July 25, 1939. V. SIMS 2,167,532

TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 1.

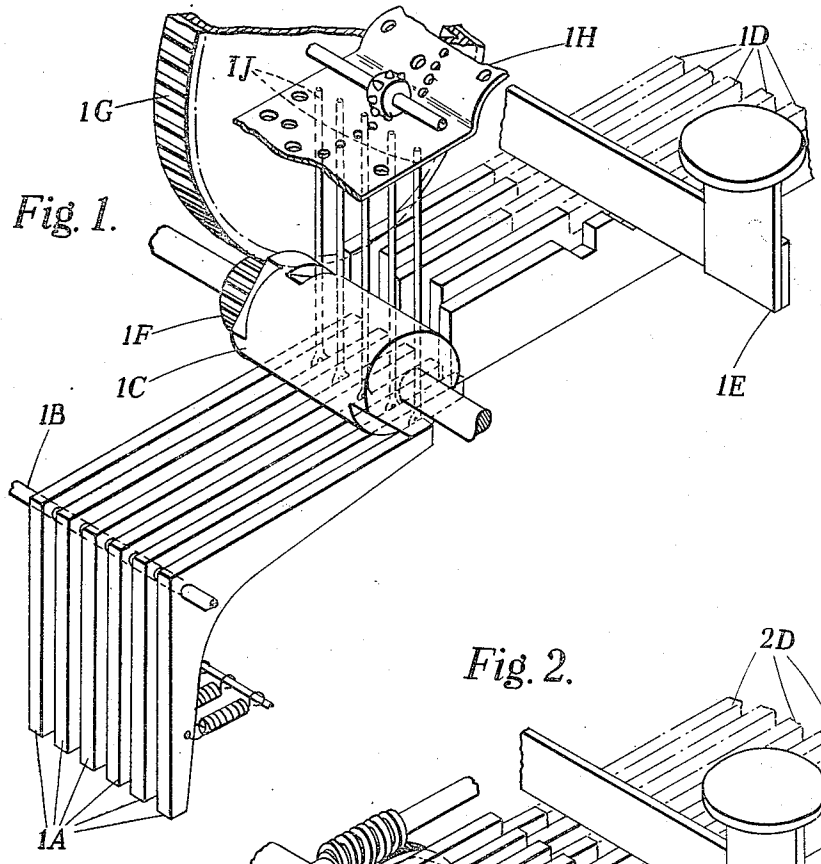
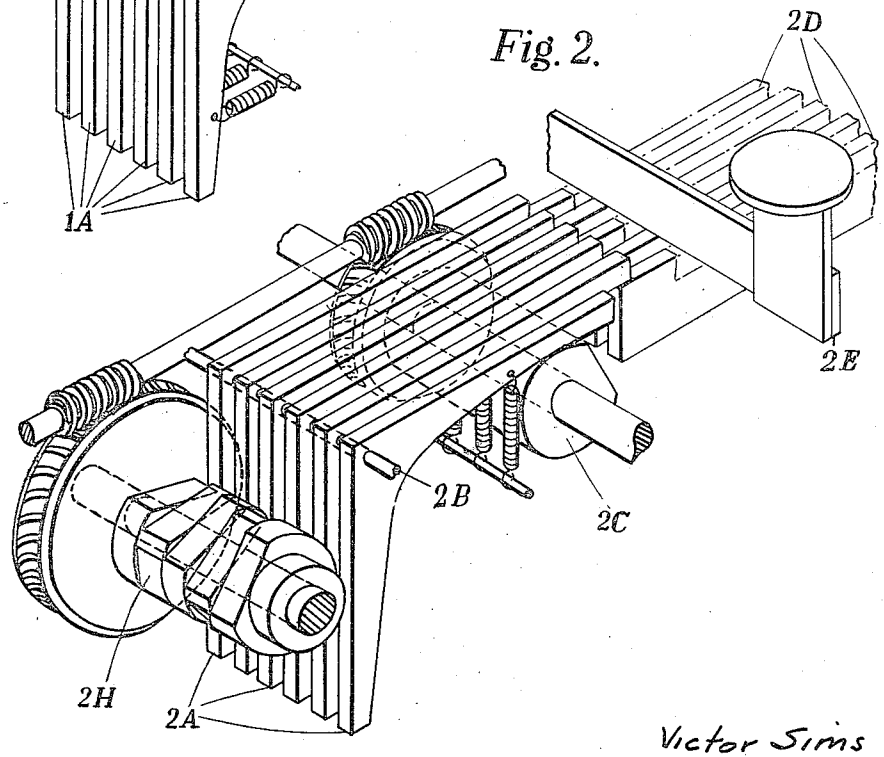


Fig. 2.



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 3.

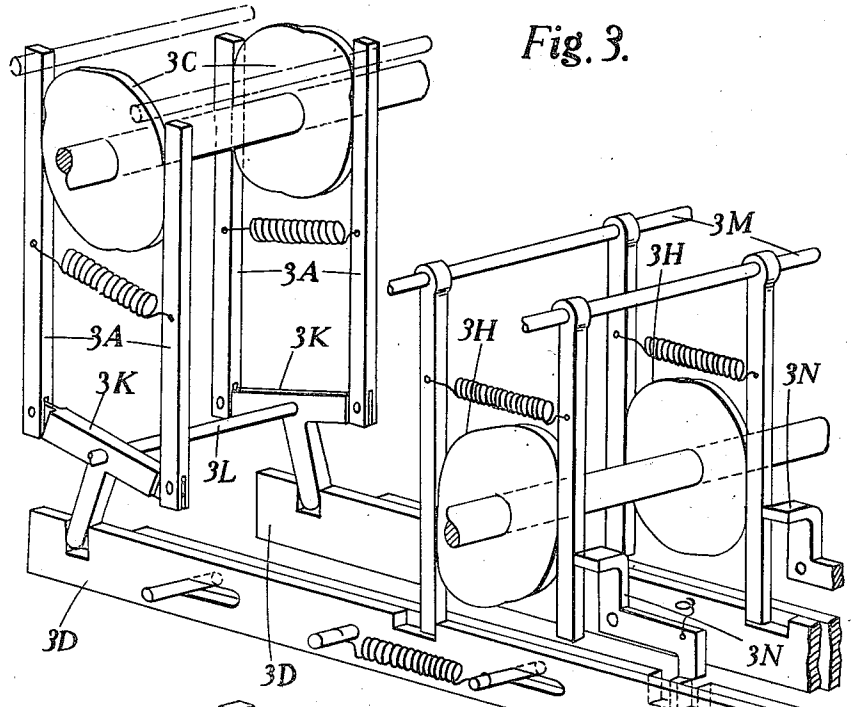
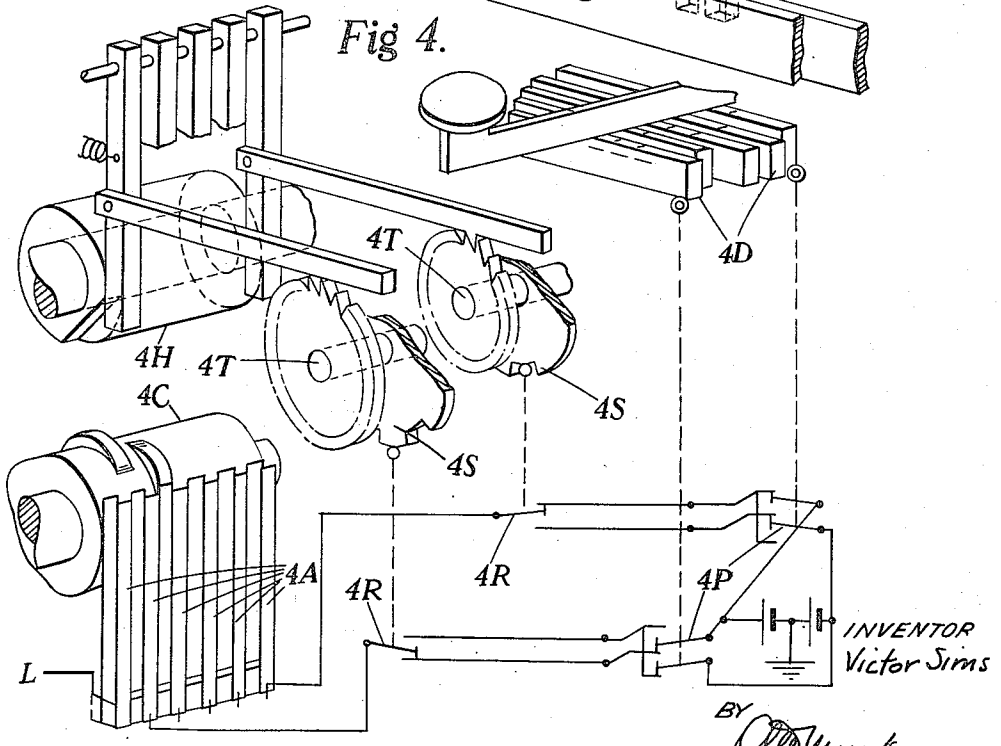


Fig 4.



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 5.

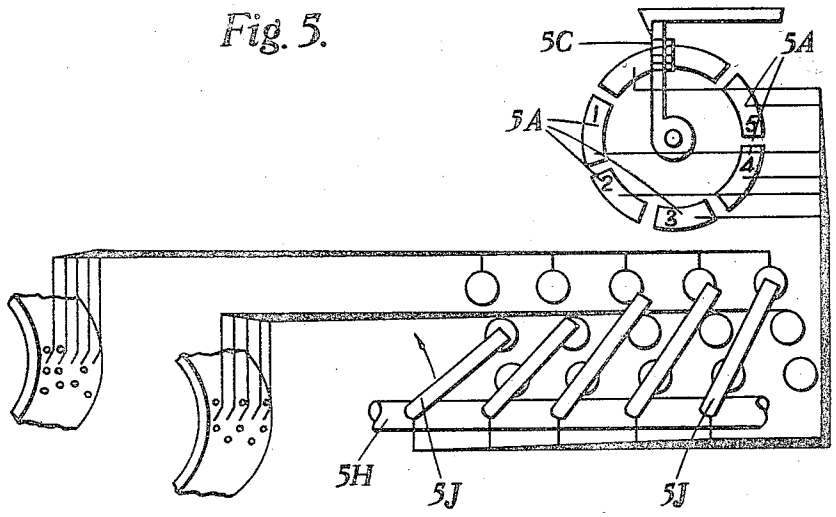
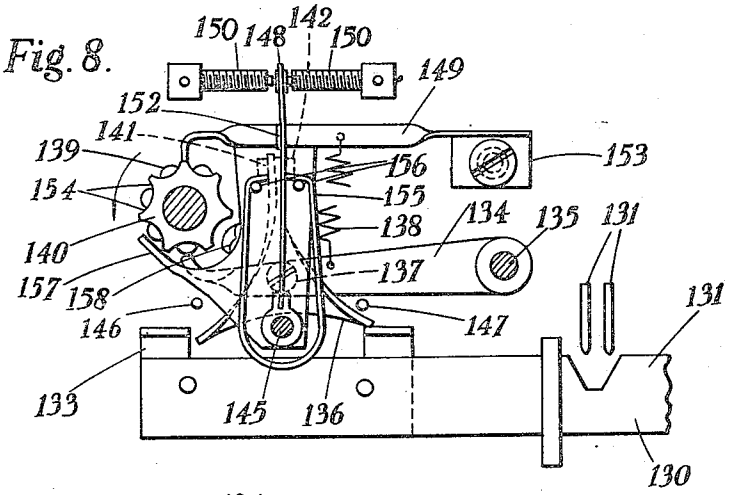


Fig. 8.



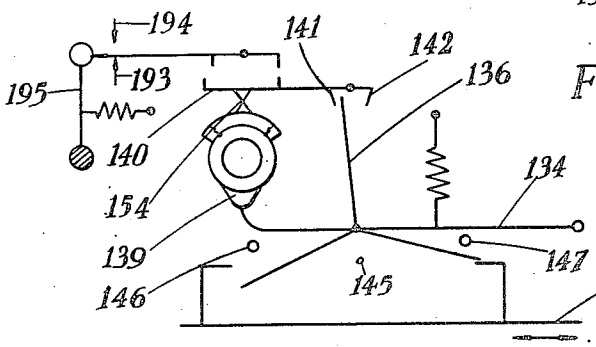


Fig. 9.

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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 6.

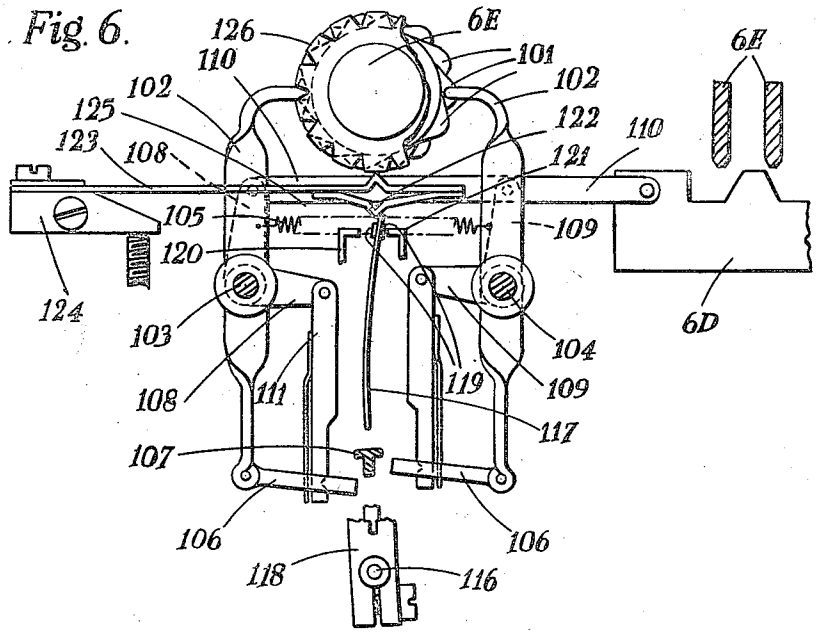
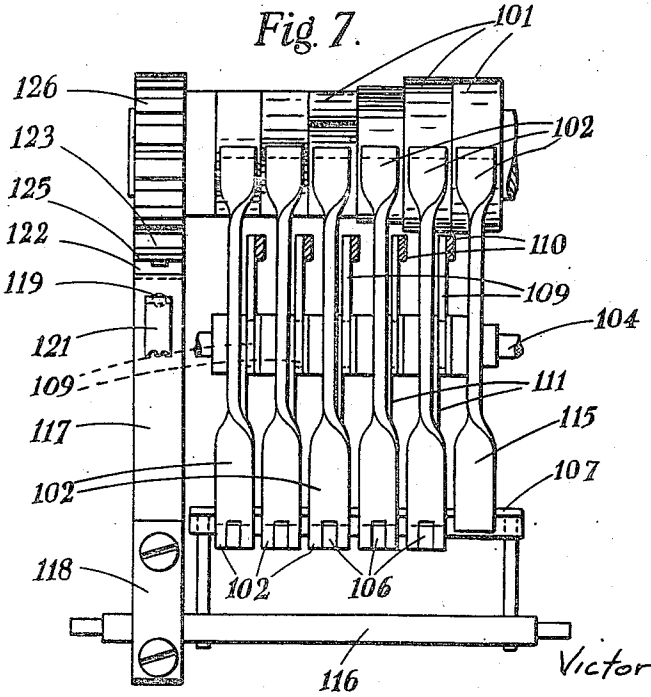


Fig. 7.



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 10.

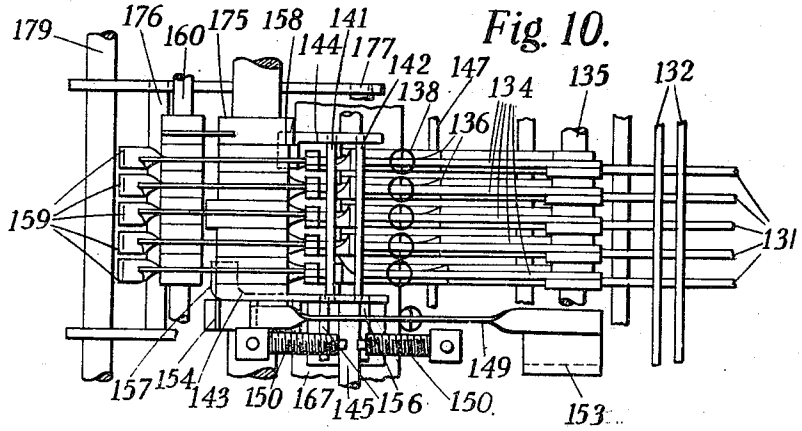


Fig. 11.

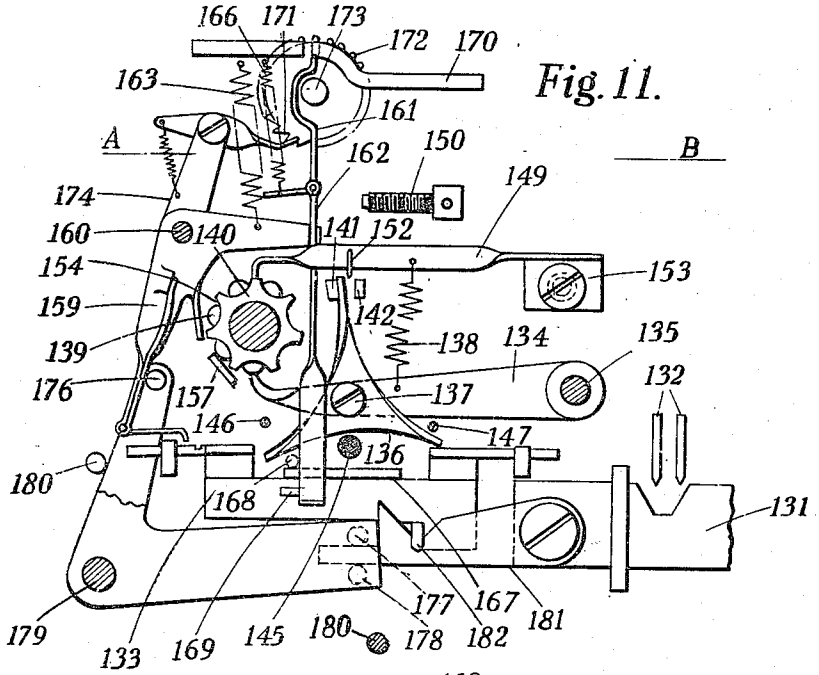
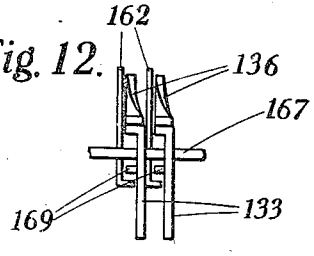


Fig. 12.



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 13.

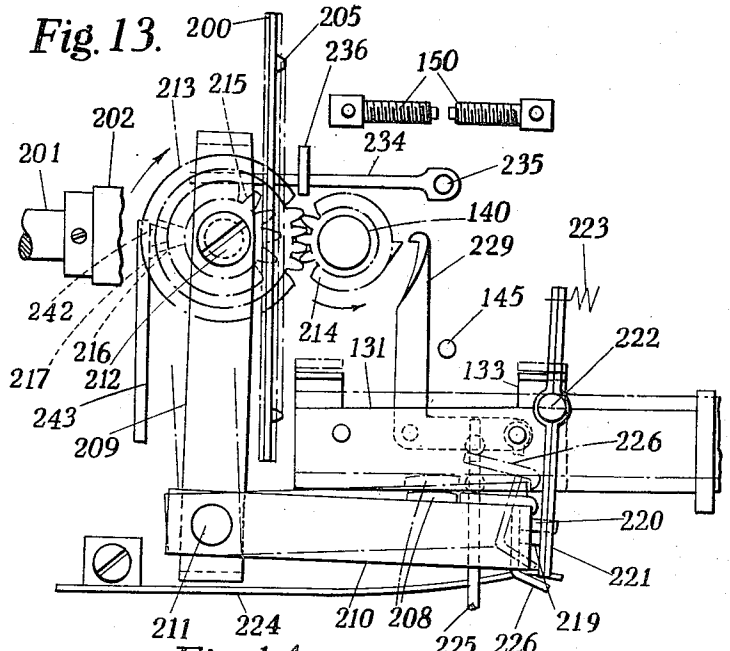
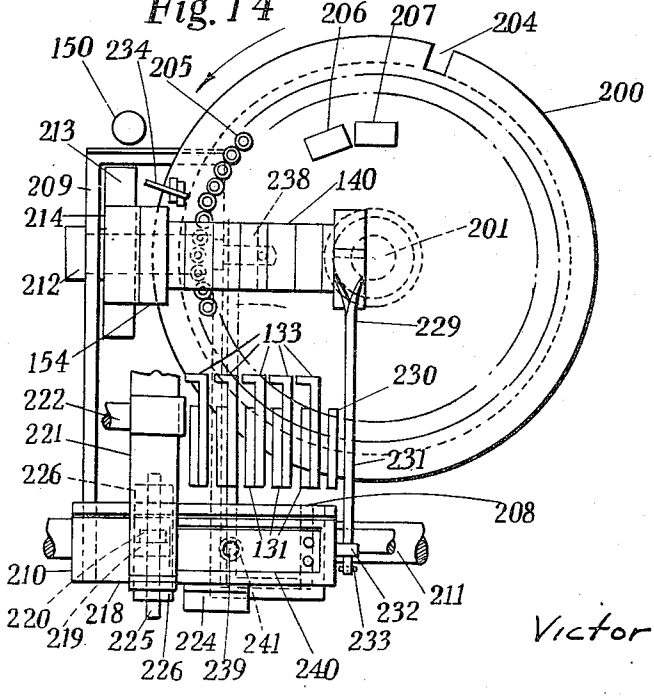


Fig. 14



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 15.

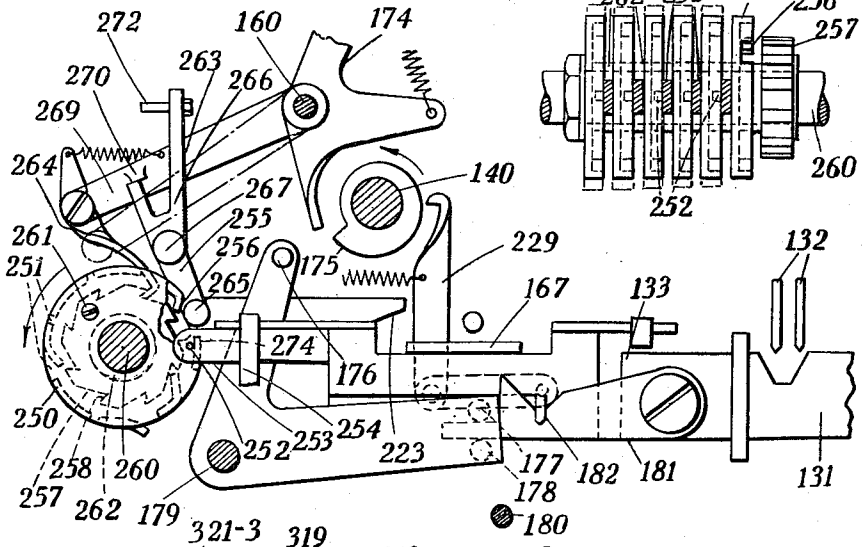


Fig. 16.

Fig. 19.

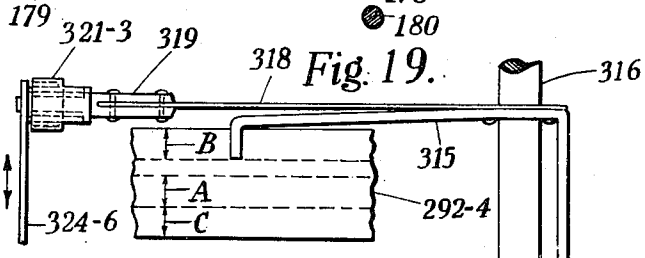


Fig. 20.

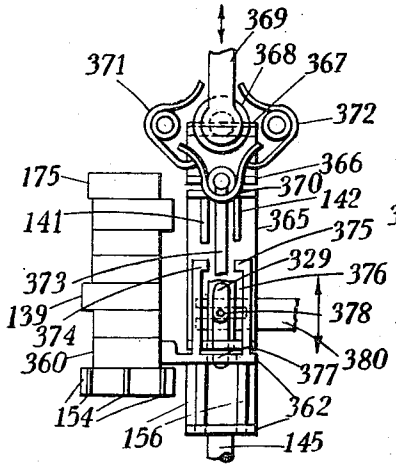
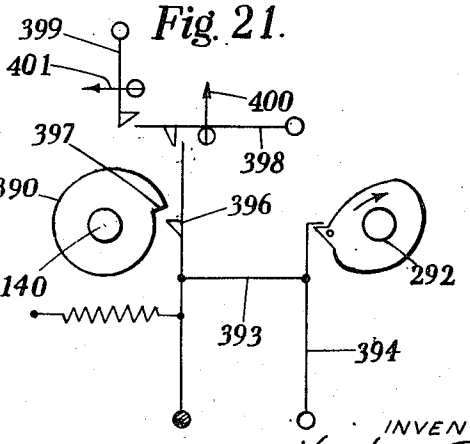


Fig. 21.



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TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

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Fig. 17.

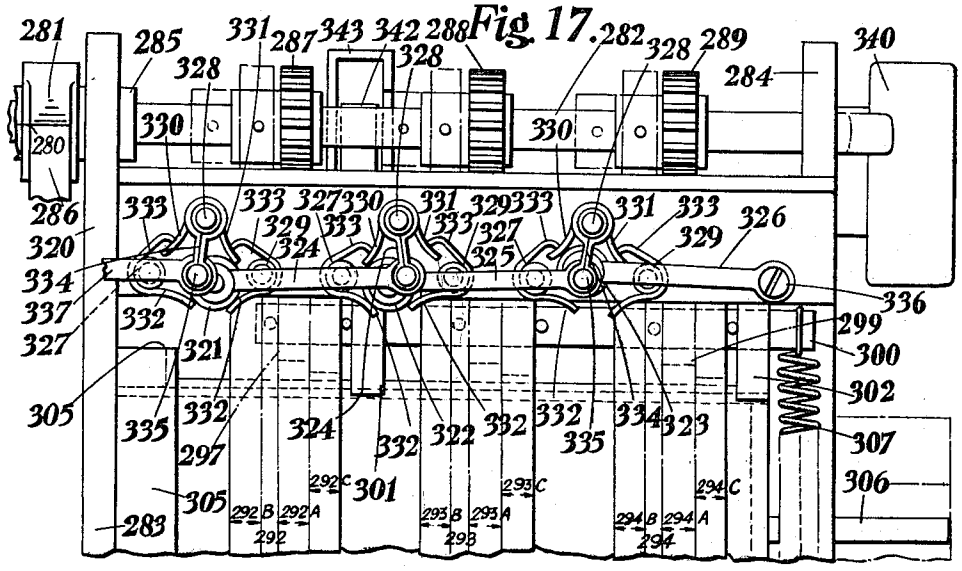
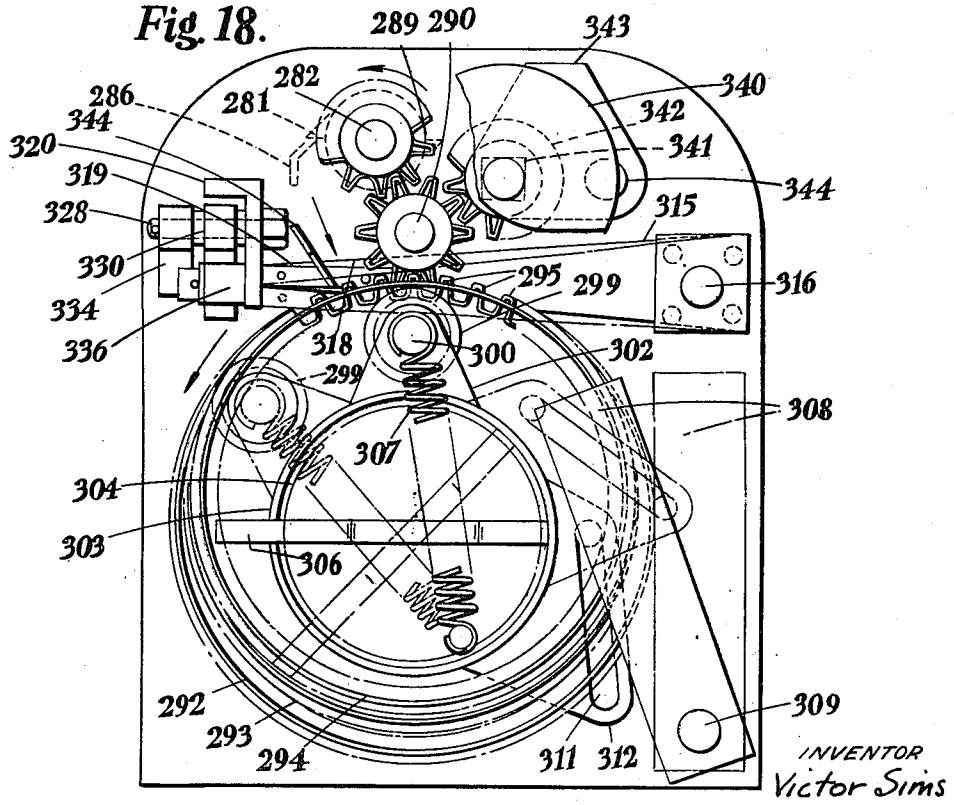


Fig. 18.



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Patented July 25, 1939 2,167,532

UNITED STATES PATENT OFFICE

2,167,532

TELEGRAPH, SIGNALING, AND LIKE SELECTIVE SYSTEM AND APPARATUS

Victor Sims, Hendon, England; Anna Maria Sims, administratrix of the estate of said Sims, deceased, assignor to Creed and Company, Limited, Croydon, Surrey, England

Application January 29, 1936, Serial No. 61,323
In Great Britain January 29, 1935

18 Claims. (Cl. 178—17)

This invention relates to telegraph, signaling, and like selective systems in which operations are selected according to signal combinations having sequential signal elements. The examples described in this specification of the improvements according to the invention refer more particularly to printing telegraph systems and apparatus operating on the so-called start-stop principle. These examples are mainly of signal transmitting apparatus, but certain aspects of the invention include signal receiving apparatus working in conjunction, both at the transmitting end of a communications circuit and at the distant receiving end. The scope of the invention is not necessarily limited to the examples shown.

In the development of start-stop printing telegraph systems, signal transmitters have been designed to effect auxiliary functions for the permutation elements in signal combinations, in addition to the main functions of transmitting in sequence the elements of each end signal combination. These auxiliary functions include, for instance those of signaling prearranged service signal combinations, return signals identifying the signaling station, and automatic case shift signaling; signal storing; and signal forming. The last mentioned instance includes certain systems of secret signaling or cryptographic telegraphy.

According to one aspect the invention comprises the combination in a telegraph, signaling or like selective system, in which operations are selected according to signal combinations consisting of groups of sequential signal elements, a main rotatable member, signaling contact means operable by said main rotatable member, an auxiliary rotatable member, and means operable sequentially by said auxiliary rotatable member in timed and sequential relationship with the operations of said signaling contact means by said main rotatable member.

According to another aspect the invention comprises in a telegraph, signaling. or like selective system, a signal transmitting distributor having a series of elemental portions, a plurality of corresponding series of control elements, and means associating at least one of said series of control elements with said elemental portions in timed and sequential relationship with the operation of said distributor.

According to yet another aspect the invention comprises in a signal transmitting apparatus, a rotatable cam member, a series of main cam projections thereon, signaling contact means, a separate series of auxiliary cam projections, and means conjointly operable by said main and said auxiliary cam projections to actuate said contact means.

The invention will be more fully comprehended from the following description and the accompanying drawings. In these drawings—

Fig. 1 is a perspective view of the essential portions of a combined keyboard and tape controlling mechanism for a signal transmitter, according to a main aspect of the invention.

Fig. 2 is a similar perspective view illustrating in a simple manner the application of the invention to a keyboard controlled signal transmitter with means for signaling automatically a group of prearranged signal combinations.

Fig. 3 is a perspective view illustrating a type of so-called metal storage, to which the invention is applicable.

Fig. 4 illustrates the application of a main aspect of the invention to a cryptographic signaling system with electrical type distributors.

Fig. 5 illustrates the application of this aspect of the invention to a pre-set automatic signaling system also with electrical type distributors.

Figs. 6 and 7 are front and side elevations respectively of an improved signal transmitting mechanism according to another aspect of the invention, as adapted for keyboard control.

Fig. 8 is a front elevation of a development of the mechanism shown in the two preceding figures.

Fig. 9 illustrates diagrammatically an alternative to certain features of these two improved signaling mechanisms.

Figs. 10 and 11 are plan and elevation respectively of the same mechanism shown in Fig. 8, but with additional means and modifications to effect control of the signaling mechanism alternatively by a perforated tape.

Fig. 12 is another view of a detail in Fig. 11.

Figs. 13 and 14 are front and side elevations respectively of an attachment to the mechanism shown in Fig. 8, to transmit a single group of signal combinations when required, in a manner developed according to the invention.

Fig. 15 is a front elevation of an alternative form of automatic signaling device for a similar purpose to that of the preceding example, and particularly applicable to the mechanism shown in Figs. 10 and 11.

Fig. 16 is another view of a cam drum shown in the preceding figure.

Figs. 17 and 18 are two elevations which may be regarded for the present purposes as front and side elevations respectively, of a mechanical cryptographic apparatus particularly adapted to operate in conjunction with the signaling mechanism operating according to the examples shown in Figs. 6 to 10 and 11, when suitably modified as illustrated in Figure 20. This cryptographic apparatus in the actual example shown and described, essentially unoperates the developments according to the present invention.

Fig. 19 is another view of a detail in Fig. 18.

Fig. 20 illustrates a modification to certain parts in Figs. 10 and 11, to enable the cryptographic apparatus of Figs. 17 and 18 to work in conjunction therewith.

Fig. 21 illustrates diagrammatically a control mechanism suitable for the cryptographic apparatus of the system described.

In Fig. 1 a series of independent members 1A pivoted at 1B are held by spring tension against an actuating cam means 1C. A corresponding series of controlling members 1D are selectively movable through code notches thereon by key-levers 1E. The actuating cam means 1C has a series of indentations helically arranged thereon adapted to release each of the series of independent members in sequence, the movement of each member 1A being intercepted or not according to the longitudinal position of its corresponding controlling member 1D. The actuating cam means 1C is rotated for one revolution by suitable means, not shown, at each depression of a key-lever 1E, and the members 1A control or effect the movement of signaling contact mechanism, all in the already well known manner. Rotatably mounted above this apparatus and meshing with a pinion 1F attached to the cam means 1C is a light gear wheel 1G fixed to a tape feed spindle and spur wheel adapted to feed a cross-perforated tape 1H a distance equal to the longitudinal spacing of the signal combinations on the tape, during each revolution of the cam means 1C. A series of feelers 1J each co-operating with a corresponding portion of the tape are pivoted on the series of members 1A and the free ends of the feelers are adapted to rise in sequence as the members 1A are released by the cam means 1C to be intercepted or not by corresponding portions of the tape according to the positions of the code perforations therein. If the actuating cam means 1C is arranged to rotate continuously during tape controlled transmission, and the series of controlling members 1D of the keyboard are moved out of operative relation with the series of members 1A, the tape controlled mechanism above described operates in a manner also already known when arranged as a separate apparatus.

It is believed that this combination of keyboard controlled signal transmitting apparatus and tape controlled apparatus operating in the manner above described, is at present broadly novel. The principles involved, however, are seen to be of possibly greater importance in the application to the types of systems and apparatus previously referred to.

In Fig. 2 an auxiliary signaling cam drum 2H suitable for a limited number of prescribed signal combinations is shown in combination with a keyboard controlled signal transmitter similar to that above described. The drum 2H bears cam indentations or perforations positioned to permit or intercept selectively the motion of the series of members 2A when released in cyclic order by the cam actuating means 2C. The two cam means 2C and 2H are shown driven through individual worm wheels from a common shaft, and the gear ratios are arranged to suit the required number and spacing of the auxiliary cam perforations on the drum 2H. Means to secure the proper timed relation of drum 2H with the cam means 2C when the auxiliary signaling means is required, and other details, are discussed later in this specification. It is important to note, however, that the cam drum 2H forms a control mechanism serially operable in timed relation with the signal contact actuating mechanism. The actual timing of the transmitted signal elements is effected by the latter mentioned mechanism, the control mechanism merely determines the character of the signal elements.

Fig. 3 illustrates diagrammatically an instance in which the main and auxiliary cam means are required to effect the movement of their respective members in either direction as determined. Each of the series of members actuated by the main cam means 3C is duplicated to form a pair of levers 3A pivoted at their lower ends on an individual three-armed member 3K which is in turn pivoted on 3L. Each portion of main cam 3C co-operates with a pair of levers 3A and carries two diametrically opposed projections which during each half-revolution of the cam-shaft simultaneously actuate the two levers 3A in an outward direction. According to the position of each control member 3D one or the other of the two levers 3A is brought into position to actuate the signal contact mechanism when the levers are moved by the cam 3C. This form of mechanical movement in signaling apparatus is already known, but Fig. 3 shows an example of the invention applied to apparatus employing positive forms of cam movement. The auxiliary cam means 3H actuates the control members 3D through pairs of levers pivoted on fixed pivots 3M, the cam projections or the lengths of the respective levers being arranged according to the required signal combinations. Each control member 3D is shown in two portions which are relatively movable against spring tension. The auxiliary cam 3H positively operates the levers 3A to the required positions through one portion of the control member whilst the other portion may be locked in its preselected position by suitable locking means, indicated in the figure by latches 3N. Similarly to the previous examples the pairs of levers are actuated by cam 3H in timed relation with the actuation of levers 3A by cam 3C. This example having positive cam movement illustrates a case where considerable advantages are obtainable by distributing the periods of actuation of the auxiliary signal control mechanism over a substantial portion of the period corresponding to a signal combination.

In the cryptographic apparatus shown in Fig. 4, each of the series of control members 4D actuates an electrical reversing switch 4P. The corresponding series of members effecting the transmission of the signal elements is shown at 4A, as a series of pairs of contact springs, and the actuating cam means therefor at 4C. Between each reversing switch 4P actuated by a control member 4D, and the corresponding member 4A is a further reversing switch 4R. Each switch 4R reverses the character of the potential applied to its corresponding contact spring 4A already selected by the setting of the associated switches 4P. Each of the switches 4R is actuated by a cam 4S individual thereto and these cams differ from each other and are interchangeable in the general manner already known, to effect any desired cycle of changes in the transmitted signals. A corresponding converse series of operations is arranged to be effected at the receiving apparatus for selecting a required character. In the example shown in Fig. 4 each cam 4S for a reversing switch 4R is moved in cyclic order by auxiliary cam means 4H. As in the other examples so far described, the controlling operation or operations for each element of the signal is effected by cams 4H before the transmission of that element by cam means 4C, and is changed in

preparation for the corresponding element in the next signal combination in the time interval between these specified elements of successive signal combinations.

Fig. 5 illustrates a known type of pre-set signaling apparatus to which the modifications according to the invention are applied. In this case an electrical type distributer is shown with a rotatable brush 5C, a series of segments 5A each connected to a corresponding auxiliary brush 5J on a shaft 5H common to all the brushes 5J. Each of these auxiliary brushes sweeps an individual series of contacts to each of which contacts a potential is connected in accordance with the character of the signal element to be transmitted. The shaft 5H moves all of the brushes 5J on to successive contacts in their respective series for each successive signal combinations as transmitted by brush 5C. According to the present invention the shaft 5H may be arranged to move continuously for the required distance during the rotation of brush 5C, or according to any of the alternative methods herein suggested. The figure shows each of the brushes 5J slightly staggered or retarded with respect to the preceding brush in the series. Each brush is adapted thereby to rest fairly in the centre of the contact to which the selected potential is connected for that signal element when brush 5C is sweeping that particular segment 5A. During the period in which the other signal elements are being dealt with in a similar manner the brush 5J just considered is moved into position on the next contact in preparation for the corresponding element in the next signal combination.

Figs. 6 and 7 show an improved keyboard controlled signalling mechanism illustrating another aspect of the invention. In this example the main cam means periodically locks and unlocks the signaling contacts for each successive element in a signal combination. The auxiliary cam means actuates selecting means in timed and sequential relationship with the successive operations of the main cam means to move the signaling contacts selectively at the unlocked periods. Both main and auxiliary cam means are adapted to effect their respective series of operations in successive half-revolutions of rotation. The various cams are therefore in duplicate at diametrically opposite points on their respective cam sleeves. The clutch mechanisms for these cam means may be of any suitable form for this purpose and will be referred to again later. Each of a series of controlling or permutation bars 6D is operable in a longitudinal direction as before to one or the other of two positions on depression of a keylever 6E. A universal bar A (not shown) is also actuated invariably in one longitudinal direction against tension of a spring on depression of any signal keylever, to release a clutch controlling a cam sleeve 6C. The auxiliary cam means comprises a series of pairs of cam projections 101 equal in number to the variable permutation elements of a signal combination, each pair of projections co-acting simultaneously with a corresponding pair of levers 102 disposed in substantially parallel positions on either side of the cam sleeve. The pairs of cam projections 101 are arranged in cyclic order around the cam sleeve to operate their corresponding pairs of levers 102 in successive order during each half-revolution of the cam sleeve. The two series of levers 102 are pivoted independently on two corresponding rods 103 and 104 with their upper ends bearing on their respective cam tracks on the sleeve under the tension of light springs 105. The lower ends of the pairs of levers 102 carry inwardly directed actuating fingers 106 pivoted thereon and the free ends of these fingers 106 can be rocked alternately into and out of position opposite a single bar 107 extending between all of the pairs of fingers 106. Each permutation bar 6D controls the position of its associated pair of fingers through a corresponding pair of oppositely acting bell-crank levers 108, 109, pivoted on rods 103, 104, respectively, but movable thereon independently of the cam actuated levers 102. The vertical arm of each pair of bell-crank levers 108, 109 is connected through link 110 to the corresponding permutation bar 6D, and each of the inwardly directed arms of these bell-crank levers carries a vertical link 111 having spring retained pivoting points with the corresponding finger 106. This forms a freely movable parallel link so that when the cam sleeve is in the arrested position with each of the pairs of levers 102 unactuated by their respective cam projections 101, all of the permutation bars 6D are free to be set by the depression of a keylever 6E, and one or the other of each pair of inwardly directed fingers 106 brought into position opposite bar 107 and the other fingers moved out of this operative position. By this means bar 107 is positively moved to one or the other of two positions in succession for each permutation element in a signal combination during a half revolution of the cam sleeve 6C. Two further cam projections 112, 113, are also arranged on the cam sleeve 6C to actuate two further levers 114, 115 for the start and stop elements of each signal combination. For this purpose the upper ends of the two further levers are provided with two inwardly directed fixed extensions respectively instead of the pivoting fingers 106. The cam actuated ends of the two further levers 114, 115, are shorter than the cam actuated ends of the other levers 102, to bear on the cam track of projections 112, 113 at different angular positions. One of these two further levers serves as the start element lever and is actuated by one cam projection 112 or 113 for the commencement of each signal combination during one half revolution of the cam sleeve 6C and the other or stop lever being actuated by the same projection after the successive actuation of the pairs of levers 102. The other projection 112 or 113 effects a similar actuation of the start and stop levers 114, 115 during the next half revolution for the succeeding signal combination. The cam actuated levers 102, 114, 115 are shown of a form adapted to be stiffly resilient to avoid the possibility of adjacent levers locking through the single bar 107 if insufficient initial clearances have been provided.

The single actuating bar 107 is fixed to a rock-shaft 116 by which it swings and this motion is employed in this example to oscillate the signaling contact means although according to the invention a further control is effected by the main cam means as will later be described. A stiff spring blade 117 is clamped at one end by a clamping piece 118 to the rock-shaft 116 and at the other end carries contact faces 119 alternately contacting with contact stops 120, 121 respectively. The free end of the spring blade 117 is formed as a V or knife edge which is engaged by a corresponding V or knife edge 122 on the free end of a horizontal locking spring blade 123. The fixed end of the locking blade 123 is carried by an adjusting piece 124 which may be unclamped and rotated to adjust the spring tension

tending to open the knife edges from engagement. The knife edge 122 on the horizontal locking blade 123 is shown as a separate spring piece 125 riveted to the blade. The contact blade 117 and the spring piece 125 may be electrically insulated from clamping piece 118 and locking blade 123 respectively. The horizontal locking blade 123 has a bearing portion riding on a notched cam 126 on the cam sleeve which constitutes the main cam means previously mentioned. This notched cam, like the auxiliary cam means effects a series of operations for each signal combination in each successive half revolution. Each half circumference of the cam therefore comprises a series of equal segmental portions separated by steep sided notches which successively actuate the locking blade 123 during rotation of the cam to lock and unlock the contact blade 117 through the knife edges. The spring piece 125 on the locking blade 123 prevents damage to the knife edges or other parts if these knife edges meet in a central position.

For the purpose of comprehending the scope and nature of the present invention it may have been helpful to regard the main and auxiliary cam means in the example as so far described, as on separate but co-acting rotatable members as in the preceding examples. In certain circumstances such as some of those later described in the present specification where further auxiliary functions are effected in conjunction with the signal transmitting mechanism, the arrangement of two separate cam sleeves may be desirable. In order to simplify the description of these various examples, and to exemplify another aspect of the invention, the two cam means in the present example are now described and referred to as fixed in the correct phase relationship on a single cam sleeve controlled by a half revolution clutch from the universal bar of the keyboard in any convenient known manner. The details of all clutch mechanisms are therefore omitted, with advantage, from Figs. 6 and 7. Methods of driving and co-ordinating two separate cam means will be readily comprehended from examples later described herein. The correct phase relationship of the two cam means, represented by the angular position of notched cam 126 relatively to the series of cam projections 101, 112, and 113, on the single cam sleeve will be seen from the following outline of the mode of operation of the present example. During the time period in which the contact blade 117 is locked by the notched cam 126 as previously described, the cam means projections 101, 112 and 113 are adapted by the setting of notched cam 126 on the cam sleeve relatively to these series of cam projections 101, 112, and 113 to change over the actuation of bar 107 by one or the other of a pair of fingers 106 to one or the other finger of the succeeding pair of levers 102. The change over from or to the actuation by the start and stop levers 114, 115 is similarly effected during the period in which the contact blade 117 is locked by the knife edges. The contact blade is strained by rockshaft 116 in one or the other direction while the contact making tip is locked in its previously selected position. At successive time periods corresponding to the junction of successive signal elements as transmitted, when bar 107 and rockshaft 116 are firmly held in one or the other position, the contact blade is unlocked by the notches in cam 126. If bar 107 has been reactuated to the same position as for a preceding signal element the contact tip is unmoved during this unlocking period. If the bar 107 has been actuated to the opposite position the contact making tip does not immediately leave its contact stop 120 or 121 but is strained in the opposite direction until the next notch in the cam 126 unlocks the knife edges when the contact tip of blade 117 rapidly snaps over to the opposite stop.

Fig. 8 shows a further improved keyboard controlled signal transmitting on the broad lines above described, Fig. 10 shows a similar view of the essential parts of the same signal transmitting mechanism together with additional tape control means and means to put either the keyboard or the tape control means into operative relation with the signaling contact mechanism. Fig. 9 shows substantially a plan on section line A—B of Fig. 10 and consequently of those parts common to both Figs. 8 and 10. Fig. 10 may also be considered to represent a development of the main features described with reference to Figs. 1, 6 and 7. As will hereinafter be seen by removing certain parts shown in Fig. 10 the essential parts of an improved tape controlled signal transmitter remain. These may be mounted for use as a separate apparatus. It will then further be seen that a tape controlled signal transmitter of a type known prior to the date of the present invention when modified and readapted by the successive improvements herein outlined permits a return by a circuitous route of development to a feature of a still earlier form of tape controlled transmitter. A similar effect will also be observed in conjunction with other developments according to the invention later.

Referring first to Fig. 8 permutation bars 131 operable longitudinally to one or the other of two positions on depression of any keylever 132 carry abutment plates 133 fixed to extensions of the permutation bars 131. Above the series of abutment plates 133 is a corresponding series of levers 134 pivoted on fixed rod 135, each lever carrying a three-armed member 136 pivoted thereon by screw 137. The series of levers 134 are actuated against tension of individual springs 138 by corresponding cam projections 139 arranged helically around cam-sleeve 140. Two arms of each said three-armed member 136 extend substantially horizontal in opposite directions on either side of the pivot screw 137, and one or the other arm is adapted to be arrested on actuation of the corresponding lever 134, by a corresponding abutment on plate 133 according to the one or other longitudinal position of the permutation bar 131. The further actuating movement of lever 134 thus positively rotates the three-armed member 136 in one or the other direction on pivot screw 137. The third arm of each member 136 extends in a vertical direction, and on each side respectively of the series of these vertical arms are two transverse bars 141 and 142 fixed to end plates 143 and 144 which are pivoted on fixed rod 145 to form a single contact actuating member. Two transversely arranged stop pins 146 and 147 are arranged above the series of horizontally extending arms of the three-armed members 136. In the unactuated position of levers 134 the two horizontal arms of each member 136 are held against these stops clear of the abutment plates 133 so that the permutation bars 131 are free to be moved longitudinally to either selecting position. The distance between the two transverse bars 141 and 142 of the single contact actuating member is proportioned to the distance through which the three-armed members 136 are moved from the

central position in either direction, so that when this contact actuating member is moved to either extreme position by cam-sleeve 140 through one of the three-armed members 136 none of the other members 136 are appreciably moved from the central or unactuated position. The horizontal distance between the tips of each of members 136 is preferably made slightly less than the distance between the abutments on the plates 133 so that no possibility of a member 136 jamming on its two associated abutments can occur.

The signaling contacts are controlled in a manner similar in principle to that described with reference to Figs. 6 and 7. In the present example the signaling contact blade 148 is pivoted freely at one end on fixed rod 145. One side of the upper end of the width of this spring blade 148 is cut away under a light locking lever 149 and the remaining portion of the upper end of the blade carries at its extremity two contact faces on opposite sides adapted to contact alternately with opposite contact screws 150 respectively. The two contact faces on blade 148 may be substituted by a contact tongue fixed to but insulated from the blade. The short horizontal edge at the cut away portion of blade 148 is formed as a knife-edge which is engageable on opposite sides thereof by a second knife-edge 153 fixed to the light locking lever 149 which at one end pivots or bends slightly on a fixed bracket 153, and at the other end bears on a notched cam 154 on the cam sleeve 140. The notched cam 154 corresponds in function to the main cam mechanism of the previous examples, and the series of cam projections 139 corresponds to the auxiliary cam means. The spring contact blade 148 is actuated by the single contact actuating member 141—144 through a U-shaped spring 155 controlled by two pins 156 fixed to the front end plate 143 of the contact actuating member. The ends of the U-shaped spring 155 are adapted to bear on opposite sides respectively of the contact spring blade 148 with a suitable initial pressure. When the contact actuating member is moved by cam-sleeve 140 in either direction, as previously described, one of the two pins 156 moves a corresponding arm of the U-shaped spring 155 out of the path of movement of the contact blade 148 on one side. The other pin 156 leaves the other arm of the U-shaped spring 155 bearing on the contact blade 148 on the opposite side and moves out of the path of this arm of the U-shaped spring. When the notched cam 154 raises the locking lever 149, the U-shaped spring 155 snaps the contact blade over to the opposite contact screw 150.

Notched cam 154 is oriented relatively to the cyclically operable cam projections 139 in similar manner to that described for the preceding example, so that the contact blade 148 is momentarily unlocked at those positions of the cam-sleeve 140 at which the contact actuating member is held in one or the other extreme position. These brief unlocking periods correspond to the junctions of successive signal elements, but the actual transit period of the contact blade is of less duration than that of the unlocking period of lever 149.

Start and stop signal elements of opposite character are effected in the arrangement shown by bent extensions 157 and 158 of the end plates 143 and 144 of the contact actuating member. These extensions 157 and 158 cooperate on opposite sides of the cam-sleeve 140 with the first and last cam projections 139 respectively for the series of permutation bars 131. The extension 157 for instance, co-operates with the cam track for the first permutation bar 131 but at a point equivalent to the angular spacing between two successive cam projections, ahead of that at which the single cam projection on this track actuates the first lever 134 in the series. The other extension 158, co-operates with the cam track for the fifth or last permutation bar 131 so that the contact actuating member is moved invariably in the opposite direction for the stop element by the fifth cam projection at an equal angular position after this cam projection actuates its lever 134.

In Fig. 9 an alternative method of actuating the signaling contact means is diagrammatically illustrated. This alternative method is described as applied to the example shown in Fig. 8, but the method is also applicable in principle to the example shown in Figs. 6 and 7. In Fig. 9 a single lever 134 is indicated with the corresponding three-armed member 136 pivoted thereon, and a single abutment plate 133. The corresponding cam projection 139 of the auxiliary cam means is shown actuating the single contact actuating member 141, 142, in the manner previously described. Instead of straining a spring to actuate the contact means at the next unlocking period, however, the member 141, 142 in this case moves longitudinally a single further light abutment plate 190. This light abutment plate is operated in a direction at right angles to this longitudinal selecting movement by each sharp cam projection of the main cam means 154. According to the longitudinal position to which the light abutment plate 190 has been moved, one or the other of two abutments thereon hits a corresponding projection on one or the other side of a fixed pivoting point of a contact lever 192. This contact lever may be held on the one or other contact screw 193, 194 to which it has thus been actuated, by a spring pressed jocket roller 195, for instance. As in the previous example, the series of auxiliary cam projections 139 operate in timed and sequential relationship with the series of main cam projections 154. As in the two preceding examples, the signal elements are timed by the main cam means and are not affected by wear of the auxiliary cam operated mechanism which controls the selecting mechanism only.

Referring now to Figs. 10 and 11 the signaling mechanism above described is also here shown, but with certain parts removed for convenience in drawing or for clarity. The only difference in the parts so far described is that the abutment plates 133 are not fixed to the permutation bars 131, but are independently supported on transverse guiding bars for longitudinal movement as before, and connectible to the series of permutation bars 131 when desired for joint movement, co-operating with the series of cam projections 139 on the cam-sleeve 140 previously mentioned is also a corresponding series of tape feeler control levers 159, each lever independently movable on fixed pivot rod 160 and having three arms. One arm of each said lever 159 extends over the cam-sleeve 140 and co-operates with a corresponding tape feeler 161 and associated plunger 162. A second arm co-operates with a corresponding cam track on the sleeve 140, the cam projection of which track actuates the lever 159 against the tension of spring 163. The third arm carries at its extremity a spring latch 164 which engages with a slot 165 in the corresponding abutment plate 133. Each feeler 161 comprises a light bent

wire or rod freely pivoted at an intermediate point thereof on the upper extremity of the associated plunger 162. The upper end of the feeler is adapted to enter a signal perforation in the tape (not shown) or be intercepted by a blank portion of the tape. The lower end of the feeler is bent substantially horizontal and is notched to serve as adjustable attachment points for a light individual spring 166 which tends to raise the corresponding feeler and plunger and to turn the feeler in a clockwise direction on its pivot point on plunger 162. Each plunger 162 consists of a flat strip slotted at the upper end to accommodate the pivoting point of the feeler end to form an engaging edge at the lower end of the slot for the first above mentioned arm of its associated lever 159. This arm passes through the slot in plunger 162, a V-notch in the underside of the tip of the arm serving as a locating or retaining means. The lower end of each plunger strip is twisted to enable the strip to pass freely between adjacent pairs of levers 134 and members 136, and is located in a slot cut in a transversely arranged plate 167. This plate also serves as a retaining means for the abutment plates 133 while the permutation bars 131 are being latched to the abutment plates 133 in the circumstances hereinafter described. A pin 168 retains the plungers in the slots in plate 167. The lower extremity of each plunger 162 is bent sharply at right-angle and co-operates with a bent over lug portion 169 of the corresponding abutment plate 3. Fig. 12 shows a side view of these parts. When each lever 159 is actuated by its corresponding cam projection 139 the feeler 161 and plunger 162 are positively moved against the combined action of springs 163 and 166. The feeler 161 is thus moved from contact with the tape, and the abutment plate 163 is moved, to the left in the drawings, to an extreme position beyond the corresponding selecting position of the abutment plate. As the cam-sleeve 140 rotates, the lever 159 then returns under spring tension, the feeler 161 rises into contact with the tape and the abutment plate 133 moves towards the first selecting position. If the feeler is intercepted by blank tape, further vertical movement of the plunger 162 is prevented. In this position the bent over portion at the lower end of the plunger 162 is opposite lug 169 on abutment plate 133, and further movement of the lever 159 brings the lug 169 into engagement with the bent over tip of plunger 162. At this first selecting position the abutment plate 133 is arrested with the right-hand abutment under the extremity of the corresponding horizontal arm of member 136. During the further movement of lever 159 the horizontal arm of this lever rises freely in the slot in plunger 162. If the feeler 161 enters a perforation in the tape the feeler and plunger continue to rise and the bent over lever tip of the plunger rises out of the position to arrest the lug 169 on abutment plate 133. The highest extreme position to which the feeler rises is conveniently limited by the engagement of the bent over tip of the plunger 162 with the underside of plate 167. The further movement of the lever 159 when abutment plate 133 is not arrested through lug 169, moves the abutment plate 133 to the second selecting position with the left hand abutment under the corresponding arm of three-armed member 136.

These operations for each feeler 161 are effected in cyclic order, each abutment plate 133 being selectively positioned before the corresponding lever 134 is actuated by the cam-sleeve 140 to move the single contact actuating member 141—144 and during the time period in which the other signal elements are being transmitted. The springs 166 attached to the lower ends of the feelers 161 serve to draw the feeler and plunger vertically into contact with the tape, and also to restore the feeler to a vertical position with the tip engaging a guiding notch individual thereto in the tape platform 170 if this feeler is moved on its pivot on the top of plunger 162 by contact with the moving tape. The tape feed arrangements shown comprise ratchet wheel 171 and tape spur wheel 172 both fixed to spindle 173, and a ratchet lever 174 pivoted on rod 160 actuated once during each revolution of the cam-sleeve 140 by a suitable cam 175 thereon. Further remarks on the tape feed arrangements will shortly be made herein.

To enable either the tape feeler mechanism, or the permutation bars 131 of the keyboard to control the signaling contact means change-over means are provided comprising chiefly a framework having two end plates connected by three cross-bars 176, 177 and 178 and pivots on rod 179 to move between stops 180. For keyboard control the framework is manually actuated to and maintained firmly in the position shown in the drawings (by means not shown). In this position all the spring latches 164 on levers 159 are moved by bar 176 out of engagement with the slots 165 in abutment plates 133, and levers 159 are rotated out of engagement with the cam-sleeve 140. By the same movement of the framework, cam latches 181 pivoted on permutation bars 131 are moved by bar 178 into engagement with laterally extending lugs 182 on the abutment plates 133. Inclined cam faces on the latches 181 ensure mutual locking of each abutment plate and its permutation bar irrespective of the position of each plate and bar prior to the latching movement. As previously mentioned plate 169 serves to take the pressure of the framework during this latching movement. The opposite movement of the framework unlatches these pairs of members and leaves the levers 159 free to actuate the abutment plates 131. The movement of the framework can readily be adapted to declutch the cam-sleeve so that this rotates continuously independently of the one-revolution means (not shown) employed with keyboard control. A tape pressure roller (also not shown) can also readily be raised or lowered by the same movements. The movement of the framework to put the keyboard into operative condition as above described, also depresses the plungers 162 so that the bent over lower tips are below the level of the lugs 169 on the abutment plates 133 and out of operative relation with these parts.

If it is desired to utilise the arrangement shown, as a separate tape controlled transmitter, the framework and permutation bars together with their latches are omitted. In this case levers 159 may be permanently linked to the abutment plates 133. Gearing of a proper ratio may be employed permanently in mesh between the cam-sleeve 140 and the tape feed spindle 173. When a combined keyboard and tape controlled transmitter is desired the ratchet means illustrated in Fig. 10 for the tape feed appears at present to be the most suitable method of ensuring sufficiently correct synchronism between the tape feed movements and the signaling cam movements when the tape feed means is put into operative condition for tape controlled trans-

mission. The tape feed amounts to one centre-hole for each revolution of the cam-sleeve and this feeding movement may be effected during transmission of the start and stop elements of each signal combination. In this case, as the tape is stationary during the permutation elements the series of guiding slots in platform 170 are arranged to guide the feeler tips to rise as nearly as possible in the centre positions of the respective perforations in the tape. This corresponds to a method long known of feeding such tape into correct relationship with a series of feelers. Alternatively the tape may be moved forward substantially continuous during transmission of a signal combination, by a snail cam on the cam-sleeve 140, for instance. In this case either the series of guiding slots in platform 170 is slightly inclined or staggered in a direction across the tape or the series of perforations for each signal combination are similarly inclined across the tape to compensate for the movement of the latter. This alternative method corresponds to the arrangement outlined with reference to Fig. 1, where the tape is moved continuously by gearing. Whichever method is employed for the means described for tape controlled transmission in Fig. 11, it will be seen that three separate series of cam actuated operations are effected, all in timed and sequential relationship, to transmit each signal combination. In this example also all the cams for this purpose are movable integrally on a single cam sleeve.

Figs. 13 and 14 show an attachment for and modifications to the signal transmitting mechanism shown in Fig. 8, for signaling automatically a single series of signal combinations. The attachment comprises essentially the three following parts: (1) a rotatable code disc which oscillates the single contact actuating member of the signaling mechanism previously described, (2) coupling gears movable into and out of engagement with a driving pinion on the transmitter cam sleeve, and (3) change-over means operable together with said coupling gears to put either the normal keyboard control means or the automatic signaling means into operative relation with the contact mechanism. The keyboard controlled signal transmitter for the description of the present attachment is identical with that described with reference to Fig. 8 with the exception of the following two modifications: (1) a pinion 214 is fixed to and rotatable with the cam sleeve 140 of the signal transmitter, and (2) the extremities of the permutation bars 131 together with abutment plates 132 under the cam actuated levers 134 are supported vertically by a transverse bar 208 that is movable in a vertical plane to one or the other of two positions.

Referring to Figs. 13 and 14 the code disc 200 is mounted on a shaft 201 in a fixed bracket 202 to rotate freely without appreciable axial motion in a plane substantially parallel to the axis of the transmitter cam sleeve 140. On the periphery of this disc 200 elemental cam portions 203 are pressed to one side or the other of the disc in a direction parallel to the shaft 201 according to the character of the desired signal elements. This peripheral strip forms a continuous waved cam surface with the exception of a small notch 204 for the home or inoperative position of the disc 200. Concentric with the waved periphery of the disc a continuous circle of bullet nosed depression 205 for driving teeth are pressed from one side of the disc, these depressions preferably corresponding in number to the elemental code portions on the periphery and serving as locating points when pressing these successive code cam portions on the periphery. Inside this circle of driving depressions 205 and also concentric therewith are two cam nodes pressed from opposite sides respectively in successive order and spaced from the notch 204 for a purpose that will presently be described. Although the code disc described is thought to present novel detail features that will be referred to later, it is already known to provide a cam disc having code cam portions on the periphery, as an attachment to a signal transmitter to actuate a common signaling contact means alternatively as required. The disc in the prior arrangement is also rotatable at a speed proportioned to the speed of the alternative control means. The present example is distinguished from this prior arrangement in that a main cam means rotates in timed and sequential relationship to the rotation of the code disc to effect a further control on the movements of the signaling contacts as selected or effected by the disc. A bellcrank lever, formed by a metal strip bent and welded together with a transverse bar 208 into a stiff framework having a vertical arm 209 and a broader horizontal arm 210, is pivoted on a rod 211. The vertical arm 207 carries a composite coupling gear and cam member, all together freely rotatable on pivot screw 212. This composite coupling member comprises (a) a spur wheel 213 having a number of teeth double that of the pinion 214 on the transmitter cam sleeve 140 with which it co-operates, (b) a sprocket 215 having bullet nosed teeth to engage the corresponding depressions 205 pressed in the code disc 200, and (c) a central cam 216 having a concentric portion with two V-shaped notches 217 axially cut therein at diametrically opposite points. The number of teeth on the sprocket 215 is twice that of the full number of elements in a signal combination so that when the disc 200 is rotated from the transmitter cam sleeve 140 through the coupling gears the disc is moved one tooth for each signal element. The horizontal arm 210 of the bellcrank lever extends under the ends of the permutation bars 131 of the keyboard that carry the abutment plates 133, and the transverse bar 208 supports these bars with the plates 133 as above mentioned. On a connecting portion 218 at the end of this horizontal arm 210 of the bellcrank lever, a small lug 219 is fixed, and adapted to latch the lever in one or the other position on either side respectively of a corresponding lug 220 on a latching detent 221 pivoted on rod 222 and actuated by spring 223 to the latching position. A spring blade 224 tends to turn the bellcrank lever in a contraclockwise direction as viewed in Fig. 13 to move the spur wheel 213 out of engagement with pinion 214. A control rod 225 actuates the bellcrank lever in the opposite or clockwise direction to engage the gears when required. This control rod 225, which may be actuated automatically or manually according to requirements, moves vertically downward to put the automatic signaling mechanism into operation, and then returns to its uppermost position. To unlatch the bellcrank lever before this is thus actuated to the operative position by the downward movement of control rod 225 a T-shaped unlatching member 226 is conveniently hooked by one horizontal arm to the upper inside edge of the connecting bar 218 at the end of the horizontal arm 210 of the bellcrank lever,

to pivot thereon; the other horizontal arm of the T-shaped member 226 being engaged on the upper side by a crosspiece 227 on the control rod 225. The vertically depending arm of the T-shaped member 226 is bent at the lower end to engage the lower extremity of the latching detent 221. When control rod 225 is actuated downward, with the bellcrank lever in the upper latched position shown dotted, the T-shaped member 226 is first rotated contraclockwise to unlatch the lug 220 of detent 221 from lug 219 of the bellcrank lever. The vertical arm of the T-shaped member 226 then engages the inside surface of the connecting bar 218 of the lever and further movement of the control rod positively moves the bellcrank lever to the opposite position. The extreme end of the vertically depending arm of the T-shaped member 226 having now passed the extremity of the detent 221 this detent is now free to return and latch the bellcrank lever in the opposite position. The code disc 200 is coupled by this movement of the bellcrank lever to rotate with the cam sleeve 140 through the coupling gears. The clutch releasing detent 229 of the transmitter cam sleeve 140 is normally actuated by the universal bar 230 of the keyboard to effect one revolution of the cam sleeve for each depression of a keylever in the keyboard in any suitable known manner and not further here shown. In this example of the invention however, the lower end of the clutch releasing detent 229 is extended horizontally and carries a vertical link 231 passing loosely through a lug 232 fixed to the horizontal arm 210 of the bellcrank lever and having a pin 233 engaging the underside of the lug 232, as seen in Fig. 15. The lug 232 on the arm 210 of the bellcrank lever only engages the releasing detent through pin 233 and link 231 to move this detent to release the clutch when the bellcrank lever is near the actuated position at which it is latched. Although for keyboard transmission the detent is automatically returned to re-arrest the clutch after one revolution it will be seen that for automatic signal transmission in the present example, the clutch cam sleeve 140, and code disc 200, will continue to rotate together, the code disc being driven from the cam sleeve. A light but stiff bar 234 having a narrow slot cut through a portion of its width near one end to engage both sides of the waved cam edge of the code disc 200, is pivoted at the other end 235 to the front end plate 143 of the single contact actuating member of the signal transmitter. The bar 234 is supported slidably in a slot in a fixed plate 236 near the code disc 200. When this disc is in the home position the bar moves freely in the notch 204 in the periphery of the disc when the contact actuating member is oscillated under control of the keyboard. When the code disc is driven from the cam-sleeve 140, the cam waved periphery of the disc oscillates this contact actuating member instead.

To arrest the automatic signaling mechanism on completion of its series of operations and to hold the parts in the home position so that the coupling gears engage cleanly when control rod 225 actuates the bellcrank lever on pivot rod 211, the following parts shown or indicated in the figures may be employed. A second bellcrank lever 237, shown dotted in Fig. 14 is pivoted on rod 211 with a roller 238 mounted at the extremity of its vertical arm to co-operate with the two cam nodes 206, 207 previously mentioned. The horizontal arm of this second bellcrank lever 237 extends inside the framework of the horizontal arm 210 of the first bellcrank lever and is shaped at its tip to form an inclined cam surface (not shown). This cam surface engages a corresponding cam projection formed as a pin 239 fixed to a flat spring blade 240 and projecting through a clearing hole 241 in the connecting bar 218 of the framework of the first bellcrank lever, in line with the inclined cam surface of the second bellcrank lever 237. The flat spring blade 240 is riveted at one end to the said connecting bar 218 and normally lies flat thereon with its free end clear of the edge of the latching detent 221. The first of the cam nodes 206, above mentioned, is pressed from the right hand side of the disc 200, as viewed in Fig. 13, to form a projection that engages roller 238 of the second lever 237. This actuates this lever so that the inclined cam surface strikes pin 239 during the last revolution of the signal transmitter cam sleeve 140, when the code disc 200 has nearly completed one revolution. The latching detent 221 is thus disengaged from the lug 219 on the first bellcrank lever which then returns slightly by pressure of spring 224 and the latching detent 221 continues to be held in the unlatching position by the engagement of the square edged lugs 219, 220. The further movement of the first bellcrank lever is however prevented by the concentric cam surface 216 on the coupling gears resting against a shaped projection 242 fixed to a stiff spring 243. This projection and spring may for normal operation be regarded as fixed; the resiliency being only sufficient to prevent breakage of any part if the coupling gears or latching means fail to operate correctly. This preliminary movement of the first bellcrank lever is sufficient however to enable the clutch releasing detent 229 to return to its unactuated position to re-arrest the clutch on completion of its revolution. The code disc 200 continues to be driven through the gears until the cam sleeve 140 is about to be re-arrested as above mentioned when one of the two V-shaped notches 217 in cam 216 moves into position opposite projection 242 on stiff spring 243. This permits the first bellcrank lever to complete its return movement to disengage the gears 213, 214 and restore the permutation bars to their normal position for keyboard operation when it is again relatched by detent 221. The roller 238 of the second lever 237 at the position where the code disc and coupling gears are arrested, falls into the second cam node 207 which as previously stated is pressed from the opposite side of the disc to the first cam node 206. The code disc is thus held in the home position with the bar 234 in notch 204 and disengaged from the waved edge of the disc; the coupling gears are held in a definite position by projection 242 and V notch 217 in cam 216; and the pinion 214 on the transmitter cam sleeve is held by the arrested clutch in a similar definite position. When control rod 225 is actuated, therefore, the gears enter cleanly into mesh and may be substantially fully meshed before the parts commence rotating.

With the arrangement as thus described, the single contact actuating member 141—144 is oscillated invariably by the extensions 157 and 158 of this actuating member for the start and stop elements of each signal combination, as described with reference to Fig. 8, although the keyboard permutation mechanism is out of operation during automatic signaling. As the code disc rotates continuously during automatic signaling, corresponding invariable cam portions are formed on the disc periphery to permit the bar 234 to follow the movements of the single actu-

ating member by the said extensions 157, 158, the slight resiliency of the disc 200 permitting any small lack of synchronism or accuracy of construction. This arrangement also permits a clean entry of the leading edge of the notch 204 in the disc 200 into the slot in bar 234 when the code disc commences rotating for the start element of the first signal combination of automatic transmission. During the permutation elements of each signal combination effected by the code disc the levers 134 of the keyboard controlled mechanism are sequentially actuated by the cam projections 139 but as the permutation bars and abutment plates are unsupported at the operative position the three armed levers 136 remain loose on their respective pivot screws 137. As thus described it will be understood that the code disc and the transmitter cam sleeve rotate continuously during automatic signal transmission and are preferably arranged not to be momentarily arrested between successive signal combinations. The signal combinations are therefore continuous as in tape controlled transmission.

Fig. 15 illustrates another example of an automatic signaling attachment, in this case arranged to operate either in conjunction with the combined keyboard and tape controlled signal transmitter shown in Figs. 10 and 11, or with the use of parts manufactured normally for this previously described apparatus. Various alternative arrangements are readily applicable in these circumstances. When a single series only of signal combinations is required to be provided for, the example illustrated in this Fig. 15 appears to present some advantages. The auxiliary cam means in this case sets in sequential order the abutment plates 133 controlling the cam operated levers 134 of the signaling mechanism previously described. When a number of alternative groups of signal combinations are required to be provided for, in a keyboard controlled signal transmitter, it may be preferable to arrange a number of such auxiliary cam means to co-operate alternatively, according to the group of signals desired, with the permutation bars of the keyboard.

In Fig. 15 the auxiliary cam means comprises a cam drum 250 formed of a number of discs corresponding to the series of permutation elements of a signal combination, each disc with its edge pressed over into a short cylindrical portion on which elemental cam projections are bent radially inward or outward, or left unbent. The short cylindrical portion of the discs, of which one is shown in Fig. 15, are divided, in this example into eight segmental portions by slots 251, so that the cam drum is adapted to transmit a group of eight signal combinations. The leading edge of each segmental portion of each pressed disc is bent or left cylindrical as above mentioned, to form a guiding surface for a pin 252 fixed to an extension 253 of the abutment plate 133 corresponding to that disc. The abutment plates are slidable longitudinally as previously described in auxiliary supports 254, 255. According to the direction in which the leading edge of a segment on a disc has been bent the pin 252 co-acting with that disc is actuated from the inner cylindrical surface of the trailing portion of the preceding segment, to the outer surface of the segment considered, or from the outer to the inner cylindrical surface. When an abutment plate 133 is required to remain in the same position for similar elements in successive signal combinations, the succeeding segment on that disc is left unbent radially so that the pin 252 on the plate is maintained on the one or other cylindrical surface to which it has been guided. A sixth disc 255 having a similar bent over short cylindrical portion but with one cam depression only 256 pressed radially inward for a purpose presently to be described together with a ratchet wheel 257 having eight teeth 258, and the series of code pressed discs above described are mounted to form a single unit, for instance by clamping by a threaded nut 259 on shaft 260 by which the cam drum 250 rotates in fixed bearings (not shown). The series of six discs and ratchet wheel 257 are assembled for this purpose in correct relationship as afterwards described herein, and a pin 261 inserted in a hole drilled through the assembled drum serves to maintain this relationship. Tubular spacing pieces 262 are inserted between the discs in assembly so that the extensions 253 of the abutment plates 133 can pass freely between the edge of the bent over cylindrical portion of their discs and the backs of the respective adjacent discs. Fig. 16 shows another view of the cam drum assembly and extensions 253. The cam drum unit is rotated one tooth of ratchet wheel 257 by a snail cam 175 on the transmitter cam sleeve 140 through an actuating arm 263 having a spring detent 264 on its extremity. The snail cam 175 is the same cam referred to previously for feeding the tape in the arrangement shown in Figs. 10 and 11 and the actuating arm 263 for the present example may be fixed to the tape feed arm 174 of this previous example and pivot on rod 160 in the same way. The angular distance through which the cam drum 250 is required to be moved by each step of notched wheel 257 is greater in the present example than the tape feed spindle 173 of the former example. The various parts are therefore proportioned approximately as shown in Fig. 15 to achieve this object. It is important to note for the purpose of illustrating the present invention that the snail cam 175 effects the actuating movement of arm 263 and cam drum 250 smoothly throughout the major portion of each revolution of the transmitter cam sleeve 140. The return movement of the arm 263 by spring tension is effected comparatively rapidly but no other function need be effected by this return movement.

The sixth disc 255, above mentioned, co-operates with a follower pin 265 fixed on the lower extremity of a shaped lever 266 pivoted at 267 and a spring 268 tends to turn the lever 266 in a clockwise direction as viewed in Fig. 15. A forked part 269 of this lever 266 extends towards and engages a tooth 270 pressed from the actuating arm 263 to hold this arm at or near the extreme actuated position when follower pin 265 has fallen into the depression 256 in the sixth disc 255. A vertically extending arm 271 of the shaped lever 266 is operable against tension of spring 268 by a control rod 272, to release tooth 270 on actuating arm 263. The clutch releasing detent 229 of the signal transmitter cam sleeve 140 may also be movable to the releasing position by the shaped lever 266 through a thrusting link 273 pivoted to the lever 266 near the follower pin 265. Each of the pressed discs co-operating with the abutment plates 133 has a clearing slot 274 cut through the bent over cylindrical portion to permit the pin 252 of the associated abutment plate 133 to pass freely therethrough when the cam drum 250 has again reached the normal or home position. In this home position of the drum follower pin 265 on lever 266 falls into the depression 256 in the sixth disc 255 and the actuating arm 263 is held

in the latched position. This permits the abutment plates to be operable by the keyboard or tape controlled mechanism in the manner previously described, when the automatic signaling means is out of operation. This change-over framework comprising the end plates connected by cross bars 176, 177, 178, described with reference to Figures 10 and 11 and also indicated in Fig. 15, is preferably interconnected in any suitable manner with the present automatic signaling cam drum means, to actuate latches 181 and disconnect the permutation bars 131 from abutment plates 133 while cam drum 250 is in operation.

The signaling contacts are actuated for the start and stop elements of each signal combination by the extensions 157 and 158 on the single contact actuating member as previously described with reference to Figs. 8, 10 and 11, and the permutation elements are effected in succession according to the positions of the respective abutment plates at the periods when the corresponding levers 134 are actuated in succession by the cam sleeve 140. Each code disc of the cam drum for succeeding elements of a signal combination is therefore displaced relatively backward when assembling the drum and before the hole for pin 261 is drilled. By this means the abutment plates are selectively set in overlapping sequence throughout successive signal combinations and each plate is firmly held in the set position by the concentric portion of the corresponding segment of the discs in the drum when the associated lever 134 is actuated by the transmitter cam sleeve. The segment on the disc for the first permutation element of the first signal combination may require, with the particular arrangement described, to be carefully bent to actuate the abutment plate to the required position for this first element with a smaller angular movement of the cam drum from the home position than for the remaining elements. The segment for the last permutation element of the last combination may also require to be set so that this signal element is correctly effected before the slot 274 for the home position of the drum finally moves into line with the pin 252 on the abutment plate. With these exceptions it will be seen that although the drum is rotated relatively slowly, the actual angular position of the drum relatively to the transmitter cam sleeve during rotation is not required to be very precise. The details of any interlocking or interlinking mechanism between the automatic signaling mechanism and the keyboard or tape controlled signal transmitter with which it co-operates, form no essential features of the present invention. The first feature it is here desired to emphasize is that the cam drum effects a series of auxiliary operations for the elements of a signal combination in timed and sequential relationship to the operations effected by the transmitter cam sleeve. The transmitter cam sleeve itself effects separate series of main and auxiliary operations as in the arrangement shown in Figs. 10 and 11. The second feature it is desired to emphasize is that the auxiliary cam means represented in this example by the cam drum 250 is rotated by ratchet means direct from the transmitter cam sleeve.

Figs. 17 and 18 show an example of the application of the principles of the invention to a cryptographic telegraph system and apparatus. The apparatus is particularly adapted to operate in conjunction with a signal transmitting apparatus of the developed types shown in Figs. 6 to 11, although not necessarily limited thereto. As will be seen ciphered signal received from a distant transmitting apparatus can be deciphered before controlling printing means in the usual manner by the same cryptographic apparatus that is employed to cipher signals. Referring to Figs. 17 and 18, a driving shaft 280 is geared by any suitable means (not shown) at the proper ratio to the driving shaft of the signal transmitting cam sleeve. A clutch 281 connected through splined member 285 to a driven shaft 282 extending between and supported by side plates 283, 284 is controlled by a releasing detent 286 to rotate the driven shaft 282 for half a revolution at each actuation of the releasing detent 286, in any suitable manner. The splined member 285 permits the shaft 282 to be moved in a longitudinal direction without affecting the relative angular positions of shaft 282 and clutch 281. On driven shaft 282 are fixed three light pinions 287, 288, 289, which pinions may be of fabricated construction as indicated by the end view in Fig. 18. Each pinion has a number of teeth twice that of the permutation elements in the signal code to be ciphered or deciphered. For the five unit code, each of these pinions therefore has ten teeth. Parallel to this driven shaft 282 is an intermediate shaft 290 (Fig. 18) having three idler pinions 291 (Fig. 18) each freely rotatable thereon to transfer motion from the pinions 287–9 on driven shaft 282 to a series of three circular metal code bands 292, 293, 294. Each code band is formed with a continuous row of driving teeth 295 (Fig. 18) pressed or rolled into a substantially strip portion 292A, 293A, 294A (Fig. 17) along the circumferential length of the band. These code bands may be prepared from long lengths of metal strip having the teeth 295 already initially formed therein, cut into lengths of desired integral numbers of driving teeth, bent into circular bands, and the ends welded or otherwise joined to form loops with teeth for meshing continuously with the idler pinions 291. On one edge 292B—294B, of each of these bands elemental code cam portions 296 are pressed radially inward or outward forming a continuous waved cam surface. Each driving tooth 295 on the band serves as a locating point for the pressing operation to form each code portion 296. The one or other radial direction in which successive code portions 296 are pressed is entirely arbitrary for the present descriptive purposes, but similar code bands with identical series of code portions must be provided at the distant receiving and printing apparatus for deciphering the signals. The plain cylindrical strip 292C—294C, at the other end of each band may be impressed with a number, a letter, or a number and a letter, opposite each driving tooth 295 to serve as an identifying mark to set each band to an initial position. The bands are supported in an easily detachable manner in driving engagement with idler pinions 291 by a corresponding series of rollers 297, 298, 299 freely rotatable on shaft 300. This shaft is in turn supported by brackets 301, 302 fixed to an outer tubular member 303 rotatable on an inner tubular member 304 which is rigidly fixed at one end by clamping ring 305 to side plate 282. The other side plate 284 is cut away near the free end of these tubular members 303, 304 to facilitate removal of the code bands 292—294. A finger piece 306 attached to the outer tubular member 303 enables this member together with the brackets 301, 302 shaft 300 and rollers 297–9 to be moved between two fixed stop positions, a bias spring 307 serving to hold the assembly in one

or the other position. In one position, shown in full lines in the figures, the rollers 297—299 support and hold the code bands 292—294 in driving engagement with the idler pinions 291 and for this purpose the rollers may be arranged to be slightly but stiffly resilient to avoid loose vertical movement of the bands. When the assembly is turned to the other position, shown dotted in Fig. 18, the bands can be removed. If the code cam portion 296 on the bands impede the removal of the bands, by engagement with the teeth of idler pinion 291 the bands may be manually rotated as later described to a position where a depression of code portions are pressed radially inward. A guiding fork consisting of a series of flared sheet metal arms 308 pivoting together on rod 309 is moved into and out of position to guide the code bands by a pin 310 fixed to the fork and sliding in a cam slot 311 in a flange portion 312 attached to the outer tubular member 303. When the code bands are in position, these three bands are simultaneously rotatable through five teeth consecutively, and consequently through five elemental cam portions, at each release of the clutch 281 by releasing detent 286. The detent 286 is actuated and controlled in a manner that will be referred to later in this specification, but the period of actuation of the detent is timed and the gearing ratio of the driving shaft 282 to the transmitted cam sleeve 140 driving means so that the five elemental cam portions of the three code discs are sequentially operable simultaneously with the five cam projections 139 of the transmitted cam sleeve 140.

The code cam portions 296 of each band oscillate a lever individual to each band, arranged substantially tangential to these bands to pivot on rod 316. Each cam lever comprises two arms, seen more clearly in Fig. 19. One a stiff flat arm 315 is bent sharply in a direction parallel to shafts 290 and 300 at the position along the length of this arm 315 where it is tangential to the code band as above stated. A slot 317 is cut in this bent-over extremity of arm 315 by which the waved cam edge 292B—294B of the corresponding code band positively oscillates the lever cam rod 316. The second arm of each lever is a flat blade 318 flexible in one direction of movement only and firmly riveted to the first mentioned arm 315 near to the pivoting point on rod 316. At the free end this blade 318 carries a short rod 319 riveted to and extending beyond this free end of the blade. The first mentioned arm 315 is bent at a slight angle to the plane of the associated code band towards rod 316. The second arm or blade 318 can then be freely bent to and fro from the free end in a horizontal direction parallel to rod 316 for a distance equal at least to the distance through which this free end of blade 318 is oscillated in a vertical direction by the associated code band. The short rod 319 at the free end of each said second arm or blade 318 is therefore independently movable in two directions mutually at right angles. These short rods 319 extend through clearing holes in a rigid bar 320 which is fixed to the two side plates 283, 284, in a position clear of the code bands. Each rod 319 carries a light roller 321, 322, 323 and one end of a flat link 324, 325, 326 respectively both co-axially pivoting on their corresponding rod 319. Equi-distantly arranged around the central, neutral, or unactuated position of each roller 321—323 three bearing pivots 327, 328, 329 are fixed to the bar 320. One pivot 328, of each three of these bearing pivots is situated at a position vertically over the said central position of its roller and the other two bearing pivots 327 and 329 horizontally on either side respectively of their corresponding roller. Each bearing pivot has a small bell-crank member movable thereon the arms of each group of three members being arranged around the roller. The arms 330, 331 of the bellcrank member on the uppermost pivot 328 in each group are symmetrically shaped to co-act directly with the roller 321—323. The two arms of each of the other two members are asymmetrically arranged, the lower arm 332 of each of these two members co-acting directly with the roller and the upper arm 333 bearing on the outside of each arm 330, 331 respectively of the uppermost or first mentioned bellcrank member at points substantially midway between the bearing pivots. These bellcrank members may be constructed from bent metal strips welded or otherwise fixed to cylindrical pivot pieces. The cylindrical pivot piece of each uppermost bellcrank member is continued and carries a short actuating arm 334 extending to a position substantially co-axial with the associated roller 321—323 when in the central or unactuated position. This arm 334 may also be of bent metal strip and at the free end of the arm accommodates a pivot 335 fixed to each flat link 324—326 the other end of which is co-axially pivoted with the roller as previously described of the next device in the series. These flat links 324—326 are arranged to be sufficiently rigid to transmit an actuating movement longitudinally therethrough but are sufficiently flexible in the thickness of the link to permit the slight angular movements of the blade 318 carrying the roller. The extreme right hand link 326 in the series shown in Fig. 17 is pivoted at a fixed point 336 on bar 320. The code bands, as will be understood, actuate their associated rollers 321—423 in a direction transversely to bar 320. The first or right hand band 294 in Fig. 17 is shown with its roller actuated to the upper of its two positions. The fixed pivot point 336 on bar 320 of the first link 326 holds the roller 323 permanently in the left hand position in the direction along the bar 320. This therefore holds or moves uppermost bellcrank member through its left hand arm 320 in the position shown, and therefore with the second link 325 connected, to the second roller 322 to the left hand position also. If the first code band 294 moves its associated roller 323 to the lower position, the lower arm 332 of the left hand, a symmetrical bellcrank member, is actuated by the roller 323 to reverse the position of the second link 325. This first device merely serves as a convenient means to translate the movements of the first roller 323 transversely to bar 320 into longitudinal movements of the second link 325. The second roller 322, however, is now caused to occupy one or the other of two positions by the second link 325 as well as one or the other of two other positions by the second code band 293. In Fig. 17 the second code band has actuated its roller 322 to the lower position. This combined with the movement of the roller 322 to the left hand position by the second link 325 has actuated the third link 324 to the right hand position. This similarly has combined with the movement of the third roller 321 by its third band 292 to the lower position, to move a fourth or last link 337 to the left hand position. The code bands are arranged as previously described, to actuate their levers and rollers simultaneously for each successive elemental cam portion. The

last or left hand link 337 is therefore moved positively from one to the other of two positions for each successively signal element of a group of five at each release of clutch 286, and each successive position in which the line 337 is actuated is a resultant of all the actuating movements by the series of code bands. The numbers of elemental cam portions 296 in each band 292—294 are arranged so that a slow relative creeping motion of the bands is obtained in a similar manner to that already known for ciphering perforated tapes. With the three bands shown in the drawings having provision for 41, 43, and 47 continuous cam portions respectively, for instance, a total number of 82,861 successive resultant movements of the final link are obtained before the cycle repeats. In the five unit code this is equivalent to 16,572 signal combinations. The bands may be readily removed and replaced by others having different arrangements of successive elemental cam portions by prearrangement with the distant receiving station. In addition, means is also shown in the drawings to permit the bands to be readily set or changed to a prearranged initial position. This means comprises a finger wheel 340 fixed to a square or splined shaft 341 rotatably mounted in the side plates 283, 284. On this shaft 341 and rotatable thereby is a pinion 342 slidable by a finger piece 343 guided by a further fixed shaft or bar 344 along the square shaft 341 to a position to mesh with any one of the idler pinions 291. The driving shaft 282 and pinions 287—289 can be moved longitudinally to the position shown dotted in Fig. 17 by any suitable means (not shown), the splined member 285 connecting this shaft 282 and the clutch 286 as previously mentioned, permitting this longitudinal movement. This disconnects the driving pinions 287—289 from the idler pinions 291. The finger wheel 340 can then be employed to move any code band to any desired position, the identifying position for which can be located by the marks impressed on the cylindrical portion 292C—294C of each band, against an index plate 344 (Fig. 18), for instance. When each band has been set to the agreed position the sliding pinion 342 can be moved out of engagement with the idler pinions 291 and the driving shaft 282 replaced in position with the driving pinions 287—289 meshing with the idler pinions 291.

The manner in which signal transmitting mechanism may be modified to co-act with ciphering means as above described is indicated in Fig. 20. This figure shows a plan of a signaling cam sleeve and contact actuating members similar to those described with reference to Figs. 8 to 11, but modified for the above mentioned purpose. A single cam sleeve in this modified signal transmitting mechanism carries a separate cam projection 360 for the invariable start and stop elements of each signal combination. This projection 360 is arranged on the cam sleeve next to the notched cam 154. The single contact actuating member of the previous examples is also here formed of three separate but co-acting portions each independently pivoted on rod 145 (Figs. 8, 10 and 11). One of these portions 362 carries the two pins 156 alternately moving the arms of the U-shaped spring 155 as before. This first portion 362 also has two extensions 363, 364 operable by the start and stop cam projection 360 to actuate the signaling contact mechanism in opposite directions respectively at the proper time periods during rotation of the cam sleeve. The start and stop cam projection 360 and co-operating parts are proportioned so that this first portion 362 of the contact actuating member can be oscillated independently during the remaining period of rotation of the sleeve. The second portion 365 of the contact actuating member carries the transverse bars 141, 142 and is operable by the series of three-armed members 134 for the permutation elements of a signal combination as before. This third portion comprises a lever 366, spring blade 367 and roller 368, similar in function to those of the devices in Figs. 17 and 18. In this case the lever 366 is oscillated on rod 145 by the above mentioned second portion 365 when coupled thereto as will presently be described. The roller 368 of this third portion is operable in a direction parallel to the cam sleeve by a link 369 and through any other necessary connecting members by the final link 337 in Fig. 17. The three bellcrank members 370, 371, 372 surrounding roller 368 are arranged to operate similarly to those previously described but the middle member 370 in this case carries an actuating arm 373 extending towards and at its extremity playing between two extensions 374, 375 bent from the first portion 362 of the contact actuating member. This arm 373 and extensions 374, 375 are proportioned so that in the central or unactuated position of the arm 373 the first portion 362 is free to be oscillated for actuating the signaling contacts independently of arm 373, but is moved in one direction or the other by this arm in either of its extreme positions in a manner that will now be understood. A manually operable coupling means having three alternative positions consists of a tubular piece 376 fixed between the side plates 365 of the above described second portion. This tubular piece 376 accommodates a sliding bolt 377 having pointed or domed ends and a pin 378 projecting through a slot 379 in the tubular piece 376. Pin 378 is engaged by a forked selecting member 380 that is manually operable as above mentioned. The ends of the bolt 377 are adapted to enter holes in the adjacent side plates of the first and third portions 362 and 366 respectively, according to the one or other direction in which bolt 377 is moved by fork 380. The central or second portion 365 can then be coupled to either the first or the third part 362 or 366. In the central position of fork 380 the three portions are independently movable on pivot rod 145. If bolt 377 is moved to couple the first and second portions together, the signal transmitting contacts can be operated by the cam sleeve under control either of the keyboard or the perforated tape, as described with reference to Figs. 10 and 11. If bolt 377 is moved to couple the second and third portions together, the first portion actuates the signaling contacts for the start and stop elements. The movements of the second portion according to the character of successive permutation elements of each unciphered signal combination, however, are mechanically combined by the roller device, 368—373. With the resultant movement of final link 377 of the ciphering mechanism, to actuate the first portion 362 after the invariable start element, according to the permutation elements as thus ciphered. With bolt 377 in the central position, the code disc 200 of the code signaling attachment in Figs. 13 and 14 can be employed to oscillate the first portion 362 directly, as previously described. In this case it is not necessary to lower the abutment plates 133 out of the operative position.

The signals are deciphered at the distant signal

receiving apparatus by combining the movements of a member responsive to the character of successive received signal elements, with the movements of the final link 337 of the deciphering apparatus, during the variable permutation elements of each signal combination, to reproduce the movements corresponding to the unciphered signal elements at the signal transmitting station. The signal receiver releases a clutch in response to the invariable start element of each signal combination and couples a cam shaft to a driving shaft in the usual manner. A cam on this driven shaft releases the clutch of the deciphering apparatus to rotate in synchronism with the received permutation elements of a signal in a similar manner to the ciphering apparatus at the signal transmitter. The final link of the deciphering apparatus may oscillate in one direction of movement the roller lever of a device similar to those already described. A relayed movement effected by the camshaft may be arranged to oscillate the roller lever in the other direction of movement, according to the character of the received ciphered signal elements. The resultant successive movements of the actuating arm and middle bellcrank member of this device can control any desired form of signal translating mechanism for selecting in known manner a printing character or other operation corresponding to the original unciphered signal combination. With suitable connecting and controlling means it will now be seen that a single apparatus can be employed, in a simplex system where signals are transmitted in one direction only at a time, to cipher signals transmitted from a station and to decipher signals received from the distant station. In this case the clutch releasing detent 286 of the cryptographic apparatus is operable both from the transmitter and from the receiver cam sleeves.

In the signal transmitting apparatus it will be seen that relatively large tolerances can be allowed in the signal preparing and combining parts of the apparatus, without affecting the accuracy and precision of the changeover or transit characteristics of the signaling contact mechanism. These characteristics are determined primarily by the main cam means represented by the notched cam 154. The auxiliary cam means in this case is composed of two chief co-acting portions, one represented by the series of cam projections 139 of the signal transmitter, and the other by the elemental cam portions 296 of the series of code bands.

The methods of control to put the cryptographic apparatus into and out of operation, and the methods and means to connect this cryptographic apparatus to the signal transmitting and signal receiving apparatus with which it works in conjunction, form no essential subject matter of the present specification. Fig. 21, however, illustrates diagrammatically a method of control of the cryptographic auxiliary cam means. A snail cam 390 on the main or signal transmitter cam sleeve 140, actuates a lever 391 against tension of a strong spring 392. Lever 391 is connected by a link 393 to the clutch releasing detent 394 of the auxiliary cam means on shaft 292. Snail cam 390 is oriental on the main cam means 140 so that a projection 396 on lever 391 falls from the step 397 in the snail cam, to release the clutch of the auxiliary cam means at the desired point during the revolution of the main cam means.

The free extremity of lever 391 is engageable by a latching lever 398 to hold lever 391 near the extreme actuated position effected by snail cam 390. This prevents the release of the auxiliary cam means. The free extremity of latching lever 398 is in turn engageable by a further latching lever 399 when the first said latching lever 398 is just clear of the extremity of lever 391. Latching levers 398 and 399 are each independently operable to their unlatching position by control rods 400 and 401 respectively. These control rods may be operated by a cam on the depression of either of two corresponding signal lug levers in the transmitter keyboard, and after the corresponding signal combination has been transmitted. The control rods may be similarly operated by the signal receiving apparatus. When control rod 400 is actuated, lever 398 is latched by lever 399, and cam lever 391 releases the auxiliary cam means each time step 397 on the snail cam passes projection 396, i. e., for each signal combination transmitted. When the other control rod 401 is actuated, latching lever 398 is released and in turn it latches cam lever 391 when this next actuated by snail cam 390.

It will be appreciated that a similar arrangement may be employed to control the auxiliary cam means for automatic signaling and other purposes described in this specification. This appears to be particularly important when it is desired, for instance to provide for any one of a number of selectable groups of signal combinations to be automatically transmitted. As in the example of the cryptographic apparatus previously described, the power required to operate the auxiliary cam means may make it desirable to provide a separate clutch and driving means less liable to react on the rotation of the main cam means.

I claim:

1. Telegraph, signaling, and like selective systems having a signal transmitting distributor with a series of sequentially operable elemental portions for transmitting a corresponding series of signal elements distinguished by two line conditions in a signal combination; a plurality of series of control elements each series being operable in sequence, of which one or more of said series control the elements of the signal combinations transmitted by said distributor, and means rendering effective at least one of said series of control elements in sequential and overlapping order with the sequential operation of the elemental portions of said distributor.

2. Selective signal transmitting apparatus comprising a signaling mechanism operable for every signal combination to transmit signal elements distinguished by substantially two line conditions only, a plurality of control elements operative in sequence to determine the character of each signal element in a signal combination, a second series of control elements operative in sequence to time the duration of each of said signal elements, the operation of each seperate series being interlinked in mutually overlapping sequence.

3. In a signal transmitting apparatus, a distributor having a series of sequentially operative elemental portions, a plurality of series of permutation control elements each series being operative in sequential relation, and means operatively driven together with said distributor to associate at least one series of said plurality of series of permutation control elements with the elemental portions of said distributor in sequential and overlapping relationship with the operation thereof.

4. In a signal transmitting apparatus, a dis-

tributor effecting a main series of sequential operations for the permutation elements of a signal combination, auxiliary means effecting a second series of sequential operations for the permutation elements of a signal combination, and driving means for said distributor and said auxiliary means including individual clutches and gearing therebetween of a ratio to effect both said series of operations in overlapping relationship.

5. In a signal transmitting apparatus, a distributor effecting a main series of sequential operations for the permutation elements of a signal combination, a movable member effecting an auxiliary series of operations in sequence overlapping said main series, for the permutation elements of a signal combination, and ratchet means actuated by said distributor to move said movable member.

6. A selective signal transmitting system for transmitting signal elements distinguished by two types of line conditions comprising a rotatable member for sequentially applying said signal elements to said line, in timed signal combination, and means operating in sequential overlapping relation with said rotatable member, for determining the nature of said separate signal elements.

7. In a signal transmitting apparatus, a rotatable member having a series of cam portions corresponding to the permutation elements of a signal combination and a second series of cam portions also corresponding to the permutation elements of a signal combination, a contact actuating member selectively actuated from one to the other of two positions in sequence by one of said series of cam portions, and signaling contact means actuated in corresponding sequence from one to the other of two contact stops according to the movements of said contact actuating member under control of the other series of cam portions.

8. A selective signal transmitting system for transmitting signal combinations composed of a plurality of different signal elements, comprising a first cam means for sequentially performing the determinations of the signal elements forming the signal combination to be transmitted, and other cam means operable in overlapped relation with said first named cam means for sequentially transmitting said signal elements in timed relation.

9. A signal transmitting system as claimed in claim 8 in which said first named cam means comprises a cam designed to transmit a predetermined message of fixed content.

10. A signal transmitting system according to claim 8 further comprising code combination selecting means, means operable by movement of said combination selecting means for adjusting signal selecting means into positions, means controlled by said first cam means for moving said signal selecting means sequentially into operative position, signal transmitting contact means conditioned for operation by movement of said signal selecting means into operative position, and means controlled by said other cam means for releasing said contact means to transmit the selected signal element.

11. A signal transmitting system according to claim 8, further comprising signal selecting means controlled by said first cam means, and signal transmitting contacts controlled by the joint action of said signal selecting means and said other cam means.

12. A signal transmitting system in accordance with claim 8, further comprising a keyboard transmitter, means movable in accordance with operation of said keyboard to set up a signal combination, means operative by said first cam means to alter said set up combination in a predetermined manner, and means controlled by said other cam means for transmitting said altered code combination.

13. A selective signal transmitting system for transmitting signal combinations composed of a plurality of different signal elements, comprising a first cam means for sequentially performing the determinations of the signal elements forming the signal combination to be transmitted, longitudinally operating means movable in accordance with the signal combination to be transmitted, a transmitting contact element, selecting means positioned in accordance with said longitudinally operating means for actuation of said transmitting contact element, means cooperating with said first cam means for operatively associating said selecting means with said transmitting contact element, stop means for retaining said transmitting contact element in its last actuated position, and means operable by said other cam means for releasing said transmitting contact element for movement in sequential timed relation with said first cam means.

14. A signal transmitting system according to claim 13, further comprising transmitter combination bars, tape controlled transmitter operating means, and selective latching means for alternatively operatively associating said combination bars or said tape controlled transmitting means with said longitudinally operating means.

15. A signal transmitting system according to claim 13, further comprising, a signal controlling means, and means coupling said signal controlling means with said longitudinally operable means.

16. A signal transmitting system according to claim 13 further comprising, signal transmitting means for transmitting a predetermined coded message, means for coupling said signal transmitting means to said longitudinally operating means, and means for releasing said coupling means after transmission of said predetermined message.

17. Selective mechanism comprising, a first cam means having a series of sequentially operable elemental portions, a series of controlling members each independently movable from one to the other of two positions, a member movable from one to the other of two positions in sequence by said first cam means according to the setting of said series of controlling members, and a second cam means comprising separate series of code cam portions each series controlling the positions of a corresponding one of said series of controlling members and each of said separate series of code cam portions successively positioning its associated controlling member in sequential and overlapping order with the operations of said first cam means.

18. In a cryptographic signal transmitter, a permutation mechanism, a ciphering mechanism comprising a series of code cams simultaneously operable in sequential and overlapping relationship with the operation of said permutation mechanism, and signaling contact means oscillated according to the resultant of the movements of said permutation mechanism and said ciphering mechanism.

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