts in succession for conveying the code unit signals of the characters to the storing devices of one of said sets, means for relaying the stored signals of one of said sets while signals are being stored in another of said sets in succession through the single channel in synchronism with its assignment to the composite channel, means for stopping the operation of the second-mentioned means upon its relaying all of the stored signals and restarting it upon the first-mentioned means storing additional code unit signals in another of said sets.

4. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, separate sets of contacts and connected storing devices for the code unit signals of a plurality of characters, a first switch arm connected to said sender and moving over said contacts in succession for conveying the code unit signals of the characters to the storing devices of one of said sets, means for starting and stopping the operation of said

first switch arm upon receipt of the start and stop signals, respectively, from said sender, a second movable switch arm connected to said single channel for relaying in synchronism through said composite channel the stored signals of one of said sets while signals are being stored in another of said sets, means for stopping the operation of the second switch arm upon its overtaking the first switch arm in stopped position and restarting it after the first arm has again started and has moved over substantially all the contacts of another set.

5. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, separate sets of contacts and connected storing devices for the code unit signals of a plurality of characters, a first switch arm connected to said sender and moving over said contacts in succession for conveying the code unit signals of the characters to the storing devices of one of said sets, means for starting and stopping the operation of said first switch arm upon the receipt of the start and stop signals, respectively, from said sender, additional contacts connected to said storing devices, a second switch arm connected to said single channel and adapted to move over said additional contacts for relaying in synchronism through said composite channel the stored signals of one of said sets while signals are being stored in another of said sets, means for stopping the operation of the second switch arm upon its overtaking the first switch arm in stopped position and restarting it after the first arm has again started and has moved over substantially all the contacts of another set.

6. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, a receiving distributor having a switch arm and a plurality of groups of contacts, each group having a storing contact for each unit of the code and a first and a second stop contact, storing means connected to each storage contacts, said switch arm having a first and a second brush, the first brush being adapted to engage the storing contacts and the first stop contact in succession and the second brush being adapted to engage the second stop contacts in succession, a relay adapted to be energized by signals from the start-stop sender, having one switch member connected to said first brush and to said second stop contacts, means for rotating said switch arm, a magnet having its coil connected to the second brush and having an armature for stopping the rotation of said arm, a repeating distributor having a switch arm, a plurality of groups of discharge and stop segments, the discharge and stop segments of each group being respectively connected to corresponding storing and first stop contacts of a group in the receiving distributor, a second stop magnet, a holding circuit for the coil of said magnet, a first and a second brush on the repeating switch arm, the first brush being connected to said single channel and adapted to engage the discharge segments and the second brush being connected to the coil of the last-mentioned magnet and adapted to engage the stop segments, and means for opening said holding circuit a predetermined time before the said channel is assigned to said repeating distributor.

7. In apparatus for transmitting code unit signals from a start-stop sender through a single

channel to the composite channel of a time division multiplex system, a plurality of sets of storing devices, each adapted to store the signal units of a code character independently of the other sets, distributing means for storing signal units of a character in said sets in succession, relaying means for transmitting the stored signals through said single channel and means for starting said relaying means into action only upon said distributing means substantially completing the storing of the units of a code character.

8. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, a plurality of sets of condensers, each condenser of each set adapted to store a signal unit of a code character, distributing means for connecting the sender to the condensers of a set in succession for storage of the signals therein, relaying means for transmitting the stored signals through said single channel and means for starting the relaying means into action only upon said distrib-

uting means substantially completing the storage of the units of a code character in said condensers.

9. In apparatus for transmitting code unit signals from a start-stop sender through a single channel to the composite channel of a time division multiplex system, a plurality of sets of storing devices, each adapted to store the signal units of a code character independently of the other sets, distributing means for storing signal units of a character in said sets in succession, relaying means for transmitting the stored signals through said single channel, means for starting said relaying means into action only upon said distributing means substantially completing the storing of the units of a code character, the average rate of relaying said signals being faster than the average rate of storage thereof and means for rendering the relaying means inactive upon relaying of all stored signals until the distributing means again stores substantially all the units of the next code character.

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