

Dec. 8, 1942.

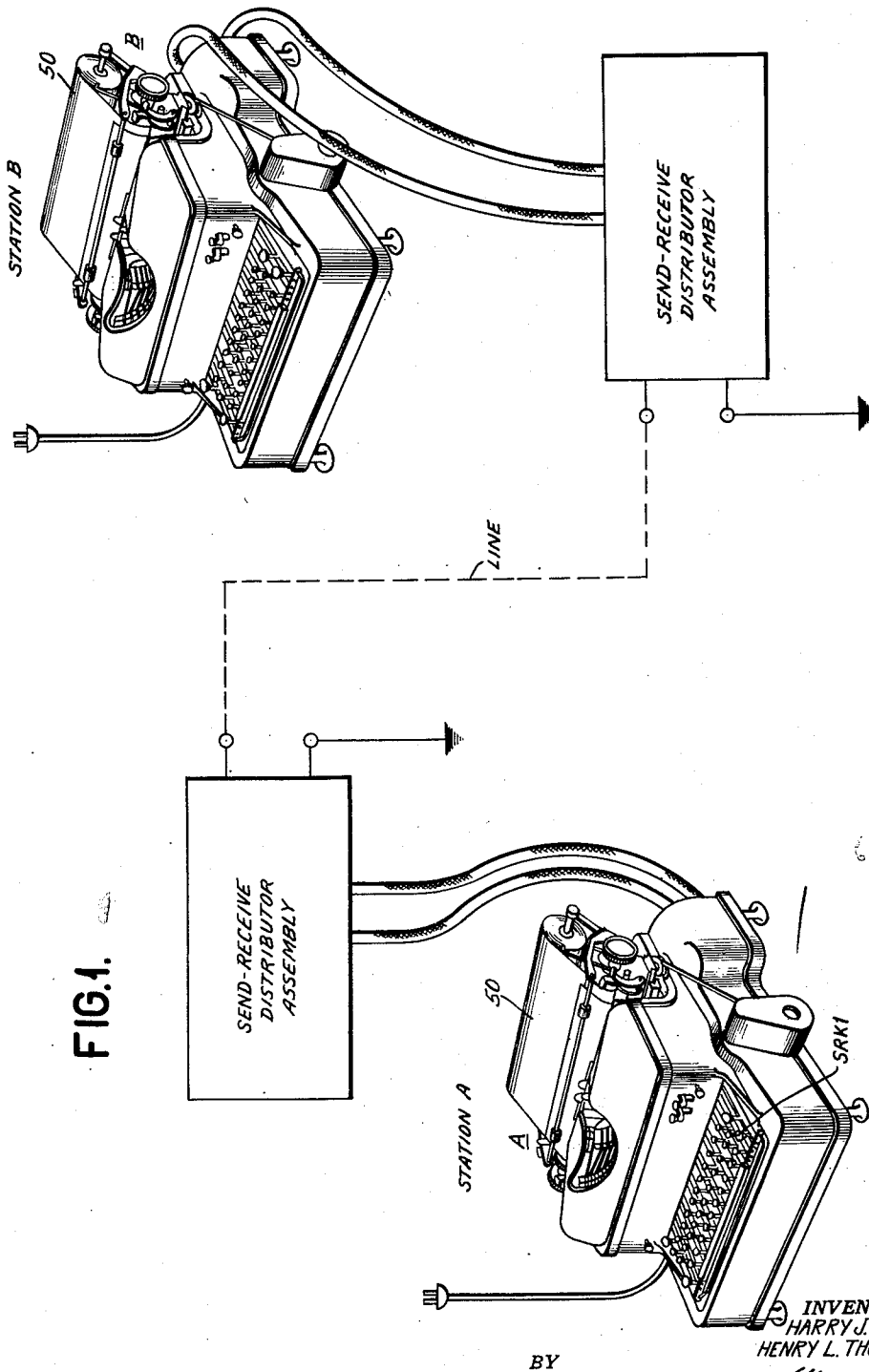
H. J. NICHOLS ET AL

2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 1



Dec. 8, 1942.

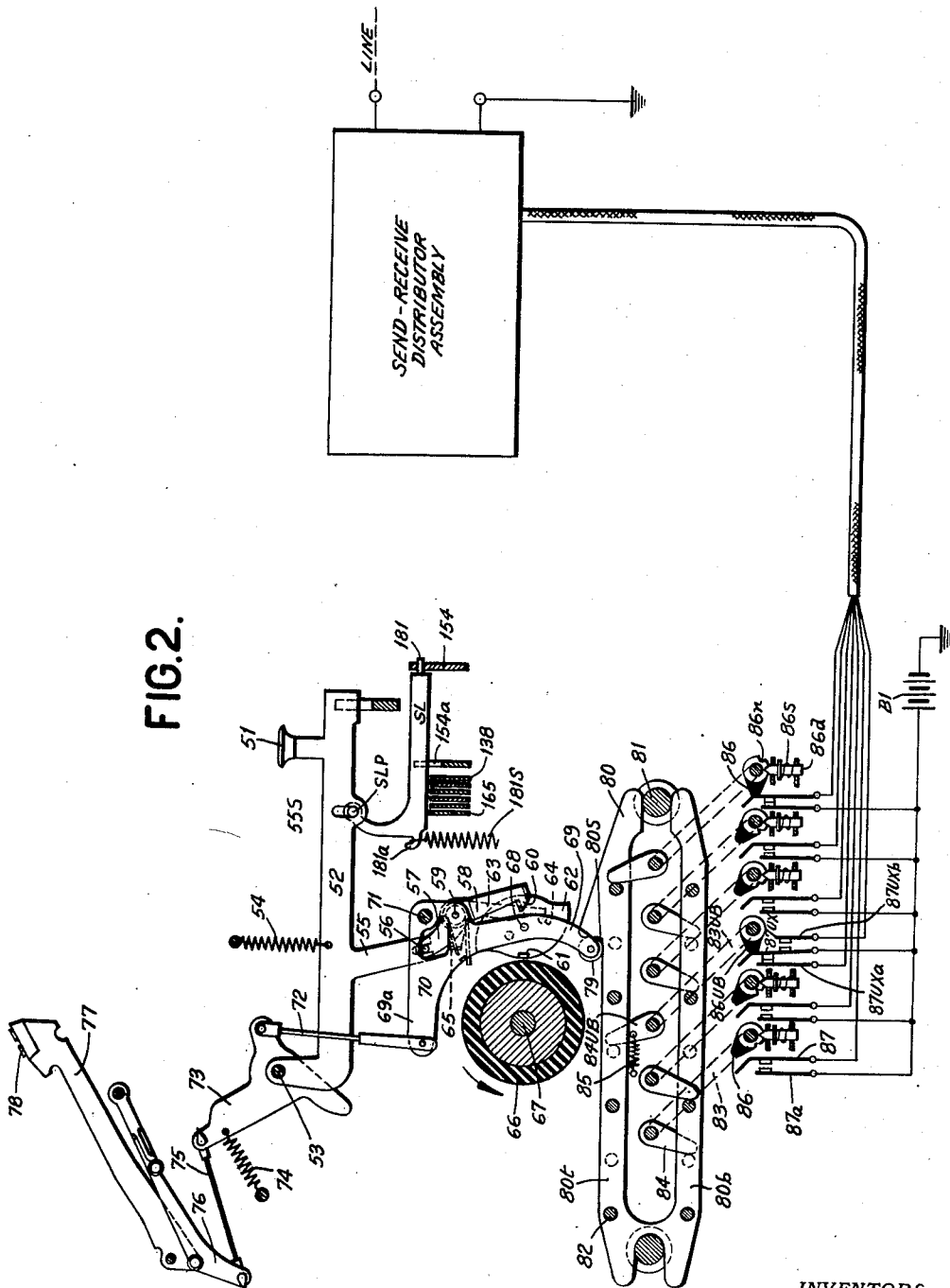
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2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 2



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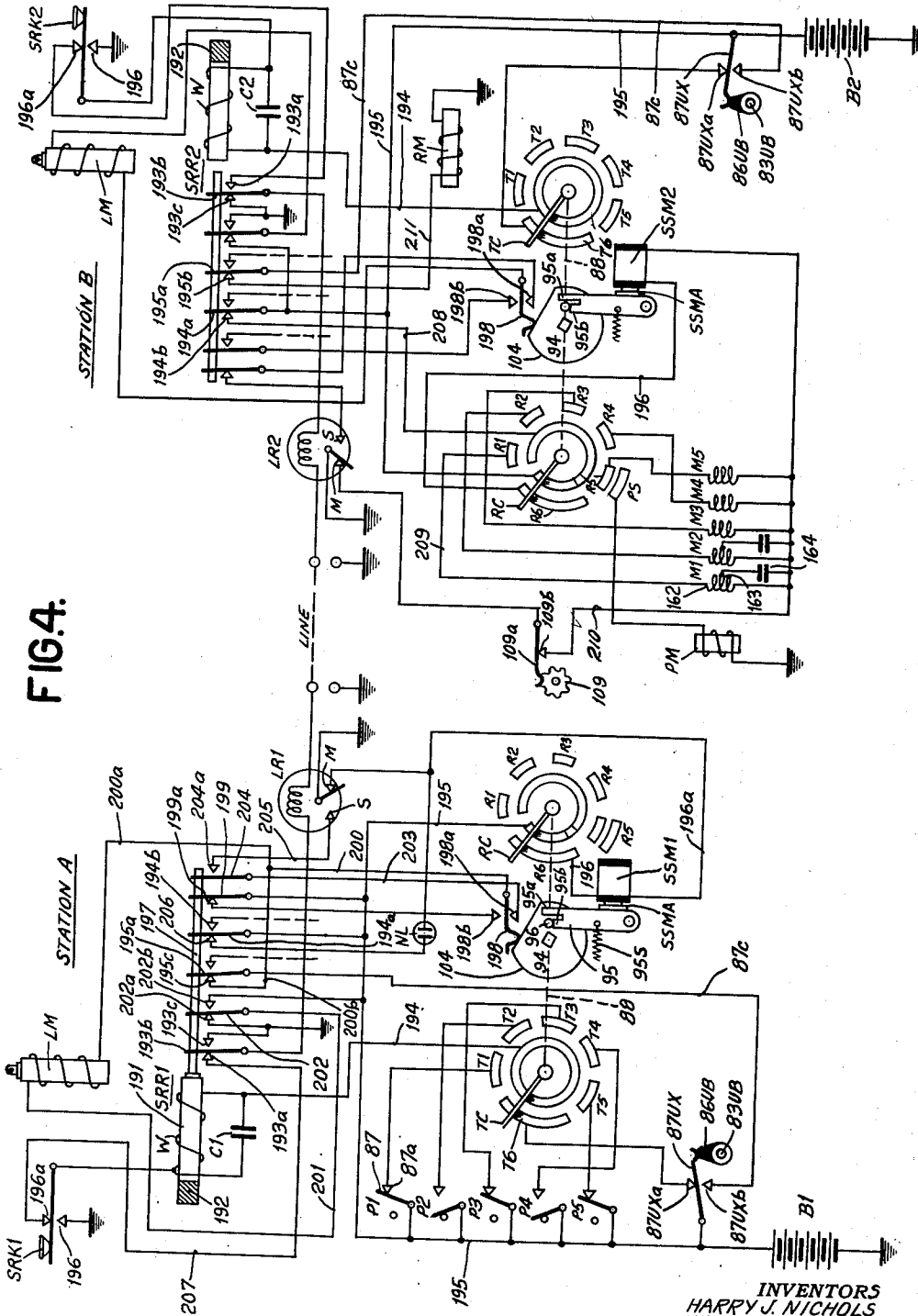
2,304,769

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11 Sheets-Sheet 4

FIG. 4.



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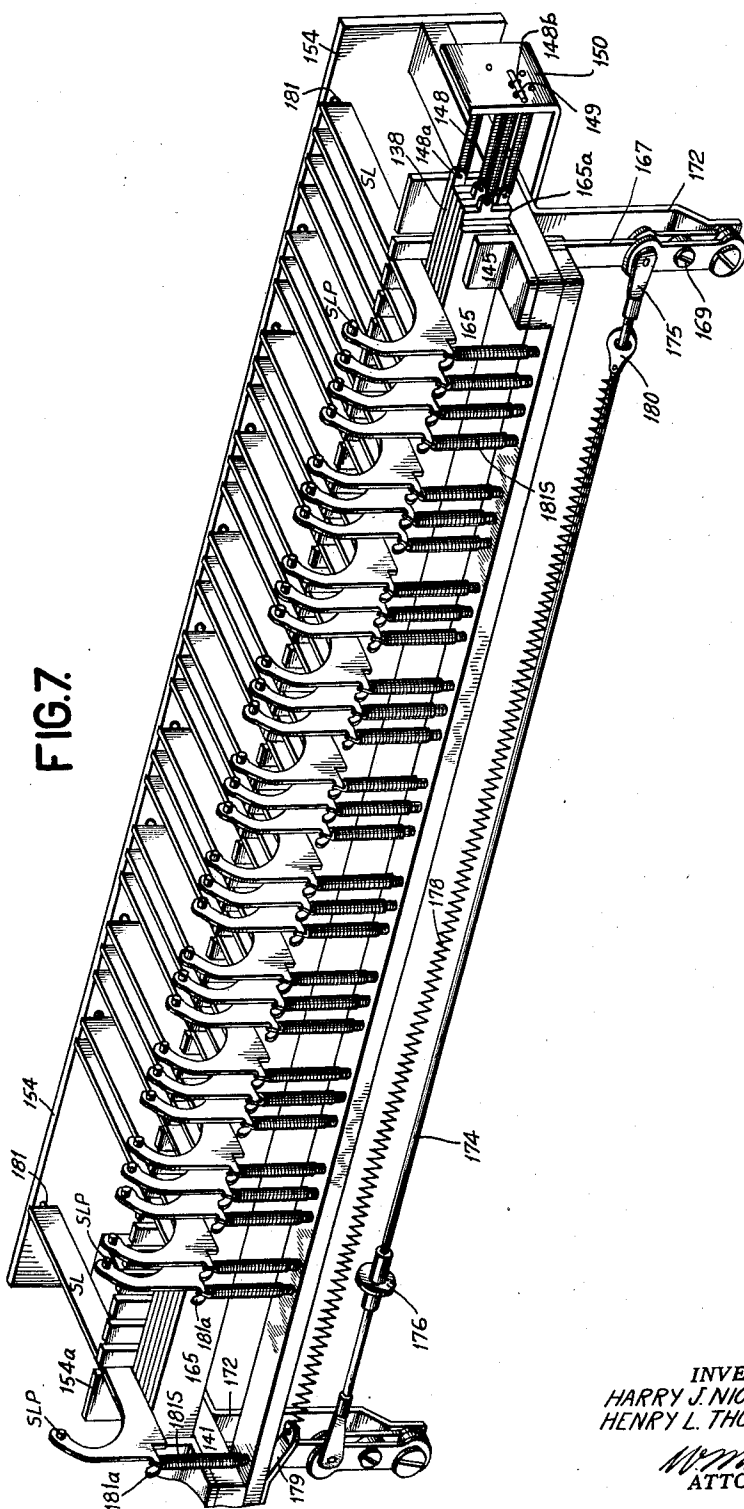
2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 6

FIG. 7.



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2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 7

FIG.8.

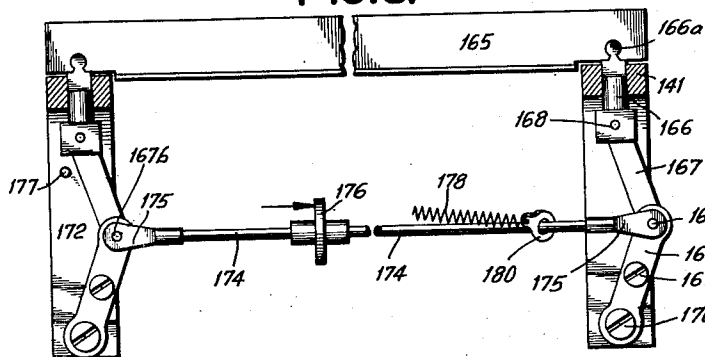


FIG.9.

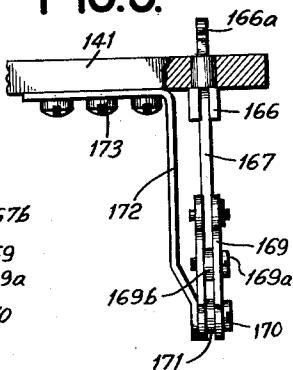


FIG.11.

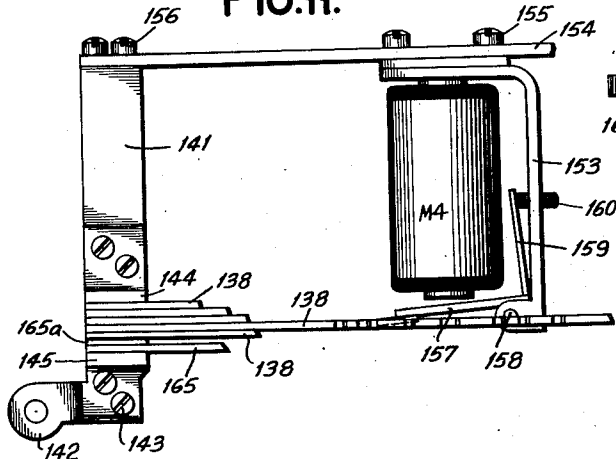


FIG.9a.

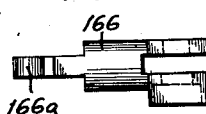


FIG.9b.

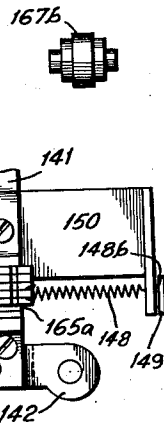


FIG.12.

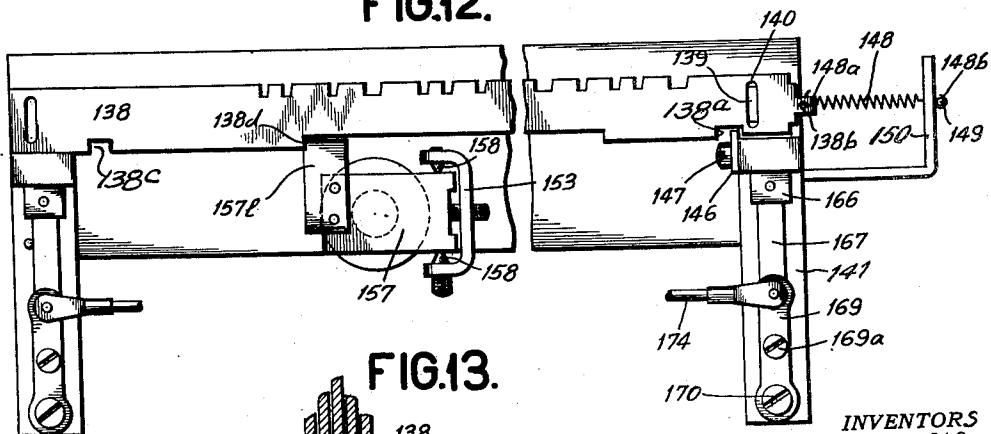
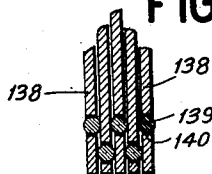


FIG.13.



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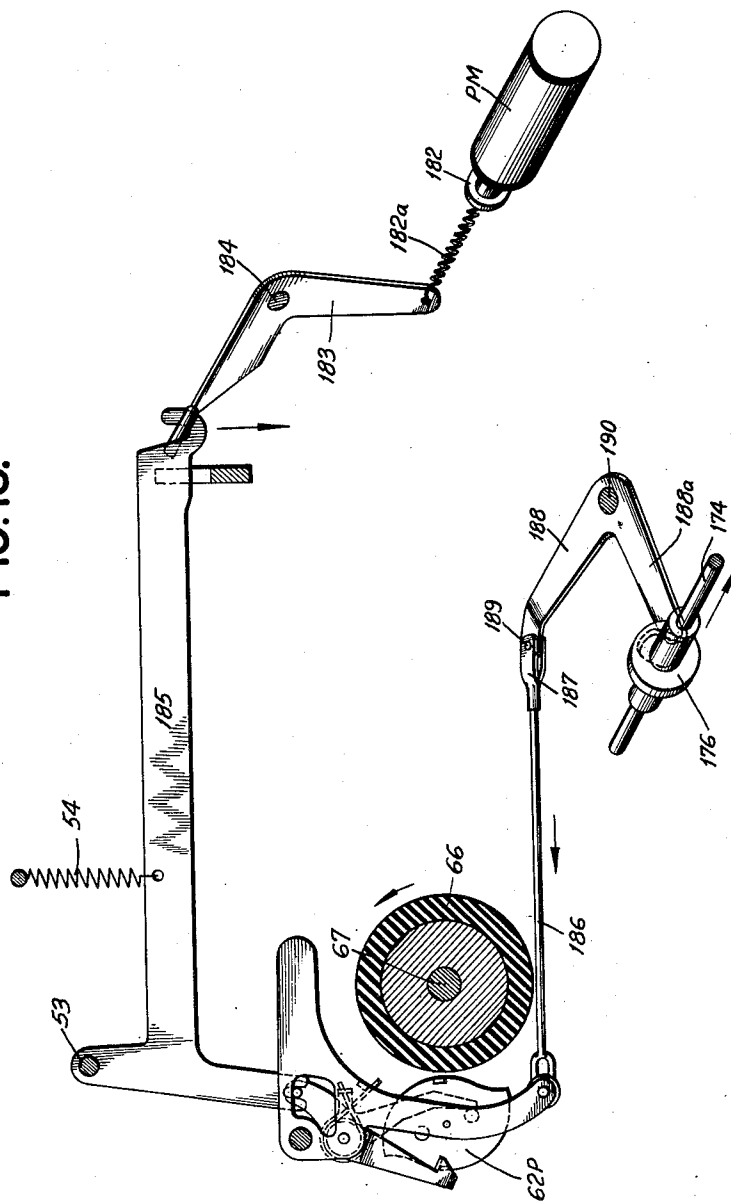
Dec. 8, 1942.

H. J. NICHOLS ET AL
COMMUNICATION SYSTEM
Filed Aug. 17, 1940

2,304,769

11 Sheets-Sheet 8

FIG. 10.



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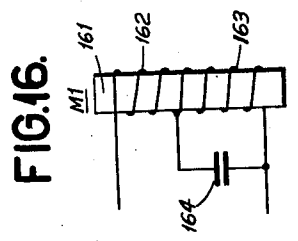
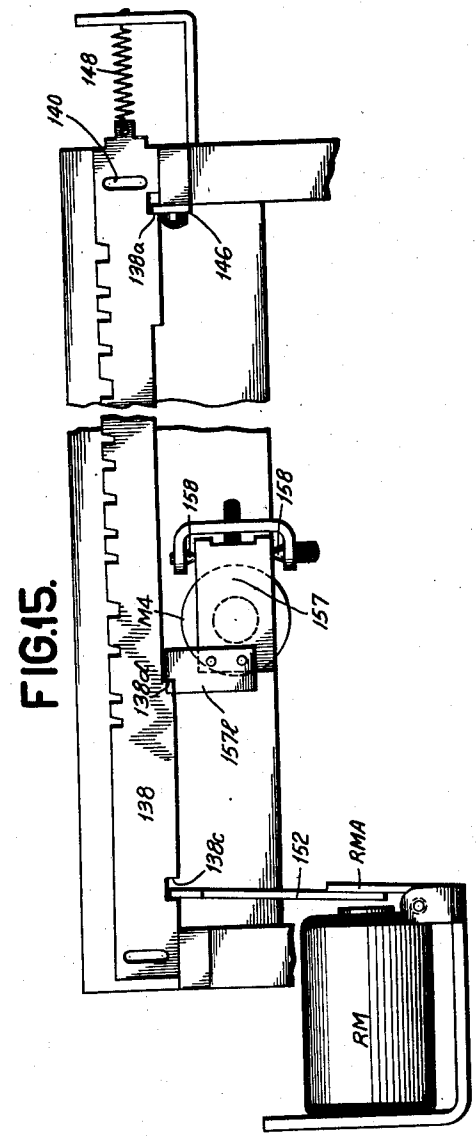
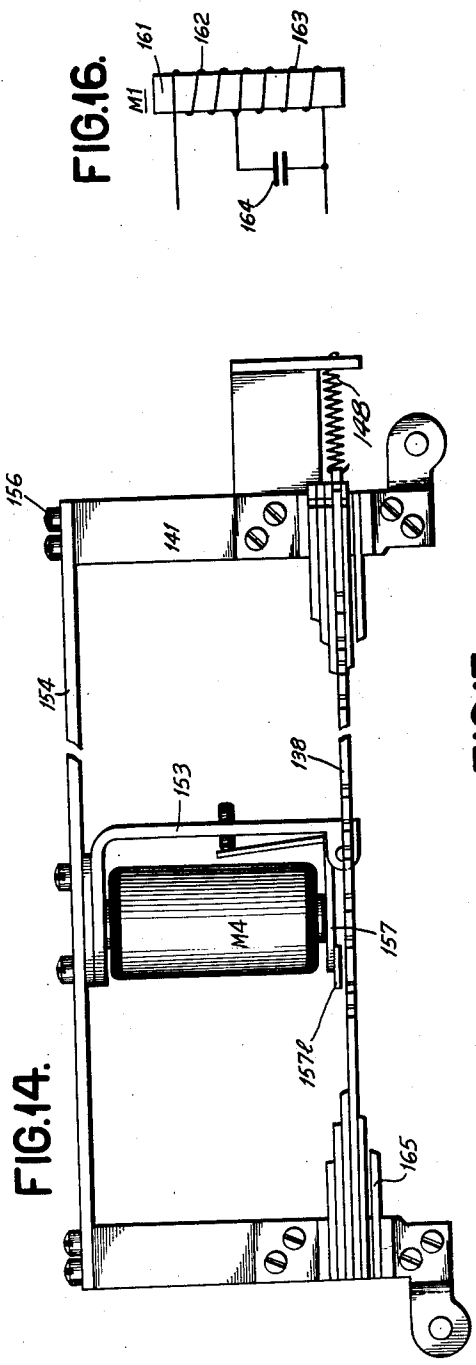
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2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 9



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2,304,769

COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 10

FIG.17.

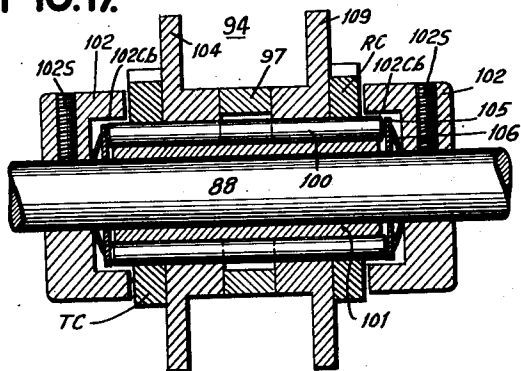


FIG.18.

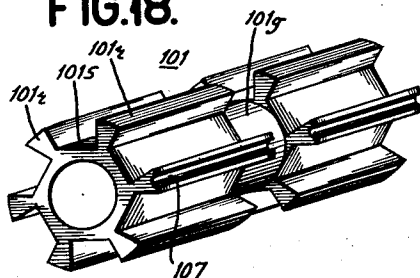


FIG.19.

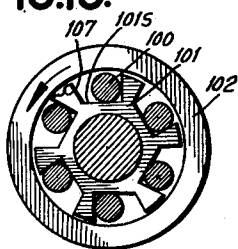
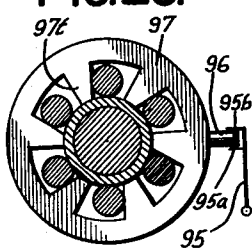


FIG.20.



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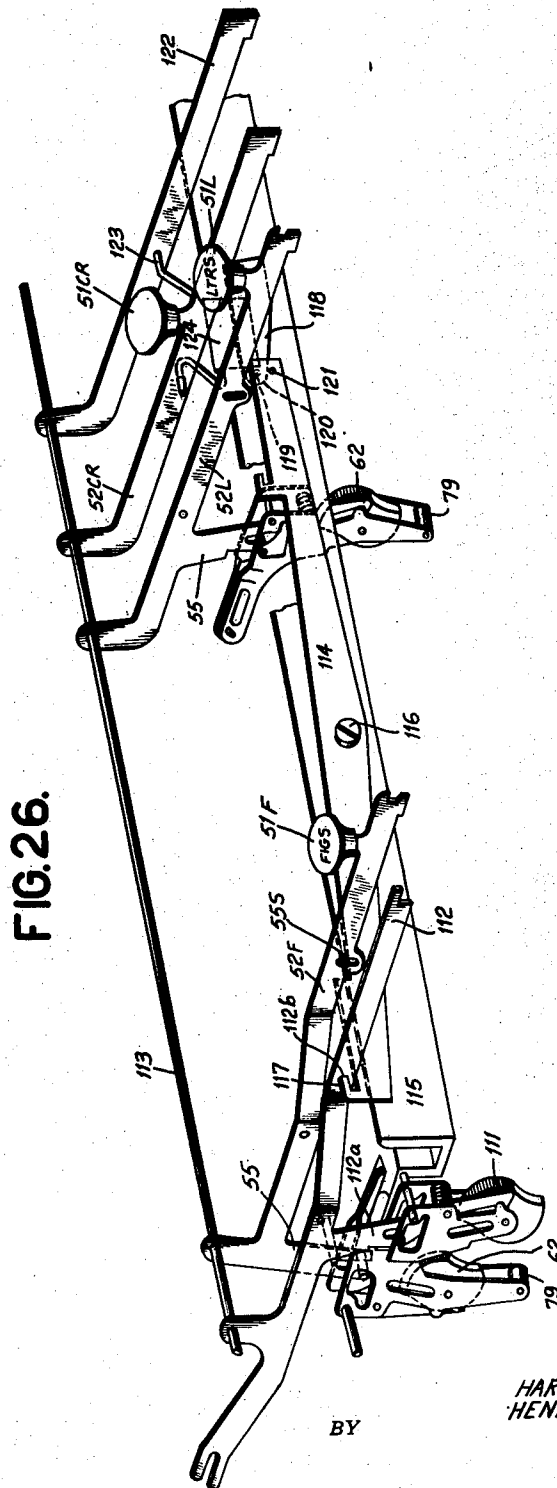
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COMMUNICATION SYSTEM

Filed Aug. 17, 1940

11 Sheets-Sheet 11



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UNITED STATES PATENT OFFICE

2,304,769

COMMUNICATION SYSTEM

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Application August 17, 1940, Serial No. 353,113

11 Claims. (Cl. 178—25)

The present invention relates to interoffice or interstation communication systems and more particularly to communication systems for interconnecting separate typewriters of a certain standard construction, modified to conform to a telegraphic keyboard wherein the operation of any one typewriter in a normal manner, can be isolated, at will, from the operation of the system, to permit ordinary individual operation of the respective typewriters or, on the other hand, operation of one typewriter in the normal manner can be utilized to locally produce a copy, at a sending station, of the intelligence to be transmitted, and to simultaneously operate a second or receiving similar typewriter or a plurality of such receiving typewriters at remote points. In like manner, each of the plurality of receiving typewriters can be utilized, when desired, as sending typewriters, and means are provided for "break-in" by a receive station, so that the direction of transmission can be reversed when necessary or desired.

In devices of the prior art wherein interoffice messages have been transmitted, special machines which are not the usual standard equipment of business offices have been employed. There have also been previously provided, electrical interconnecting systems for standard typewriters, but such systems have generally required an extensive rebuilding of the mechanical structure of the typewriter itself, to adapt it to such a system.

Accordingly, one of the objects of the present invention is to provide novel means for interconnecting and operating two or more standard office equipment typewriters, such as the well known "Electromatic" typewriter, modified to conform to a telegraphic keyboard so that such an instrument is utilized merely with parts of the original machine omitted and with very little additional equipment, in an interoffice communication system, to produce speedy and accurate transmission and reception of messages and the device is so constructed that a great part of the additional equipment is incorporated within the ambit of the typewriter frame.

Another object is to provide a novel system of communication including "break-in" for interconnecting two or more typewriters, wherein an absolute minimum number of signal channels is utilized between interconnected machines.

A further object is to provide a novel system of communication for interconnecting at least two typewriters, comprising means controlled by each depressed key of the keyboard for setting

up, in a simple and direct manner, a code combination of signal impulses, representative of the function or character represented by the depressed key and including start and stop signal impulses, said code combination comprising a plurality of electrical impulses of identical characteristics and of equal duration, a single signal channel interconnecting the typewriters, means for transmitting selectively and sequentially over said channel, the individual impulses or elements of a signal, representing a particular function or character, and a mechanical translator whose elements are positioned selectively in accordance with the individual elements of the code combination to select one key bar only, corresponding to the key depressed at the sending station, which key bar is operated by a seeker lever, released by a print bar controlled by a timed local impulse, whereby the depression of a chosen character key of such a standard typewriter at one station produces typing locally and also produces the typing of the selected character at a remote station by means of a similar typewriter.

Still another object is to provide a novel system of interoffice or interstation communication including at least a pair of typewriters at different stations, each having a modified keyboard, means controlled by a selected character key for producing a characteristic combination of signal code elements, an electrical connection between the respective typewriters comprising one signal channel over which the code signal elements of said character are sequentially transmitted, start-stop, send-receive distributor means for sending or receiving, respectively, at each station, and in synchronism, the code elements comprising a characteristic signal, and mechanical translator means controlled by received code elements for translating the same and selectively releasing a seeker lever to operate that key bar only, which corresponds to the key depressed at the sending station.

A further object is to provide a novel "break-in" system whereby the operator at a receiving station can interrupt transmission of signals, indicate the "break-in" to the original sending operator and reverse the direction of transmission.

Another object is to provide a novel clutch for operation of the start-stop mechanisms at the sending and receiving stations.

Still another object is to provide a novel mechanical translator and operating means therefor.

A further object is to provide a novel distribu-

tor for sequentially transmitting signal elements in accordance with a permutation set up by a selected character key.

Still another object is to provide a novel distributor including novel ranging means.

A further object is to provide novel means for setting up a code signal combination characteristic of a figures or letters shift function.

Still another object is to provide novel means for setting up a code signal combination characteristic of a carriage-return function.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

Fig. 1 is a diagrammatic view illustrating teleprinting devices such as typewriters suitable for ordinary office work and also utilized in the production of code signal permutations representative of a character and also controllable by remotely originating signals to type a character, and means for electrically interconnecting a pair of such devices by a minimum number of signal channels for signal transmission therebetween, the translator and permutation units being contained within the framework of the typewriter.

Fig. 2 is a diagrammatic view, in skeleton outline only, illustrating fundamentally how the operation, at the send station, of a character key produces a code permutation of signal components representative of the particular character, which components, by means not shown in Fig. 2, in turn are relayed, in seriatim, to the signal channel, by a send-receive distributor assembly, and also illustrating fundamentally how a corresponding key bar is operated by a seeker lever corresponding to a characteristic signal received from a remote station, after said signal has been translated, to thereby select the corresponding seeker lever.

Fig. 3 is a schematic diagram, illustrating in skeleton outline the essential elements of a complete communication system including separate transmitting and receiving stations, respectively, with the start-stop clutches in the preliminary stop position and illustrating the signal channel between the stations.

Fig. 4 is a schematic diagram, generally like Fig. 3, but illustrating in greater detail circuits and elements of the transmitting and receiving mechanisms and including the circuits for "break-in" and keyboard "lock-out" or latching.

Fig. 5 is a fragmentary perspective view illustrating diagrammatically the mechanism for producing keyboard "lock-out" or latching.

Fig. 6 is a diagrammatic view illustrating the means for and manner of operation of the contacts comprising a transmitting or a receiving distributor, and the ranging mechanism for adjusting the timing of the distributor.

Fig. 6a is an end view of the device of Fig. 6.

Fig. 7 is a perspective view illustrating the translator unit, the seeker levers and the mechanism for operating the print or drop bar.

Fig. 8 is a side elevation, illustrating in more detail, the mechanism for operating the print or drop bar.

Fig. 9 is a fragmentary side view, partly in section, of the device of Fig. 8.

Fig. 9a is a detailed view of the piston element of Figs. 8 and 9.

Fig. 9b is a detailed view of the combined pin and pivot element of Figs. 8 and 9.

Fig. 10 is a schematic view illustrating fundamentally the manner of operation of the actuating mechanism for the print or drop bar under the control of a timed local impulse.

Fig. 11 is a plan view of the translator unit, in part, illustrating schematically the latching of a permutation slide bar by a translator magnet latch.

Fig. 12 is a front view of the device of Fig. 11 and illustrating further details of the translator unit.

Fig. 13 is a fragmentary sectional view illustrating the rollers located between the permutation bars.

Fig. 14 is a plan view of the translator unit, in part, illustrating schematically the release of a permutation slide bar by a translator magnet.

Fig. 15 is a front view of the device of Fig. 14, and also illustrating schematically the restore magnet and its armature for resetting the permutation slide bars.

Fig. 16 is a diagrammatic view, illustrating a part of a circuit associated with a translator magnet.

Fig. 17 is a side elevation, in section, of one form of novel start-stop, single revolution clutch mechanism and including the transmitting and receiving cams, the latch contact operating cam, and the circuit breaker cam.

Fig. 18 is a perspective view illustrating the construction of the spider of the clutch mechanism.

Fig. 19 is a partial sectional view, illustrating the position of the clutch driving pins, with relation to the spider and a driving cup, when the clutch is disengaged.

Fig. 20 is a partial sectional view illustrating the clutch controlling disk mounted on the spider, and the manner in which the controlling disk actuates the clutch driving pins to the disengaged position of Fig. 19.

Fig. 21 is a view similar to Fig. 20 but with the controlling disk advancing the driving pins to their engaged position.

Fig. 22 is a view similar to Fig. 19 but with the driving pins in the engaged or locked position of Fig. 21.

Fig. 23 is a sectional view illustrating the latch contact operating cam, the controlling disk and the accelerating spring in position.

Fig. 24 is a sectional view of the latch contact operating cam hub and the clutch spider, and the detent pawl for holding the parts in stopped position.

Fig. 25 is a diagrammatic view illustrating the coaction of the start-stop magnet, start-stop magnet armature and the stop pin of the clutch controlling disk.

Figs. 25a, 25b and 25c are diagrammatic views illustrating the relative positions of the stop pin and start-stop armature under different operating conditions.

Figure 26 is a perspective view illustrating the shift and carriage-return operating and signaling mechanism.

Referring to the drawings wherein like reference characters refer to like parts throughout the several views and more particularly to Fig. 1, the invention is illustrated in the present example, as applied to a pair of modified "Electromatic" typewriters A and B at the sending station A and the receiving station B, respectively, but it is to be expressly understood that any

type of standard office typewriter with a modified keyboard can be utilized in the novel combination of the present invention and that any number of typewriters can be so interconnected.

Typewriter A comprises an "Electromatic" typewriter provided with a modified or telegraphic keyboard wherein the typebars are power actuated in a well known manner, upon depression of a chosen character key and wherein a blank key SRK1, controls a send-receive relay (Fig. 4) as will be described in detail later.

Upon depression of any chosen character key, the character is typed on the record sheet 50 at station A and the permutation unit (Fig. 2) is conditioned, as will be described later, so that an electrical signal is produced, composed of a predetermined permutation of similar electrical components, which components; by means of a send-receive distributor assembly, diagrammatically represented in Fig. 1, including a novel start-stop, single revolution clutch mechanism and send-receive and line relays; are transmitted sequentially over a signal channel represented as a line to the typewriter B at the receive station. It is to be specifically understood that any type of signal channel may be utilized. The respective signal components, when received by the send-receive distributor assembly at the receive station B, sequentially condition the respective translator magnets (Fig. 11) of a novel translator mechanism, as will be explained in detail later, whereby the permutation slide bars of the translator are operated to align their respective slots with a certain seeker lever (Fig. 7), in accordance with the particular signal code permutation received. All the seeker levers are each connected to a key bar, respectively, (Fig. 2), and the key bar at a receive station controlled by the chosen seeker lever corresponds to the character key depressed at the send station.

Alignment of the slots of the slide bars as described above, by the selecting code signal elements of the signal, conditions one selected seeker lever for operation, and upon reception of the seventh or print pulse of the complete signal, the print magnet PM (Figs. 4 and 10) is energized to depress the print or drop bar as described in detail later and the selected seeker lever is actuated by its associated spring to operate the corresponding character key at the receive station, so that the same character is typed on the record sheet 50 (Fig. 1) at both the send and receive stations. Similarly, any of the letters can be typed and any function can be performed, so that any message can be typed at station A and signals set up at station A, which when transmitted to station B, will produce typing of the same message on the machine at that station.

When the operator at station A wishes to send a message to station B, to be simultaneously typed upon both machines, the operator at station A, depresses the blank key SRK1, thereby conditioning the machine at station A for sending, station B being normally in receive condition, all as will be described in detail later. Warning and other signaling means may be provided between stations, in a manner well known in the art but such warning and signaling means do not constitute any part of the present invention.

Referring specifically to Fig. 2, there is illustrated, in skeleton outline only, the mechanism and circuits for the operation of a chosen character key at station A with the consequent mechanical typing of the selected character at station A and the setting up of means for producing a signal, representative of the character, whereby such a signal may be transmitted to station B to produce typing of the corresponding character at said station. The operation of the send-conditioned machine to produce a signal for remote operation of a receive-conditioned machine is as follows: Upon depression of a chosen character key 51, the key bar 52 is oscillated about its pivot pin 53 against the force of return spring 54 to move an extension arm 55 downwardly. Upon such downward movement, the bifurcated lower end of arm 55 engages a pin 56 on arm 57 integral with the stop lever 58, to thereby rotate stop lever 58 counterclockwise about its pivot 59. This rotation disengages the channel shaped lug 60 of stop lever 58 from the right hand one of a pair of detents 61, on cam 62. An impeller arm 63, in contact with an impeller lug 64 on cam 62 is constantly urged in a clockwise direction by means of a spring 65 and upon the disengagement of the channel shaped lug 60 of the stop lever from a detent 61 of the cam, the impeller arm 63, by means of its contact with impeller lug 64, rotates the cam 62, slightly in a clockwise direction, until the cam engages the constantly rotating power roller 66 which is rotated about the stationary shaft 67 by means of the typewriter motor (not shown) in a manner well known in the art. The cam 62 by means of its engagement with power roller 66 is thereupon rotated a full half revolution clockwise, until the other, detent 61, of the pair of detents on cam 62, engages the channel shaped lug 60 of stop lever 58, in a well known manner. Cam 62 is pivotally mounted by its axis 68 upon an arm 69 of a bell-crank 70 which in turn is mounted for oscillation about a pivot 71, and upon such rotation of cam 62, its eccentric contour causes a lateral movement of the cam axis 68 to thereby oscillate bell-crank 70 in a counterclockwise direction. Such oscillation causes a downward movement of the arm 69a of bell-crank 70 to thereby pull down a link 72, to rotate a bell-crank 73 against the force of spring 74 to actuate link 75 to oscillate bell-crank 76 to in turn actuate the typebar 77 to strike one of the type characters 78 against the record 50 (Fig. 1), in a manner well known in the art.

Also, upon rotation of cam 62 and consequent lateral movement of the cam axis 68, a roller 79 carried on the lower end of arm 69, is moved laterally to the right, as viewed in Fig. 2. Roller 79 is in engagement with a shoulder 80s on a permutation slider 80 mounted on suitable slotted guide bars 81 secured to the frame (not shown) of a typewriter unit. Each slider is provided with spaced studs 82 extending outwardly and alternately from one side and the other of the slider and such studs are carried on both the top and bottom horizontal bars 80t and 80b, respectively, of the slider member. Rotatably mounted on each of a plurality of code rockshafts 83, and alternately on opposite sides of the sliders, are the diagrammatically represented rockshaft actuating clips 84 which may be of the type as disclosed in the copending application of Harry J. Nichols, Serial No. 353,114 filed Aug. 17, 1940. These clips 84 are removably attached to the rockshafts, as described in said copending application, the relative number and disposition of the clips in the assembly for each slider being

dependent upon the particular code value of the character whose key controls the respective slider member. Therefore, upon depression of any chosen character key, the respective code rockshafts 83, to which the clips are attached, will be rotated, as described in said application, and in such a direction that the particular code permutation representing the character, will be set up by the respective permutation switches. It is to be particularly noted, that the universal bail rockshaft 83UB is always actuated by means of its clip 84UB to move one out of a pair of its controlled switch arms comprising the universal bail switch, momentarily out of engagement, to thereby produce a spacing condition on the signal channel, this rockshaft being diagrammatically illustrated as spring biased by means of a coil spring 85 acting through its associated clip 84UB so that the rockshaft and slider 80 are returned to their original positions upon completion of the half revolution of cam 62.

Upon the above described lateral movement of the cam axis, the roller 79 moves slider 80 to the right, as viewed in Fig. 2, against the spring bias effect of spring 85 acting through clip 84UB and its cooperating stud, whereby the studs carried by the slider actuate the associated clips and rotate the universal bail rockshaft 83UB and such code rockshafts 83, as is required to set up the signal. Such actuation of the clips rotates the associated rockshafts to actuate the diagrammatically represented switch operating elements 86UB and 86 to thereby permit the associated spring switch arm 87UX of the universal bail rockshaft to move out of contact with its associated switch arm 87UXb and into engagement with switch arm 87UXa and to force certain of the associated spring switch arms or tongues 87 of the code rockshafts selectively into engagement with the associated switch arms 87a, dependent upon the direction of rotation of the code rockshafts, respectively. It is to be particularly noted, that all code permutation signal settings are differentially produced and only those rockshafts are actuated which require a change from the setting for the previously typed character. If the same letter is typed twice in succession, the corresponding slider is twice actuated, but only the universal bail rockshaft is rotated, the second time, since the remaining rockshafts are retained in their previously set position by the diagrammatically represented associated detent pin 86d, spring pressed, by spring 86e, into engagement with a notch 86n in the operating element, as described in detail in said copending application. Thus, such permutation switch elements 87a and 87 as are moved into engagement, close a circuit from the positive side of a D. C. source B1, as illustrated diagrammatically in Fig. 2, and the universal bail on the other hand opens the circuit from the positive side of the same source by separation of its pair of contacts 87UX and 87UXa, in series between the positive side of said source and the distributor assembly. Contacts 87UX and 87UXb are simultaneously moved into engagement, to momentarily energize a latching circuit, as described in detail later.

The particular permutation of switches closed, will thereby supply positive potential to the send-receive distributor assembly; including the novel start-stop, single revolution clutch mechanism, send-receive relay and line relay, diagrammatically illustrated in Fig. 2 as the send-receive distributor assembly; which in turn, at the proper time and in proper sequence, will transmit the

set up code permutation of signal components, through the signal channel represented by the line, to the send-receive distributor assembly at the receive station, in a manner to be described in detail later. Upon completion of a full half revolution of the cam 62, the universal bail rockshaft 83UB is returned to its normal position by spring 85 thereby forcing contacts 87UX and 87UXb apart and producing closure of contacts 87UX and 87UXa, but the code rockshafts 83 are retained in their actuated positions by the coacting detent pins, until depression of another character key bar. It is seen, therefore, that in a simple and direct manner, a standard office typewriter, such as the "Electromatic" typewriter, modified as stated above, can be utilized, to locally type a character and to set up a code signal having a desired permutation of components, characteristic of the selected character, which signal may be transmitted over the signal channel represented by the line, by the novel means now to be described and which may be utilized at a remote typewriter to type the same character.

The novel communication system comprising the present invention consists of the permutation means as just briefly described, at each station, for setting up a code signal representative of a character to be remotely typed, a send-receive distributor assembly, comprising in addition to a send-receive relay and a line relay, novel distributor mechanism, and a novel start-stop, single revolution clutch mechanism controlled by the line relay to in turn control the operation of the distributor mechanism at the same station. The code signal set up by the permutation unit, is sequentially transmitted by the sending distributor to maintain synchronism between the distributor mechanisms at the local station and at the remote station and to produce typing of the desired character or performance of the desired function, the remote distributor mechanism controlling novel mechanical translator means, set in accordance with the signal elements received to thereby operate that key bar only, corresponding to the character key depressed at the sending station.

A general description coordinated by reference to the respective figures of the drawings, will first be given, of the essential elements of a complete communication system and then a detailed description of the sending or transmitting mechanism and circuits and of the receiving mechanism and circuits, including a detailed description of the respective component elements of these mechanisms and circuits will be given, which will be followed by a detailed description of the operation of the complete system including transmission, reception, break-in, lock-out and other communication functions.

General description

A plurality of typewriters, such as the machine at station A and the machine at station B (Fig. 1) with their respective associated electrical elements, a send-receive distributor assembly including start-stop mechanism and various control elements are interconnected to comprise the novel teleprinting communication system. The system operates on the start-stop, Baudot 5-unit code principle, and by means of associated circuits and mechanisms, two-way transmission of messages over a single channel is provided.

A permutation mechanism, generally as shown and described in detail in said copending applica-

tion, and controlled in the manner as diagrammatically illustrated in Fig. 2, is utilized to produce the start signal by opening the line circuit, to set up a code signal of separate signal components, characteristic of the character represented by a chosen depressed key, and to produce a stop signal. The particular permutation switch elements which are placed in a closed circuit relation by the permutation mechanism close a circuit up to their associated distributor contacts, as illustrated in Figs. 3 and 4, which contacts are sequentially controlled upon rotation of the start-stop clutch, by the transmitting distributor cam, which is driven by the start-stop clutch along with the receive cam, the control of said contacts being conventionally illustrated only, in Figs. 3 and 4.

Upon depression of a chosen character key to thereby locally type the character and to simultaneously set up the code signal representative of that character, two of the universal bail contacts are operated to open the line circuit and thereby release the novel start-stop clutch mechanism of Fig. 17 whereby it is rotated one complete revolution, only, and the selecting code signal permutation, as set up by the permutation unit, is sequentially transmitted to the line by means of the sending distributor unit and the send-receive relay, as diagrammatically illustrated in Figs. 3 and 4. The line signal elements received at station B, operate a line relay to sequentially control local circuits to the respective contacts of the distributor unit of typewriter B (Fig. 1) as this distributor rotates to thereby sequentially and selectively energize the translator magnets (Fig. 4) of the novel translator mechanism of Figs. 11, 12, 13, 14 and 15, which magnets thereby selectively set the permutation slide bars of the translator so that the one seeker lever, (Fig. 7), and the associated key lever only which corresponds to the chosen character is operated (Fig. 2) upon depression of the print bar at station B (Figs. 2, 8 and 10) to thereby produce remote typing of the chosen character.

Transmitting mechanism

The transmitting mechanism comprises the permutation unit of the above mentioned copending application which is controlled by the key bars of the transmitting typewriter, to control circuits leading to contacts controlled by the transmitting cam of the distributor mechanism. The circuits, closed by the transmitting distributor cam, transmit code elements of the signal to a send-receive relay at the send station, which relay controls the transmission of the signal elements through a line relay at the sending station and to a line relay at the receiving station. The line relay at the sending station, controls the operation of a novel start-stop single revolution clutch mechanism which, in turn, controls the operation of the distributor mechanism. The construction of the permutation unit is as described in detail in said copending application. The construction of the transmitting distributor unit and ranging device of the send-receive mechanism, the start-stop single revolution clutch mechanism, the shift and carriage-return mechanisms and the keyboard "lock-out" or speed lock means, will now be described in detail.

Referring to Fig. 6, there is illustrated therein the construction and assembly of a novel transmitting or receiving distributor including a novel ranging device as shown and described in applicant's copending application Ser. No. 398,069,

filed June 14, 1941. This distributor is diagrammatically illustrated as separate from the typewriter in Fig. 1, but in actual construction it may be fastened to the back of the typewriter to produce a compact unit.

A transmission cam TC is loosely mounted for rotation about the shaft 88 (Fig. 17) along with a similar receive cam RC and the other elements as shown in Fig. 17, the receive cam and other elements being omitted in Fig. 6 to clarify the illustration. Transmission cam TC controls a plurality of movable contacts or switch arms of the switches T1, T2, T3, T4 and T5 cooperating with the permutation switches P1, P2, P3, P4 and P5 (Fig. 3) and each switch including at least a pair of switch arms *a* and *b*. The switches T1—T6 are in series between the permutation unit switches and the send-receive relay, as diagrammatically illustrated only, in Fig. 3, and thereby control the circuits leading from the respective permutation switches to the line. Cam TC also controls the switch T6 shown as comprising a pair of switches operated simultaneously by means of the web T6a interconnecting the movable blades *a* of the two switches.

Referring to Figs. 6 and 6a the horizontal shaft 88 is transversely journaled in ball bearings 89 (only one being shown) forced into suitable recesses 90 bored in the end of a spider 91, rotatably mounted in the distributor end plate 92 of the distributor mechanism. The shaft 88 is driven by motor means (not shown) to produce rotation of a novel start-stop single revolution clutch mechanism 94 (Fig. 17), as described later, under the control of one of the start-stop magnets SSM or SSM2 diagrammatically illustrated in Figs. 3 and 4.

The send or transmitting cam TC (Figs. 6 and 17) is attached to a spider of the clutch, as described later, for rotation therewith. Upon rotation of the start-stop clutch, the cam TC sequentially closes the *a* contacts of switches T1 to T6, inclusive, (Fig. 6) against the cooperating *b* contact respectively to thereby transmit to the line, the elements of a particular code signal, as set by the permutation switches P1 to P5, inclusive, (Fig. 3) each comprising the pair of contacts 87 and 87a, as described above, and to transmit a stop or marking line signal, as described later. The contacts comprising the switches, each comprises a spring stack-up, as illustrated in Fig. 6, mounted on the spider 91 and distributed about the circumference thereof, whereby, upon rotative adjustment of the spider, as will now be described, the particular timing of the closure of the contacts of the respective switches T1 to T6, inclusive, by cam TC, may be adjusted.

The novel ranging device comprises the spider 91 mounted for rotative adjustment about the shaft 88 by means of the spider adjusting plate 98 attached to the spider by screws 98a, and including a slot 98s into which projects the adjustable thumb screw 99 for locking the spider in any desired adjusted position, the relative position being indicated by the index pointer 98p, carried by and movable with the plate 98, and cooperating with the index plate 98b mounted on the distributor end plate. By loosening the thumb screw 99, the spider adjusting plate 98 may be rotatively advanced or retarded, which in turn, advances or retards the time of closure, by cam TC, of the respective switches T1 to T6, inclusive, carried by spider 91. In this manner

any shift in phase of the line signal elements may be compensated.

The details of the novel start-stop and single revolution clutch mechanism 94 as shown and described in applicant's copending application Ser. No. 398,070, filed June 14, 1941, are diagrammatically indicated only in Figs. 3 and 4 and are illustrated in Figs. 17 to 23, inclusive. This clutch mechanism comprises generally an overriding roller type clutch in which six small pins or rollers 100 coact with a spider 101 and a pair of driver cups 102 and are engaged by means of a wedge action to produce a positive drive. After the clutch has been engaged, it continues to rotate, locked in step with the shaft 88 by means of cups 102, until the pawl 95a, for example, of stop arm 95 engages the stop pin 96. The engagement of the stop pin and pawl arrests the motion of a controller disk 97 to which the pin is attached while the energy of the other parts of the clutch causes the clutch to rotate through a small angle which disengages the rollers 100 and thus releases the clutch.

Referring to Fig. 17, the complete clutch mechanism 94 is illustrated as comprising the pair of driver cups 102 fastened to shaft 88 by means such as set screws 102s. Each cup comprises a cylindrical member, bored to fit the shaft 88 and provided with a counterbored portion 102cb turned concentric with shaft 88, the interior surface of the counterbores constituting the drive surfaces of the clutch. Located between the pair of driver cups is the spider 101 (Fig. 18) mounted on and in loose contact with the shaft 88 and extending at its ends into the interior of the counterbored portions of the cups. The rollers 100 are mounted in axially extending slots or grooves 101s (Fig. 18) formed in the outer periphery of the spider and the ends of the rollers are so positioned as to contact the interior surfaces of the respective counterbores 102cb of the respective cups when the clutch is engaged. As is seen in Figs. 18 and 19, the slots 101s are formed eccentrically with respect to the shaft 88 so that motion of the rollers 100 along the bottom of the slots or grooves, moves the rollers further from the center line of the shaft or closer thereto in accordance with the direction of motion, so that the rollers are either thereby engaged or disengaged from the driver cups 102. The driving rollers 100 are jointly controlled by an interiorly toothed controller disk or ring 97 (Fig. 20) which ring is rotatably mounted in a radially extending groove 101g (Fig. 18) formed in the spider 101 and is provided with a torque spring 103 (Fig. 23) having one end inserted into an axially extending opening 97a in the controller ring 97 and the other end inserted into an axially extending opening 104a in the latch contact operating cam 104. The spring 103, upon release of the controller ring 97, tends to rotate the controller ring so that the rollers 100 are urged towards the engaging position (Fig. 22). The spider 101 is in frictional engagement with a fiber pad 105 (Fig. 17) at each end thereof which in turn is urged into engagement with the rollers by a cup-shaped spring washer 106 bearing on the bottom of the counterbores 102cb of the cups 102, respectively, so that a force is always exerted upon the rollers by the rotation of the driver cups to aid in positioning the pins in the engaged position. By adjustment of the position of the cups on the shaft 88, the frictional force on the spider may be varied. A notch or axially extending slot 107 (Figs. 6 and 18) is formed in the outer edge of one of the radially extending members 101r of the

spider and a driving key 108 (Figs. 6 and 24) fastens the transmitting cam TC, latch contact operating cam 104, (Fig. 17), circuit breaker cam 109 and receive cam RC to the spider 101 for rotation therewith upon release of the controller ring 97 and engagement of the clutch.

As illustrated in Figs. 20 and 21, the controller ring is provided with a stop pin 96 cooperating with the pawls 95a and 95b on the arm 95 (Fig. 25) controlled by the armature SSMA of the start-stop magnet SSM. Engagement of the pin 96 with either the pawl 95a or 95b, holds the controller ring 97 in position, against the force of the torque exerting spring 103, so that the rollers 100 are held, out of the interlocking engagement, between the rollers, the driver cups and the spider. This condition is illustrated in Figs. 19 and 20, the stop arm 95 being schematically illustrated as engaging the stop pin 96. The teeth 97t (Fig. 20) of the controller ring 97 hold the rollers 100 in the position, as shown in Fig. 19, so that the rollers are located in the deepest part of the slots 101s of the spider and the rollers are therefore out of engagement with the peripheries of counterbores 102cb, respectively. Upon release of the stop pin 96, as illustrated diagrammatically in Fig. 21, the controller ring 97 is rotated by spring 103. Simultaneously, the friction due to washer 105 (Fig. 17) and cup shaped spring washer 106 tends to rotate the spider 101 in the direction of rotation of the clutch.

In order to obtain positive and rapid engagement of the driving pins, by the ring or controller disk 97, to lock the driving cups to the spider, the controller ring not only must be accelerated by the accelerating spring 103, as just described, but the spider must be held stationary in the meantime. As is seen in Fig. 24, the hub 104a of cam 104 is provided with a V-notch 110b into which projects the V-shaped end 110a of the detent lever 110. Since the spider 101 is connected to cam 104 by key 108 (Fig. 24) the lever 110 holds the spider stationary when the clutch is disengaged. Therefore, although the friction of members 105 and 106 tend to rotate the spider, as above stated, the detent lever holds the spider against such immediate rotation. The spring 103, therefore, snaps the ring 97 into rotation and the ring or controller disk teeth 97t quickly assume the position, as shown in Fig. 22, to thereby move the pins 100 into the shallow parts of the groove 101s so that the rollers engage the surfaces of the counterbores 102cb formed in the cups 102 and the clutch is rotated. Upon the engagement of pin 96 at the end of a revolution of the clutch, the ring 97 is arrested and the momentum of the other parts of the clutch rotates the spider until lever 110 engages the notch 110b so that the spider assumes the position of Fig. 19, the rotation of cam 104, with respect to ring 97, before it is stopped by lever 110, thereby placing a stress on spring 103, to condition the same for the next cycle of operation.

The complete operation of the novel start-stop single revolution clutch mechanism of Figs. 17 to 23, inclusive, is as follows: Responding to a spacing line condition, the start-stop magnet SSM (Fig. 25) is denergized and the spring 95s moves the armature SSMA away from the magnet SSM and thereby rotates the stop arm 95 counterclockwise to the position shown in Fig. 25a so that the pawl 95b is moved out of the path of rotation of the pin 96 and pawl 95a is moved into the path of rotation of this pin thereby stopping the clutch in the preliminary stop position upon the engagement of pin 96 and pawl 95a

(Figs. 3 and 25a). This is the position of the clutch when the system is deenergized and is not in use.

Upon depression of the send-receive key SRK1 (Fig. 4) at the transmitting station A, for example, the line is energized, thereby energizing start-stop magnet SSM1 at this station, as will be explained in detail later. The armature SSMA of SSM1 is thereby attracted, as diagrammatically shown in Fig. 4, so that arm 95 is rotated counterclockwise against the force of spring 95s to the position, as shown in Fig. 25b, and the pawl 95b is rotated into position to intercept the stop pin 96 so that the clutch is arrested in the normal stop position (Fig. 4).

Now, upon transmission of the normal start or spacing line condition, magnet SSM1 is deenergized and the arm 95 is rotated counterclockwise to the position, as shown in Fig. 25c. As is clearly illustrated in the diagrammatic illustration of Fig. 25c, this release will permit the pin 96 to clear both of the pawls 95a and 95b and such release of pin 96 permits ring 97 under control of spring 103, as described above, to move the rollers into engagement with the cups to rotate clutch 94 until either the pawl 95a is engaged, at the preliminary stop position before the completion of a full revolution, as shown in Fig. 3, or until pawl 95b is engaged, as shown in Fig. 4, which occurs at the end of one complete revolution during normal operation because a stop or marking line condition is transmitted as the last signal, component of a complete signal which stop signal energizes magnet SSM1 to attract armature SSMA to rotate arm 95 to the position, as shown in Fig. 25, and diagrammatically illustrated only, in Fig. 4. Such engagement of pin 96 stops the clutch and resets spring 103, as described above.

Rotation of the cam TC (Figs. 3, 4, 6 and 17), cam 104 (Figs. 4 and 17), cam 109 (Figs. 4 and 17) and cam RC (Figs. 3, 4 and 17) and rotation of the cam TC (Figs. 3, 4, 6 and 17) for example, sequentially operates the transmitting switches T1—T6, inclusive, as previously explained. Upon receipt of the stop signal near the end of one cycle of operation, the start-stop magnet is energized to stop the clutch in the normal stop position, as previously described, thereby limiting the start-stop clutch mechanism 94 to a single revolution only.

Mechanism for locally producing shift or carriage-return and simultaneously producing a letters or figures shift signal or a carriage-return signal for remote control of these functions, will now be described. Referring to Fig. 26, a standard power cam 111 for locally producing letters or figures shift, which shift cam is, as is well known, normally operative upon the downward stroke and also operative on the upward stroke, is operatively connected for control thereby in the well known manner, to an extension 112a of an auxiliary key lever 112, in this instance, instead of being operatively connected to the standard "Figs." key lever 52F. Key levers 112 and 52F are mounted for rotation about the cylindrical rod element 113, in a manner well known in the art, the key lever 52F by means of its extension 55 controlling a single half revolution cam 62, as in Fig. 2.

The "Figs." key lever 52F is remotely controlled, as diagrammatically illustrated in Fig. 2, upon reception of a signal, by a seeker lever SL, and its connecting pin SLP extending into

a key bar slot 55S. The power shift cam, when operated by remote control or when manually operated through the digital operation of the "Figs." key 51F controls, in a normal manner, the shifting of the typewriter basket locally, to "Figs." case, by operation of key lever 112 and consequent downward stroke of extension 112a, while upon the upward stroke of lever 112 produced, by means of interconnecting mechanism as will be presently described, by depression of the letters key 51L, the basket is locally shifted to the "Letters" case. The letters key lever 52L may be remotely controlled by means of a seeker lever, in the same manner as the remote control of lever 52F, or it may be digitally operated. The letters key lever 52L, by means of its extension 55, controls a standard, single half revolution power cam 62 having a slider actuating roller 79 mounted on an extension of the support arm thereof, as in Fig. 2.

A rocker lever 114 is pivotally mounted on the frame 115 by means of a pivot screw 116. An inverted L-shaped lug 117 integral with the left end of the lever 114 engages in an opening 112b formed in the auxiliary key lever 112. The "Figs." key lever 52F, in its unoperated position, abuts the top of the rocker lever 114, and upon depression, of the key 51F, will rotate the rocker lever counterclockwise. Likewise, the "Letters" key lever 52L in its unoperated position, abuts the top of the rocker lever and upon depression of this key lever it produces clockwise rotation of the rocker lever. A spring arm 118, attached to the frame 115, is provided with a circular, protruding element 119 which engages in either an upper indentation 120 or a lower indentation 121 formed in the right hand end of the rocker lever 114. When the rocker lever is rotated clockwise upon depression of the "Letters" key 51L, the protruding element 119 engages the top indentation 120 of lever 114, as shown in Fig. 26, to thereby hold the rocker lever in the extreme clockwise position. Likewise, when the lever 114 is rotated counterclockwise by depression of the "Figs." key 51F, the element 119 engages the lower indentation 121 to hold the lever 114 in its extreme counterclockwise position.

The operation is as follows: The "Figs." key 51F is first depressed and allowed to return to its normal position. Depression of the "Figs." key not only releases its associated cam 62, in the well known manner, to permit roller 79 to operate the associated slider, as in Fig. 2, to set up the permutation code signal characteristic of "Figs." shift but also rotates the rocking lever 114 counterclockwise, and this lever is held in the extreme counterclockwise position by means of spring arm 118, element 119 and indentation 121. Counterclockwise rotation of the rocker lever depresses the key lever 112 by means of the inverted L-shaped lug 117 integral with the lever 114. Upon depression of lever 112, this lever remains down, releasing cam 111 for a half revolution only, whereby the type basket is locally shifted to the "Figs." case and will remain in that condition until the "Letters" key is depressed.

Upon depression and release of the "Letters" key 51L, on the other hand, not only is its associated cam 62 released to rotate a half revolution, so that its roller 79 will operate its associated slider, in a manner now well understood, to set up the permutation code signal representative of "Letters" shift, but also the rocker lever 114 is, this time, rotated clockwise to thereby raise lever

112 to release cam 111 for another half revolution whereby the type basket is locally shifted to "Letters" case.

Successive depressions of the "Figs." key or of the "Letters" key will permit repeat signals to be transmitted to the line but will not at all affect the rocker lever 114, so that the typewriter basket will locally remain in either "Figs." case or "Letters" case, depending upon whether the "Figs." key or "Letters" key is being successively depressed.

There is also disclosed in Fig. 26, a novel carriage-return signaling and operating arrangement. It is to be noted, at this point, that in the standard "Electromatic" typewriter, the carriage-return power cam is of the single lobe type, in contrast to the ordinary double lobe type, such as is illustrated in Fig. 2. Upon actuation of the carriage-return key, the single lobe cam is locked in operative position until the typewriter carriage completely returns to the left hand margin. Due to the variable operating time of the carriage-return cam, means must be provided to produce a signal, corresponding to carriage-return, which will occupy the same time interval as all other signals.

Referring to Fig. 26, a carriage-return lever 52CR is mounted for rotation about the rod 113 as a pivot, in the well known manner. An auxiliary lever 122 is likewise mounted for rotation about rod 113. A generally U-shaped connecting link 123 is pivotally mounted in a bracket 124 fastened to a part of the frame, by any well known means. One end of the link 123 engages in an opening formed in the key lever 52CR while the opposite end of the link 123 engages in an opening formed in the lever 122. The carriage-return lever 52CR controls the usual single lobe cam (not shown) producing carriage-return locally. The lever 122, controls an ordinary two-lobe power cam (not shown) in the same manner generally, as lever 52L, for example.

The operation is as follows: Upon depression of the carriage-return key 51CR, a single lobe power cam is released and the carriage at the local machine is returned to its left hand margin.

Simultaneously, upon depression of the key 51CR, the lever 52CR is depressed and the link 123 operated thereby depresses lever 122 thereby releasing the ordinary two-lobe power cam such as 62, associated therewith, to set up the carriage-return signal permutation so that consequently the machine at the remote station is controlled by the received signal to operate the carriage-return lever at said remote station and thereby produce a return of the carriage at the remote station, to its left hand margin. By utilizing the combination of lever 52CR and lever 122 with the respective cams, as controlled by these levers, the function of carriage-return is produced locally, in the usual manner, and a carriage-return signal, of equal duration to all other character or function representing signals, is transmitted to a remote station.

The details of the keyboard "lock-out" or speed lock mechanism which comprise a part of the novel "break-in" means is disclosed in Fig. 5. This keyboard "lock-out" is of the type as disclosed in the copending application of Henry L. Tholstrup, Serial No. 298,005, filed October 5, 1939, now Patent 2,255,030 granted Sept. 2, 1941.

Referring to Fig. 5, the "lock-out" means are seen as comprising a comb 125 of the typewriter provided with a "lock-out" mechanism comprising a plurality of rollers 126, mounted in a roller

guide 127, these rollers being of such diameter and so spaced that only one key lever or the "lock-out" lever only, can be depressed at any one time. A "lock-out" lever 128, similar to the ordinary key lever of a typewriter, is mounted, by means of rod 113, for oscillation in a vertical plane about said rod as a pivot. A spring 129, attached by a hook 130 to the lever 128 at one end thereof and fastened to the frame of the typewriter by means such as 131 at the other end thereof, biases the lever against the top of a guide slot 131 in the comb 125.

A coil spring 132 having one end 133 thereof threaded through an opening 134 in lever 128, is connected at its other end to a lug 135 integral with the top of plunger 136 comprising the armature of a "lock-out" or latch magnet LM (see also Fig. 4) mounted in the U-shaped base 137. The energization of latch magnet LM is controlled by the novel "break-in" system which will be described in detail later.

The operation of the "lock-out" is as follows: Upon energization of the magnet LM, the plunger or armature 135 is drawn downwardly, as viewed in Fig. 5, applying a force to the coil spring 132 whereby the "lock-out" lever 128 is oscillated, about the rod 113 as a pivot, against the force of bias spring 129 and thereupon lever 128 is pulled downwardly to the bottom of the guide slot 131 and between a pair of the rollers 126 whereby the spacing between the rollers is so decreased, that no key lever of the typewriter can now enter therebetween until lever 128 is retracted by the spring 129 upon deenergization of magnet LM. The utilization of the "lock-out" means in combination with a novel "break-in" system, will be described in detail later.

Receiving mechanism

The receiving mechanisms and related circuits are illustrated diagrammatically only, in Figs. 3 and 4, and it is to be particularly noted that such circuits and such mechanisms are provided at both the sending and receiving machines. It is also to be particularly noted, as described above, that elements of the transmitting mechanism and of the receiving mechanism at any one station are both mounted upon a single shaft 88 for operation by the same clutch 94, as illustrated diagrammatically in Figs. 3 and 4. The receiving mechanism comprises a receive cam RC similar in construction to the transmission cam TC (Fig. 6) and mounted on the same shaft 88 as the transmitting cam, as diagrammatically illustrated in Figs. 3 and 4. This receiving cam controls a plurality of switches R1, R2, R3, R4, R5 and R6, each including at least a pair of switch elements *a* and *b*, and similar to the transmission switches T1 to T6, inclusive, as illustrated in Fig. 6. As is seen from Figs. 3 and 4, the contacts comprising the individual switches R1 to R6, inclusive, are in series with a power source; through the contacts of the send-receive relay, the permutation slide bar magnets M1 to M6, inclusive, and the armature of line relay LR2, for example, and printing magnet PM; and switch R6 is similarly in series with the start-stop magnet solenoid SSM2; whereby the switches R1 to R6, sequentially and selectively control the current through the permutation slide bar magnets and switch R6 controls the energization of SSM2 in accordance with the characteristic of the received code signal permutation elements, respectively. Since the receive cam RC is controlled by the same clutch 94 as the transmitting cam TC, the two cams at

any one machine are rotated in unison. Means are provided, as described in detail later, for rendering the receive cam and its associated switches, at the sending station, ineffective during transmission, while the receive cam, at the receiving station, is released for rotation in step with the transmitter cam at the sending station, all as described later.

Referring to Figs. 7 to 16, inclusive, the construction, arrangement and manner of operation of the signal storage mechanism, including an overlap arrangement, will now be described in detail. This signal storage mechanism is of the mechanical storage type as shown and described in applicants' copending application Ser. No. 398,068, filed June 14, 1941, wherein the translator or permutation slide bars are selectively positioned, in accordance with the character of the respective signal elements comprising a received line code signal permutation, to align a certain series of notches in the respective bars, so that one seeker lever only, will be operated, to thereby operate its associated key lever upon operation of the drop or print bar, when the latter is actuated in response to a timed local impulse from print segment PS of the receive distributor. The translator is mounted in the typewriter directly beneath the key levers and above the permutation unit.

Referring to Figs. 11, 12 and 13, the translator unit is shown as comprising a plurality of five permutation slide bars 138, separated by elongated rollers 139 (Figs. 12 and 13) mounted in openings 140 in the respective slide bars. The bars are slidably mounted on cross members 141. A pair of brackets 142, attached to cross members 141 by screws 143, serve to securely fasten the translator unit in place beneath the key levers. Support members 144 and 145 maintain the bars in proper alignment and prevent lateral separation of the bars. The permutation slide bars are provided with notches arranged in accordance with the Baudot code, so that, upon relative longitudinal arrangement of the bars, selectively in accordance with the elements of a received code signal permutation, only one series of slots will be aligned for any one signal permutation received. A stop member 146 fastened by screws 147 to one of the cross members 141 cooperates with an extension 138a on each permutation bar to limit the longitudinal movement of the bar, when it is released by the permutation bar magnet corresponding thereto. A coil spring 148, is provided for each slide bar, having a hook 148a at one end attached to the corresponding bar by insertion into an opening 138b in the bar and the opposite end is maintained in position by a pin 149 passing through an eye 148b, the pin abutting an angle member 150 attached to one of the cross members 141 by screws 151 (Fig. 11). The permutation slide bars are positioned in their extreme left hand position, by means of the restore magnet RM (Fig. 15) controlling its armature RMA carrying the restore arm 152 extending into each of the notches 138c formed in the permutation slide bars. Upon energization of the restore magnet, as will be described in detail later, its armature is attracted and the restore arm 152 engaging a side of a notch 138c, moves the slide bars against the force of their bias springs 148, to the left, to their extreme left hand position, as illustrated in Fig. 11. A series of permutation slide bar magnets M1 to M5, inclusive, one for each slide bar respectively, is provided and their

armatures provided with latches maintain the slide bars in the extreme left hand position, as described presently, when the magnets are de-energized, and upon energization of the magnets by received signal elements they selectively release the slide bars from said position, in accordance with the particular code signal permutation received. Each of the translator magnets, such as M4 of Fig. 11, for example, is mounted on a frame 153 attached to the front plate 154 by means of screws 155, which plate in turn is attached to the cross members 141 by screws 156. Each magnet is provided with an armature 157, mounted for oscillation about a pair of pivot points 158 carried by frame 153. Armature 157 is provided with a latch member 1571 (Figs. 12 and 14) at one end and is urged to the position as illustrated in Fig. 11 against a stop (not shown) by means of a spring bias member 159 whose biasing force is adjusted by means of an adjustable screw 160. When the restore magnet RM has been energized to restore the slide bars 138 to their extreme left hand position, as illustrated in Figs. 11 and 12, the latches 1571, when magnets M1 to M5 are deenergized, abut a shoulder 138d, on each slide bar 138, to hold the bar in position against the force of its related spring 148. Upon selective energization of any of the permutation slide bar magnets, in accordance with the respective received code permutation elements, the energized magnet, such as M4, for example, attracts its armature 157 to thereby disengage the latch 1571 from the shoulder 138d (Fig. 12) whereupon the spring 148 pulls the slide bar to the right, to the position as illustrated in Figs. 14 and 15. The particular permutation of slide bars, so released, determines the particular array of notches which is aligned, which in turn determines the particular seeker lever that can enter the aligned notches, which seeker lever, upon operation of the print bar, depresses its connected key lever to operate the same, as illustrated diagrammatically in Fig. 2.

As illustrated in Fig. 16, certain of the permutation slide bar magnets, such as M1 and M2, for example, may be provided with novel means whereby the slide bar magnet is maintained energized long enough for the restore magnet to operate fully, which latter operation may not occur until the first and second selecting code signal elements of the next succeeding character signal have been transmitted over the line and received at the receive station, whereby the full signal transmitting capacity of the system may be utilized.

As is seen in Fig. 16, a permutation slide bar magnet such as M1 or M2, for example, comprises a core 161 upon which is wound a low resistance coil 162 of comparatively few turns concentrated at the armature end of the core. In series with coil 162 is a high resistance winding 163 of several thousand turns occupying the heel end of the core and shunted by a storing condenser 164. When the local pulse, corresponding to a received code signal permutation element, is applied to the winding of the corresponding magnet, a rush of current flows through the low resistance winding 162 into the storing condenser 164, which, because of its large capacity, offers comparatively little impedance to such rush of current and hence the current magnetizes the core 162 at the armature end to attract the armature 157 so that the latch 1571 assumes the position as illustrated in Fig. 14. The electrical energy thus stored in condenser 164, combined

with that stored in the coil, maintains the core energized after decay of the local pulse, to thereby hold the armature in the position shown in Fig. 14, for a time interval determined by the electrical constants of the condenser and coil. The armatures 157 of magnets M1 and M2, are thus maintained in the position as illustrated in Fig. 14, until the restore magnet RM has operated its restore arm 152 (Fig. 15) to restore all of the permutation slide bars to the position as illustrated in Figs. 11 and 12, and also until the restore magnet RM has been deenergized, so that the slide bars 138, corresponding to magnets M1 and M2, respectively, are released and moved to the right by their springs 140, so that the respective shoulders 138d are in the position as illustrated in Fig. 15, whereupon the magnets M1 and M2 may release their armatures and latches 157i, without interfering with the setting of the permutation bars in accordance with the first two selecting components of a succeeding received code signal permutation.

Referring to Figs. 8 and 9, there is diagrammatically illustrated therein, a drop or printing bar 165 and its associated operating mechanism. Print or drop bar 165 is supported for movement in a plane parallel to the plane of the permutation slide bars. Novel means are provided for producing movement of the drop bar in response to an element of the code signal permutation received. Referring to Fig. 11, the print bar 165 is supported between tabs 165a and the support members 145, respectively. Piston members 168 (Fig. 9a) mounted for movement vertically in the cross bars 141 (Fig. 8) are provided with rounded ends 166a fitted into corresponding sockets in the print bar. A pair of toggle links 167 are connected to the piston members, respectively, at the lower split end thereof, by means such as a pin 168, and a pair of double toggle links 169, each pair held together by a screw 169a passing through a spacer 169b, are connected at one end to the lower end of link 167, by a combined pin and pivot element 167b (Fig. 9b) and are pivotally mounted at the other end by means of a screw 170 passing through a spacer 171 (Fig. 9) and connected to the bracket 172 which, in turn, is fastened to a cross bar 141 by screws 173. A tie rod 174 is threadedly connected at each end to a clevis 175, respectively, which in turn are respectively connected to the pins 167b. Tie rod 174 is provided with a tie rod operating member 176 fastened to the tie rod whereby the rod is moved longitudinally upon reception of a print signal, as will be described presently. The toggle links are held in normal position against a stop pin 177 on one of the brackets 172 by means of a retractile spring 178, one end of which is fastened to a bracket 179 (Fig. 7) and the other end of which is secured to an adjustable member 180 connected to the tie rod.

As explained in detail later under "Receiving," when the receive cam RC closes its receive switches R1 to R5, inclusive, and a line relay at a receive station is energized in response to a line signal received, the magnets M1 to M5, inclusive, are selectively, sequentially energized and during the last code signal element, the print magnet PM may be energized. On the other hand, the print magnet may also be energized at the same time that magnet M5 is selectively conditioned, as illustrated diagrammatically in Figs. 3 and 4, in which case the print magnet action is slower than that of magnet M5.

Referring to Figs. 2 and 7, the print bar 165 is mounted at one side of the permutation unit slide bars, and the top of the print bar extends above the top of the permutation bars. A plurality of seeker levers SL is provided, one for each key bar and each seeker lever is guided by a comb 154a and rests upon the top of the print bar 165. Each lever is mounted for oscillation about one end 181 thereof, pivoted in the front plate 154. A seeker lever pin SLP, integral with each seeker lever is provided, which pin engages a slot 55s (Fig. 2) in the corresponding key lever. A lug 181a is also provided on the other end of the seeker lever, to which lug is attached a spring 181s which constantly urges the seeker lever against the top of the print bar. Upon depression of the print bar, in the manner as subsequently described, the spring 181s depresses that seeker lever only which is aligned with the particular array of notches in the permutation bars, corresponding to the code signal permutation received, and the key lever attached to the seeker lever is thereby depressed to release its cam 62 to thereby produce typing of the character corresponding to the code signal received.

Referring to Figs. 7 and 10, the manner of operation of the tie rod 174 (Fig. 8) will now be described. Upon energization by a local impulse of the print magnet PM (Fig. 4), its plunger or armature 182 (Fig. 10) is attracted thereby exerting a force on the spring 182a to in turn oscillate the bell crank 183 about its pivot 184 to pull down the print lever 185. Depression of print lever 185, releases its associated power cam 62P which transfers motion through the pull rod 186. Pull rod 186 is threaded at one end to receive the adjustable clevis 187 fastened to the bell crank 188 by a pin 189. Bell crank 188 is mounted for oscillation about a pivot 190 and one arm 188a of the bell crank has a bell shaped end which imparts a sidewise motion to the adjustable shoulder nut comprising the tie rod operating element 176 (see also Fig. 8). Upon motion of the element 176, this element and tie rod 174 are moved longitudinally in the direction of the arrow, as indicated in Fig. 8, against the force of spring 178, and the toggle links 169 and 167 break their alignment and assume a position as shown in Fig. 8 thereby pulling down the piston element 166 to lower the print bar 165. The particular selected seeker lever which is aligned with a chosen array of notches in the actuated permutation slide bars is resting in position on top of the print bar 165 prior to the lowering of this bar. Upon lowering of the print bar, the seeker lever is pulled downwardly by its associated spring 181s and such depression of the seeker lever, by means of its integral pin and slot connection with its associated key bar, depresses the key bar to release its cam to cause printing of the character corresponding to the code signal permutation received so that the character typed on sheet 50 at station A (Fig. 1) by manual operation of the key at that station is likewise typed on the sheet 50 at station B, by the lowering of the print bar 165, all as diagrammatically illustrated in Fig. 2.

Send-receive relay

The send-receive relay SRR1 at the sending machine (Fig. 4) comprises a relay proper of the well known type commonly referred to as a telephone relay. On the core 191 is wound a coil of approximately 3500 ohms resistance comprising the winding W which winding is shunted

by a storing condenser C1. At the heel end of the core is assembled a concentric sleeve or "slug" of copper 192. This assembly comprises a well known, quick acting, slow release relay wherein the relay is quickly energized by an electrical pulse and maintains its armature and associated contacts in attracted position for a period determined by the electrical constants of the respective parts. The relay is so designed that upon energization of the relay by an electrical pulse, even though the energizing pulse is then removed, the energization of the complete relay, including the coil and shunting condenser, maintains the relay armature and associated contacts in the attracted position until the send-receive shaft has rotated from its normal start position (start-stop relay and line energized) to the position wherein the transmission cam TC (Fig. 4) mounted on the shaft 88, closes the contacts comprising switch T6, so that during this rotation all signal components are transmitted through the send-receive relay contacts to the line. As will be explained in detail later, the stop pulse is thereupon transmitted through the send-receive relay to the line so that the send-receive relay is maintained continuously energized during operation of the transmitting device.

Referring to Fig. 4, the operation of the send-receive relay is as follows: It is assumed that the line between stations A and B (Fig. 1) was previously deenergized so that the start-stop clutch 94 was arrested in its preliminary stop position with its stop pin 96 in engagement with the stop pawl 95a as illustrated schematically only, in Fig. 3. In this position, the latch cam 104 permits the contact 198 to move into engagement with the contact 198a (Fig. 4) so that the latch magnet LM will be energized, as explained in detail later, the contacts 198 and 198a in Fig. 4, however, being illustrated as separated since the clutch 94 is in the normal stop position in Fig. 4. The send-receive relay is deenergized under the conditions just assumed and since the line is also assumed to be deenergized, the line relay LR1 (Fig. 3) has its armature in the spacing position or, in other words, in engagement with contact S so that the circuit through the start-stop relay SSM1 (Fig. 3) at station A, is open at contact M, and relay SSM1 is deenergized to release its armature and stop arm 95.

In order to energize the line, which is the normal condition for operation in the present system, and referring to Fig. 3, which illustrates in skeleton outline the essential circuits of a complete system, the send-receive switches 193A and 194A at the send station A will be closed to the S or send contact and the send-receive switches 193B, 194B and 195B at the receive station B will be closed to the R or receive contact.

Upon closure of send-receive switch 193A at station A, for example, to the send position, with switch 193B at station B in the receive position, the following circuit is closed: From battery B1 at station A, switch arm 87UX of the universal bail rock-shaft, switch arm 87UXa of the universal bail switch, to one contact of switch T6, and since switch T6 is closed by the transmitter cam TC, through the other contact of switch T6, and the circuit continues through line 194, the S contact of switch 193A, line relay LR1, over the line to line relay LR2, contact R of switch 193B to ground. Energization of line relays LR1 and LR2 moves their respective armatures into engagement with the marking contact M, as illustrated in Fig. 4. Upon engagement of the arma-

ture of line relay LR1 with its contact M, a circuit is closed (Fig. 3) from battery B1, line 195, the contacts of receive switch R6 closed by cam RC, start-stop magnet SSM1 at station A, line 196, contact M, armature of LR1 to ground, whereupon the armature SSMA of magnet SSM1 is attracted to move the stop arm 95 against the force of spring 95s to the position as shown in Fig. 4 so that pin 96 will engage pawl 95b, as illustrated in Fig. 4, to stop the clutch 94 in the normal stop position.

At the same time that magnet SSM1 is energized at station A, the movement of the armature of line relay LR2 into engagement with its contact M, closes the following circuit: from battery B2 at station B, line 195, the contacts of receive switch R6 closed by cam RC, line 196, start-stop magnet SSM2, line 196a, contact M of relay LR2, to ground, whereupon the armature of magnet SSM2 is attracted to move the stop arm 95 at station B against the force of spring 95s to the position as shown in Fig. 4 and the pin 96 of the start-stop clutch 94 at station B will engage pawl 95b, as illustrated in Fig. 4. The line is therefore energized and the devices at stations A and B are conditioned, ready for the reception of the start signal or spacing line condition.

Referring to Fig. 4, there is illustrated in greater detail, the circuits and elements comprising a complete send and receive system of a plurality of stations. The switches 193A and 194A, as diagrammatically illustrated only, in Fig. 3, are incorporated into the contacts controlled by the send-receive relay SRR1 while the switches 193B, 194B and 195B, as diagrammatically illustrated only, in Fig. 3, are incorporated into the contacts controlled by the send-receive relay SRR2. The line and send-receive relay SRR1 are illustrated in Fig. 4 in an energized condition and SRR2 in a deenergized condition with the start-stop clutches in the normal stop position and the line relays in the marking condition. In order to produce this illustrated energization of the line and to place the relay SRR1 in energized or sending condition and the relay SRR2 in deenergized or receiving condition, the key SRK1 is depressed, thereby closing the following circuit: from battery B1, contacts 87UX, 87UXa, contacts of the transmission switch T6, line 194 to coil W of relay SRR1, the switch blade of key SRK1, contact 196 to ground, thereby charging the condenser C1 and energizing the coil W of the relay SRR1 so that the armature 197 is attracted to close certain of the cooperating contacts of the relay among which are contacts 193a, 193b and 193c corresponding to switches 193 of Fig. 3, contacts 194a and 194b corresponding to switches 194 of Fig. 3 and contacts 195a and 195b corresponding to switches 195 (only one shown) of Fig. 3 and to hold the relay energized for a predetermined period, even after removal of the energizing pulse, as described above. When the start-stop clutch is in its preliminary stop position, the energization of relay SRR1 produced by depression and release of the key SRK1 thereby closes the following holding circuit: from battery B1 (Fig. 4), contacts 87UX, 87UXa, switch T6, line 194, coil W of relay SRR1, switch blade of key SRK1, contact 196a, relay contacts 193a and 193b of SRR1 corresponding to switch 193A (Fig. 3) in the send position, coil of line relay LR1 to the line and to the coil of line relay LR2, contacts 193b and 193c of relay SRR2, corresponding to switch 193B of Fig. 3 in the receive position, to ground, thereby maintaining the relay SRR1 en-

energized. Energization of the line and of the coil of line relay LR1 causes the armature of LR1 to move to marking position and thus into engagement with contact M, as described above in connection with Fig. 3 and as illustrated in Fig. 4 so that a circuit is closed through the start-stop magnet SSM1 to cause it to attract its armature to allow the clutch 94 to rotate until its stop pin 96 is engaged by pawl 95b, as illustrated in Fig. 4, and the clutch is thereupon stopped in the normal stop position ready to be controlled by the start signal or spacing line condition.

Speed lock system

Referring to Figs. 4 and 5, there is disclosed therein the speed lock or "lockout" circuit and mechanism used to control a keyboard for preventing depression of more than one key of a keyboard during a particular signal period. The mechanism comprising the "lock-out" was described above and comprises a part of the novel "break-in" system.

Upon depression of any chosen character key of the typewriter keyboard, the universal bail contacts 81UX and 81UXa open, thus breaking the line circuit, deenergizing the line relays and causing transfer of the line relay tongue from the marking contact M to the spacing contact S so that start-stop magnet SSM1, for example, is released, to permit rotation of the start-stop clutch carrying the latch contact operating cam 104 (Figs. 4 and 17). Upon depression of any chosen character key to break the line circuit, as described above, and before cam 104 operates, the universal bail contacts are transferred to close the following circuit: from battery B1, universal bail contact 81UX, contact 81UXb, line 87c, contacts 195a and 195c, line 200b, line 200a, latch magnet LM, line 201, contacts 202, 202a to ground. The latch magnet is held energized until cam 104 operates.

As cam 104 rotates from the position as shown in Fig. 4, which is the normal stop position of the clutch, the contact 198 is moved from a position mid-way between contacts 198a and 198b and is moved into engagement with contact 198b to close a holding circuit through the coil of the speed lock magnet LM as follows: from battery B1, line 195, contact 199 of send-receive relay SRR1 now energized, contact 199a, contacts 198b and 198, line 200, line 200a, latch magnet LM, line 201, contacts 202 and 202a, to ground. The latch magnet will remain closed due to closure of contacts 198 and 198b by cam 104, until shortly before the end of the cycle, thereby maintaining the "lock-out" lever 128 (Fig. 5) in its lower position and preventing depression of any other key, or even repeated depression of the same key, as described above, until the distributor cam TC has transmitted all the elements of the signal.

Break-in system

The speed lock arrangement above described is utilized as one of the elements of a novel "break-in" arrangement. Assuming that during transmission of a message, the operator at receive station B wishes to interrupt and reverse the direction of transmission; the operator thereupon depresses the key SRK2 at station B (Fig. 4) and holds this key down until the send-receive relay SRR1 at station A has time to become completely deenergized. When key SRK2 at station B is depressed, the following circuit is closed: from battery B2, universal bail contacts 81UX and 81UXa, switch T6, line 194 at station 75

B, coil W of send-receive relay SRR2 in parallel with condenser C2, the blade of send-receive key SRK2, contact 196 to ground. Energization of the send-receive relay SRR2 causes transfer of its associated contacts and upon opening of contacts 193b and 193c of relay SRR2, the line circuit from station A, to ground at station B, is interrupted, and since key SRK2 is maintained depressed, as stated above, relay SRR1 is completely deenergized. Such interruption, therefore, since it deenergizes relay SRR1 at station A causes transfer of its contacts to the receive, or normal position.

The keyboard "lockout" at station A is controlled from station B during "break-in" as presently described in detail, to prevent depression of any character key at station A to thereby indicate to the operator at station A that the line circuit has been interrupted from receive station B and that the operator at station B wishes to take over. As long as the key SRK2 at station B is depressed to interrupt the signal and to open the line, the line relays LR1 and LR2 are deenergized and their armatures are transferred from the marking contacts M to the spacing contacts S. Upon such transfer, the start-stop magnet circuits at both stations are opened at the marking contacts M and the start-stop magnets at both stations are deenergized thereby releasing the stop arms 95 which interrupt the rotation of the start-stop clutches by engagement of pins 96 with pawls 95a so that the clutches are in the preliminary stop position. In this position, cams 104 at both stations permit contacts 198 and 198a to close and the coil of the speed lock magnet LM at station A only is energized by means of the following circuit: Battery B1, line 195, contacts 202b, 202 of send-receive relay SRR1, now deenergized, line 201, coil of magnet LM, line 200a, line 200, contacts 198 and 198a, line 203, contacts 204, 204a of SRR1, line 205 of the spacing contact S of line relay LR1, armature of relay LR1 to ground. Upon release of key SRK2 at station B, the send-receive relay SRR1 at station A remains deenergized but it is to be noted that line relay LR1 at station A is thereupon energized from station B which thereupon closes a circuit through the start-stop magnet SSM1 to energize the same so that the stop arm 95 at the station A is attracted and clutch 94 is released for rotation until the stop pin 96 engages the pawl 95b, as illustrated in Fig. 4, and the clutch 94 is rotated so that cam 104 moves the contact 198 to the position mid-way between contacts 198a and 198b, as illustrated in Fig. 4, to thereby interrupt the circuit through the coil of magnet LM to release "lockout" lever 128 (Fig. 5) controlled thereby, as described above, and spring 129 raises the lever 128 to the top of the slot 131 and out of engagement with the rollers 126 so that the keyboard at station A is released. As long as the operator at station B, however, holds down the key SRK2, the "lockout" at station A is operated and the operator at station A cannot transmit and is thereby warned that station B wishes to take over. When SRK2 is released at station B, relay SRR2 is held energized by a holding circuit as follows: from battery B2, universal bail contacts 81UX, 81UXa, switch T6, line 194, coil W and condenser C2 in parallel, the switch blade of send-receive key SRK2, contact 196a, contacts 193a and 193b of relay SRR2, line relay LR2, to the line, to line relay LR1, contacts 193b and 193c of SRR1 to ground. Re-

lay SRR2 is now in a send condition and relay SRR1, as stated above, is in the receive or de-energized condition instead of its previous send condition and the "lockout" at station A is released. It is to be noted that the start-stop clutches at both stations has been arrested in their normal stop positions.

Signal light

A neon glow tube NL, as illustrated in Fig. 4, is incorporated into the teleprinter system to indicate to the operator the condition of his send-receive relay. When the neon tube glows, the operator is assumed that the relay at his station is in the send condition and that the station is thereby prepared for sending. The circuit through the neon tube is established as follows: Upon depression of key SRK1 at station A, for example, a circuit is closed as follows: from battery B1, line 195, contacts 194a and 206, since the send-receive relay SRR1 is energized, via the neon tube NL, marking contact M, armature of the line relay LR1, to ground. During transmission of signals, it is to be noted, that the transfer of the tongue of relay LR1 from marking to spacing, momentarily interrupts the continuous glow of the neon tube in accordance with the particular permutation of line signal elements.

Sending

While the respective elements comprising a complete sending and receiving system and the specific operation have been described in detail, individually, a complete sending operation will now be briefly described in order to bring out the specific coordination among the several elements of the novel system in the transmission of a code signal permutation representing a character, and a complete receiving operation will subsequently be briefly described.

After the station A, for example, has been conditioned for sending, by depression of the key SRK1, the send-receive relay SRR1 is energized and the start-stop clutch is in the normal stop position, as illustrated in Fig. 4, with relay SSM1 energized and stop arm 95 as illustrated. Thereupon, depression of a chosen character key (Fig. 2) produces a corresponding setting of the permutation unit switches in accordance with the code value of the character and the universal bail contacts 8TUX and 8TUXa are opened while contacts 8TUX and 8TUXb are closed. Assuming that the permutation unit switches are positioned as illustrated in Fig. 4, in which succeeding permutation switches are illustrated as alternately opened and closed, the disengagement of the universal bail contacts 8TUX and 8TUXa, deenergizes the circuit through these contacts to the contacts 193a and 193b of the send-receive relay, traced as previously described, so that the line relay LR1 and the line are deenergized. The armature of the line relay LR1 moves from engagement with contact M into engagement with contact S, the start-stop magnet SSM1 is deenergized, arm 95 is released and oscillated counterclockwise by its spring 95a and the clutch 94, being in the normal stop position, as illustrated in Fig. 4, is released, since pawl 95b releases the pin 96 (see also Figs. 25b and 25c) to thereby permit clutch 94 to begin its one complete rotation. The release of the clutch 94 permits engagement of its driving pins, as described above, so that the transmission cam TC, the latch contact operating cam 104, the circuit breaker

cam 109 and the receive cam RC are all rotated to operate, respectively, switches T1 to T6, inclusive (Figs. 4 and 6), contact 198 (Fig. 4), contacts 109a and 109b (Fig. 4) and switches R1 to R6, inclusive (Fig. 4) which switches R1 to R6, inclusive, are constructed generally like switches T1 to T6, inclusive (Fig. 6) as stated above.

Upon operation of the universal bail rock-shaft, contact 8TUX engages contact 8TUXb and since relay SRR1 is energized, the following circuit is closed: from battery B1, contacts 8TUX, 8TUXb, line 87c, contact 195a, contact 195c, line 200b, line 200a, latch magnet LM, line 201, contacts 202, 202a, latch magnet LM, line 201, contacts 202, 202a, to ground, so that latch magnet LM is energized and the keyboard at station A is locked out so that no second character key can be depressed. As start-stop clutch 94 rotates, the latch cam 104 operates contact 198 to move it into engagement with contact 198b to close the following holding circuit through latch magnet LM during one complete revolution of the start-stop clutch: from battery B1, line 195, contact 199, contact 199a, contact 198b, contact 198, line 200, line 200a, latch magnet LM, line 201, contacts 202, 202a to ground. This circuit holds latch magnet LM energized during one complete revolution of start-stop clutch 94 and hence locks up the keyboard so that no second key can be depressed until the complete signal corresponding to the chosen key depressed has been completely transmitted over the line.

Also upon rotation of start-stop clutch 94, the contacts comprising switch R6 at station A are opened so that the circuit through start-stop magnet SSM1 is open at switch R6 and therefore this magnet is free of all changes in line conditions until the last signal component is transmitted, which as previously stated, is an "on" line condition and since at this time the contacts of switch R6 are again closed, magnet SSM1 will be energized to attract its armature 95 against the force of spring 95s and the start-stop clutch will be stopped, as illustrated in Fig. 4.

Since, under the conditions as assumed and as illustrated in Fig. 4, the permutation unit switch P1 is closed, the closure of switch T1, upon rotation of cam TC, places a marking condition upon the line by means of the following circuit: battery B1, contacts 87, and 87a of permutation switch P1, the switch blades of transmitting switch T1, line 194, coil W of relay SRR1, the switch blade of send-receive switch SRK1, contact 196a, line 207, contacts 193a and 193b of relay SRR1 (now energized), the coil of line relay LR1 to the line. Energization of the coil of the line relay LR1 produces movement of its armature from the spacing contact S to the marking contact M. It is to be noted, as stated above, that the circuit through the start-stop magnet SSM1 is open, since switch R6 is open, so that the line signal has no effect upon the start-stop magnet. The marking impulse continues from line relay LR1, over the line to the coil of line relay LR2 at station B (Fig. 1), contacts 193b and 193c of the send-receive relay SRR2 to ground. The energization of relay LR2 produces movement of its armature from the contact S to the contact M which produces a receiving effect, as will be described in detail later.

As the start-stop clutch 94 continues to rotate on its single complete revolution, the contacts of the transmitting switch T2, as controlled by cam TC, will be sequentially closed, but since the permutation switch P2 is in the open posi-

tion, as illustrated in Fig. 4, a spacing impulse is transmitted over the line and the armatures of line relays LR1 and LR2 are shifted into engagement with the spacing contacts S.

As indicated in Fig. 4, the permutation switch P3 is closed so that a marking condition occurs on the line and the line relays LR1 and LR2 transfer their armatures back from the contacts S to the contacts M. Since the start-stop magnet SSM1 at station A is no longer affected by the line relay LR1, the marking signal transmitted through the permutation switch P3 has no effect at station A. Upon receipt of the marking impulse at station B, however, the line relay LR2 transfers its armature from engagement with contact S to engagement with contact M to produce a receiving effect, similar to that corresponding to closed permutation switch P1, but since the start-stop magnet SSM2 at station B was deenergized at the same time as magnet SSM1 at station A, the start-stop clutches 94 at stations A and B are rotating in synchronism, so that the marking impulse, corresponding to P3, will affect a different element at station B than did the marking impulse corresponding to P1, as described in detail later.

As the start-stop clutch continues to rotate, the particular character code signal elements set up by the permutation switches P1 to P5, inclusive, are transmitted to the line by sequential closure of the switches T1 to T5, inclusive, which line conditions affect the line relay LR2 at station B in accordance with the electrical quality (marking or spacing) of the individual components, to thereby produce a receiving function characteristic of the particular character code combination, as will be explained presently. As the cam TC closes the contacts of switch T6, the cam RC at station A closes the contacts of switch R6 and since the contacts 87UXa and 87UX at station A, in the meantime have reclosed, following the release of the chosen character key, a stop signal of uniform duration, as determined by the rotation of the transmitting cam TC, is transmitted from battery B1, contacts 87UX, 87UXa, contacts of switch T6, line 194, coil W of relay SRR1, switch blade SRK1, contact 196a, line 207, contacts 193a and 193b of send-receive relay SRR1, through the coil of line relay LR1 at station A over the line to the coil of line relay LR2 at station B, contacts 193b and 193c of relay SRR2 at station B, to ground. Energization of line relay LR1 transfers its armature into engagement with contact M. Since the cam RC at station A has closed the contacts of switch R6, as described above, the start-stop magnet SSM1 is again controlled by the line conditions and a circuit is closed from battery B1, line 195, contacts of switch R6, line 196, magnet SSM1, line 196a, contact M, the armature of line relay LR1, to ground, whereupon the magnet SSM1 is energized to attract its arm 95 into position so that pawl 95b engages the stop pin 96 whereby the clutch 94 is disengaged and stopped in its normal stop position, as illustrated in Fig. 4, after a single complete revolution, with cam TC closing the contacts of switch T6 and with cam 104 holding contact 198 mid-way between contacts 198a and 198b.

The code signal permutation elements corresponding to the chosen depressed character key are, therefore, transmitted, as set out above, over the line to the receive station, and the single revolution clutch is released from the normal stop position, as illustrated in Fig. 4, and sub-

sequently stopped at the normal stop position, as shown in Fig. 4, so as to be ready to transmit the next succeeding character code signal combination.

Receiving

Referring to Fig. 4, when station A is condition for sending, the send-receive relay SRR1 is energized, as illustrated, and the start-stop clutch is in the normal stop position, as shown, with the start-stop magnet SSM1 energized. The line relays LR1 and LR2 are energized and their respective armatures are in engagement with the respective marking contacts M. The send-receive relay SRR2 is deenergized, as illustrated, and the start-stop clutch 94, at the receive station B, is in the normal stop position and start-stop magnet SSM2 is energized.

Upon depression of a chosen character key at station A; with consequent opening of the universal ball contacts, whereby the line is deenergized for the duration of a single element period and the line relay armatures are moved from engagement with contacts M into engagement with contacts S, respectively; the magnet SSM1 at station A is deenergized, as explained above, and the stop arm 95 is released and start-stop clutch 94 is started on its one complete revolution. Likewise, magnet SSM2 at station B is deenergized, the stop arm 95 at station B is released and its associated start-stop clutch 94 is released for one complete revolution, simultaneously with the release and rotation of the start-stop clutch 94 at station A. When station A has completed transmission of all of the selecting code elements comprising the character signal proper (five elements of code, excluding the start element) the universal ball contacts at station A having been closed upon release of the chosen depressed character key, and a stop (marking) signal element having been transmitted, through closed switch T6 at station A, over the line as described above, so that the armatures of line relays LR1 and LR2 are in engagement with their respective contacts M, then magnets SSM1 and SSM2 are energized and the stop arms 95 at stations A and B are attracted so that the stop pins 96 engage the respective stop pawls 95b and the start-stop clutches at stations A and B are stopped, at the end of a single revolution, in the normal stop position. The start signal element and the stop signal element, namely, the No. 1 and No. 7 components of a full complete signal, serve therefore to maintain the start-stop clutches 94 at stations A and B, in synchronism, while the line signal sequences are directly controlled by the sending distributor, thereby assuring accurate timing of these sequences.

Since the start-stop clutches 94 at both stations are rotating in synchronism subsequent to the transmission of the No. 1 component or start element of the full complete signal, the five selecting components of the signal comprising the characteristic code signal proper, (excluding the start and the stop components) can be utilized to sequentially affect elements at the receive station in a predetermined time sequence to thereby produce results representative of the particular character, as represented by the particular quality of the sequential components and their particular sequence in the code signal permutation.

Referring to Fig. 4, it is noted that the send-receive relay SRR2 thereof is illustrated in a de-

energized condition, which condition corresponds to a receiving condition. Before reception of the first or "start" component of a full complete signal, cam TC is in the position shown in Fig. 4, with the contacts of switch T6 in engagement, the start-stop clutch being, as shown, in the normal start position, and contact 198 controlled by cam 104 being mid-way between contacts 198a and 198b, as illustrated.

Were the start-stop clutch in the preliminary stop position, such as occurs when station B "breaks in" and the line is deenergized, the clutch at station A would also be in the preliminary stop position, the cam 104 would permit contact 198 to move into engagement with contact 198a to close a circuit through latch magnet LM at station A, as previously described, and the typewriter at station A would be locked up until the key SRK2 at station B is released, all as described above.

Assuming that a complete signal is to be transmitted in accordance with the conditions as illustrated in Fig. 4 and the setting of the permutation unit switches P1 to P6, inclusive, as illustrated in Fig. 4, the following ensues: After the first or "spacing" component of the full complete signal which component is the start element and which releases the start-stop clutches of the two machines at the respective stations, as stated above; the selecting code elements or the No. 2 to No. 6 elements of the complete signal, are transmitted from station A by means including the permutation switches P1—P6, shown alternately as closed and open in Fig. 4, and if the elements are marking pulses, the line is energized, as above described, and the armature of line relay LR2 is moved into engagement with contact M. This partly closes circuits through the permutation slide bar magnets M1 to M5, inclusive, which circuits are respectively sequentially completed, as the start-stop clutch rotates and the receive cam RC at station B, sequentially closes the switches R1 to R6, provided, as stated, that the code elements are marking impulses and the armature of line relay LR2 is therefore in engagement with the M contact, so that circuits will be sequentially closed or not closed through the permutation bar magnets, selectively, in accordance with the electrical quality of the respective line signal elements.

Since permutation switch P1 is shown as closed at station A, the armature of line relay LR2 at station B is in engagement with contact M and at this same time, since clutches 94 are simultaneously released and rotate in synchronism, switch R1 is closed by cam RC so that a circuit is completed as follows: from battery B2, line 195, contacts 194a and 194b of relay SRR2 (deenergized) line 208, switch R1, line 209, permutation slide bar magnet M1, line 210, contacts 109b and 109a of circuit breaker cam 109, contact M, armature of line relay LR2, to ground. The circuit breaker 109 opens the circuit at contacts 109b and 109a before the contacts of the switches R1 to R6, inclusive, are respectively opened, thereby preventing sparking at the contacts comprising these switches.

Since permutation switch P2 is open, line relay LR2 will be deenergized when switch R2 at station B is closed and the armature of line relay LR2 will be in engagement with contact S and no circuit will be closed through magnet M2.

In accordance with the illustration in Fig. 4, only magnets M1, M3 and M5 will be selectively energized. As described above in connection with

Figs. 11 to 16; inclusive, selective energization of the magnets M1, M3 and M5, permits the permutation slide bars 138 controlled by these respective magnets, to be pulled to the right, as viewed in Fig. 14, by their cooperating springs 148, respectively, and the ensuing relative arrangement of the five permutation bars aligns a certain group of notches to permit only that one of the seeker levers 181 (Figs. 2 and 7) corresponding to the particular code permutation received, to be selected for operation by the one aligned group of the notches in the slide bars. As switch R5 is closed, since the armature of line relay LR2 is in engagement with contact M, under the conditions as assumed above, the permutation bar magnet M5 is energized and also, at the same time, as illustrated in Fig. 4, a circuit is closed through the print magnet PM. The printing mechanism introduces a delay, so that the permutation slide bar corresponding to magnet M5 is positioned, before printing can be accomplished. Upon energization of the print magnet PM the tie rod operating element 176 (Figs. 8 and 10) is moved by the interconnecting elements, as illustrated in Fig. 10 and as described above, to actuate the tie rod 174 as illustrated by the arrow, and the toggle mechanism of Fig. 8 is operated, as previously described, to lower the print bar 165 to the position as shown in Fig. 8. Depression of print bar 165 (Fig. 7) to the position as shown in Fig. 8 permits one seeker lever only, to enter the particular single array of notches, under control of its associated spring 181s, and the seeker lever pin SLP engaged in the slot 55s (Fig. 2) of its associated key lever, depresses the key lever to thereby produce typing of the character represented by the particular permutation bar setting and hence of the particular code permutation signal received. The same character is therefore typed on the record 50 at both stations A and B.

Upon signal operated depression of the corresponding key lever at station B, as just described, the universal bail switch contacts 87UX and 87UXb are moved into engagement thereby closing (Fig. 4) the following circuit: from battery B2, switch blade 87UX, switch contact 87UXb, line 87c, contact 195a, contact 195b, line 211, restore magnet RM (see also Fig. 15) to ground. Energization of the restore magnet RM (Fig. 15) attracts its armature RMA to move the connected restore arm 152 so that the operated permutation slide bars corresponding to magnets M1, M3 and M5, respectively, are returned to their original positions against the bias of springs 148. Since magnets M1, M3 and M5 are now all deemed to be deenergized, the latches 1571 respectively engage the shoulders 138d (Fig. 12) on the associated slide bars 138 and these bars are now held in their original position. At the same time as the bars are being restored the universal bail switch blade 87UX is returned to its normal position in engagement with contact 87UXa.

If the system is operated at full capacity, magnets M1 and M2, for example, may be energized, by the first and second selecting code elements, of a succeeding signal, to attract their armatures and associated latches 1571, and these armatures might also be released before the restore magnet RM (Fig. 15) has completed the restoration of the permutation slide bars to their original position. However, as described above, such a condition is overcome since the magnets M1 and M2 are provided with the circuit elements, as illus-

trated in detail in Fig. 16. As explained in detail above, the magnets M1 and M2, when provided with the particular coil and condenser arrangement of Fig. 16, will, when energized by a received signal element, remain energized, and will hold their armatures and associated latches out of the path of the shoulders 138d on the associated slide bars, until the restore magnet RM has completely returned the slide bars to their original position and the restore arm 152 has been released so that the bars corresponding to the magnets M1 and M2 will be pulled to the right by their springs 148 before the magnets M1 and M2 are deenergized. Therefore, when M1 and M2 are deenergized, their latches will not intercept the shoulders 138d on the slide bars 138, respectively. Novel means are therefore provided for producing a desired overlap whereby the capacity of the system may be fully and effectively utilized.

During the receiving operation, it is to be noted from Fig. 4 that the print contacts controlled by the cam RC are opened before the start-stop clutch is stopped by the stop pawl. During the last signal interval of a complete signal, which is always a "marking" line condition, the start-stop magnet SSM2 is energized to thereby stop the clutch 94 at station B in the normal stop position, as illustrated in Fig. 4, the clutch 94 at station A being stopped in synchronism.

Novel start-stop clutch and single revolution producing means, novel ranging means, novel means for producing shift and carriage-return signals, novel means for "break-in" including "lockout," and novel means for producing overlap and consequent full utilization of the system capacity are therefore provided.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a system for interconnecting a plurality of typewriters, having keyboards, for reciprocal control of the respective corresponding key bars, the combination of means at each typewriter controlled by each key respectively for setting up differentially, code combinations of signal elements in accordance with the code value of the selected key character, a plurality of permutation bars, one for each selecting element of code, for selectively conditioning said key bars for individual operation by remote control, a magnet for controlling each of said permutation bars, a single channel conductively interconnecting said typewriters, an electromagnet at each typewriter electrically connected to said conductive connection, means for sequentially transmitting the respective signal code elements representative of a particular character, at one typewriter, and distributor means, operative in step with said transmitting means, for sequentially receiving said code signal elements, means electrically connecting said receiving distributor means and said permutation bar magnets, and means controlled by said electromagnets, respectively, and cooperating with said receiving distributor means to selectively condition said permutation bar magnets in accordance with signal code elements received

whereby said permutation bars are selectively set in accordance with the received character code combination, means for resetting said bars under control of a transmitted signal, and means controlling the conditioning of certain of said permutation bar magnets whereby these magnets are maintained conditioned for a period longer than the duration of respective received signal elements to permit operation of said resetting means during a portion of the transmission of a succeeding code signal combination.

2. In a system for interconnecting a plurality of typewriters, having keyboards, for reciprocal control of the respective corresponding character key bars, means at each typewriter for setting up a signal code combination of signal elements in accordance with a character to be typed, means for conditioning one of said typewriters for sending and simultaneously conditioning another for receiving, start-stop means for distributing the code combination elements corresponding to a selected character, a lock-out for said keyboard, an electromagnet for controlling said lock-out, means controlled by one line condition for stopping said start-stop means in one position, means controlled by another line condition for stopping said start-stop means in another position and contact means controlled by said start-stop means in one of said positions for controlling the energization of said electromagnet, and means at said other typewriter for changing over said other typewriter from a receive condition to a send condition and for simultaneously changing the line condition to control said start-stop means.

3. In a system for interconnecting a plurality of typewriters, having keyboards, for reciprocal control of the respective corresponding character key bars, a line interconnecting said typewriters, means at each typewriter for conditioning one typewriter for sending and simultaneously conditioning another typewriter for receiving, start-stop means at each typewriter, means controlled by one line condition for stopping said start-stop means in one position and controlled by another line condition for stopping said start-stop means in another position, keyboard lock-out means at each typewriter, a solenoid for controlling said lock-out means, contacts controlled by said start-stop means for energizing said solenoid in one position of said start-stop means and for deenergizing said solenoid at another position of said start-stop means, and break-in means at said other typewriter for controlling the position of said start-stop means.

4. In a system for interconnecting a plurality of typewriters, having keyboards, for reciprocal control of the respective corresponding character key bars, a send-receive magnet at each typewriter, contacts controlled by said send-receive magnet, a start-stop distributor, means controlled by one line condition for initiating operation of said start-stop distributor, keyboard lock-out means, means including said magnet controlled contacts and rendered effective upon operation of a chosen character key bar for rendering said keyboard lock-out operative, and means operative upon initiation of operation of said start-stop means for maintaining said lock-out means operative for a full revolution of said start-stop means.

5. In a system for interconnecting a plurality of typewriters, having keyboards, for reciprocal control of the respective corresponding character key bars, a send-receive magnet at each typewriter, contacts controlled by said send-receive

magnet, a start-stop mechanism including a distributor, a solenoid, a double-stop armature controlled by said solenoid, means on said start-stop mechanism cooperating with one of the stop elements of said armature in one electrical condition of said solenoid to stop said mechanism at one position and cooperating with the other one of said stop elements for stopping said mechanism at another position in another electrical condition of said solenoid, lock-out means for said typewriter key bars, an electromagnet for controlling said lock-out means, contacts controlling said electromagnet and controlled by said start-stop mechanism at one position thereof to energize said electromagnet and at the other position thereof to deenergize said electromagnet, means for simultaneously energizing the send-receive magnet at one typewriter and deenergizing the send-receive magnet at another typewriter, means controlled by a chosen key bar for initiating operation of said start-stop mechanism, and for stopping said mechanism subsequently at one of said stop positions, and break-in means at another typewriter for stopping said start-stop means at the other of said stop positions to render said lock-out means operative.

6. In a start-stop communication system employing a definite interval code, the combination of a pair of communication devices, a line circuit interconnecting said devices, each device comprising a set of transmitting selector switch elements, a start-stop mechanism, a set of switches controlling the effect of said selector elements, respectively, a distributor element for operating said controlling switches, successively, carried by said start-stop mechanism whereby said line is maintained selectively open or closed in accordance with the setting of said transmitting selector elements, means for holding said distributor in its initial position during one line condition, means controlling said start-stop means, respectively, for releasing said distributor for rotation thereof upon change of said line condition, a receiving distributor including a distributor element controlled by its associated start-stop means, and means at one device controlled by a change in line condition produced at another device to release the start-stop means at said one device simultaneously with release of the start-stop means at said other device whereby said sending and receiving distributor mechanisms are simultaneously and synchronously rotated upon release of said sending distributor means, and means for independently adjusting the relative rotative positions of said distributor elements and said control switches.

7. In a device of the character described, means for producing case shift and including a pair of key bars, and means controlled by operation of one of said key bars for producing a signal, represent-

tative of shift to one case position, and means controlled by the other of said key bars for producing a code signal combination, representative of the shift to the opposite case, and means controlled upon operation of said one key bar for locally producing a shift to one case position, and means effective upon operation of said other key bar to control said last named controlled means to produce a shift to the other case position.

8. In a device of the character described, a first lever, means controlled by said lever for setting up a code signal combination representative of a desired function, a second lever, means controlled by said second lever for performing said desired function, a pivoted lever controlled by said first lever and controlling said second lever, and means for holding said pivoted lever in one of its pivotal positions.

9. In a device of the character described, a first lever, means controlled by said lever for setting up a code signal combination representative of a desired function, a second lever, means controlled by said second lever for performing said desired function, a pivoted lever, means connecting said second lever to said pivoted lever for operation thereby, a third lever, said pivoted lever being oscillated to one pivotal position by operation of said first lever and oscillated to another pivotal position by operation of said third lever, and means for frictionally holding said pivoted lever in one or the other pivotal position.

10. In a device of the character described, a first lever, power cam means controlled by said lever, means controlled by said power cam means for setting up a code signal combination representative of a desired function, a second lever, power cam means controlled by said second lever for performing said desired function, a pivoted lever, means connecting said second lever to said pivoted lever, a third lever, power cam means controlled by said third lever, means controlled by said power cam means for setting up a code signal combination representative of another desired function, said pivoted lever being oscillated to one pivotal position by operation of said first lever and being oscillated to another pivotal position by said third lever, and means for frictionally holding said pivoted lever in one or the other pivotal position.

11. In a device of the character described including a carriage and carriage-return mechanism, a lever, cam means controlled by said lever for producing carriage-return, a second lever, means controlled by said second lever for setting up a code signal combination representative of a carriage-return function, and means interconnecting said levers for simultaneous operation thereof comprising a pivotally mounted coupling member.

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