

Oct. 31, 1944.

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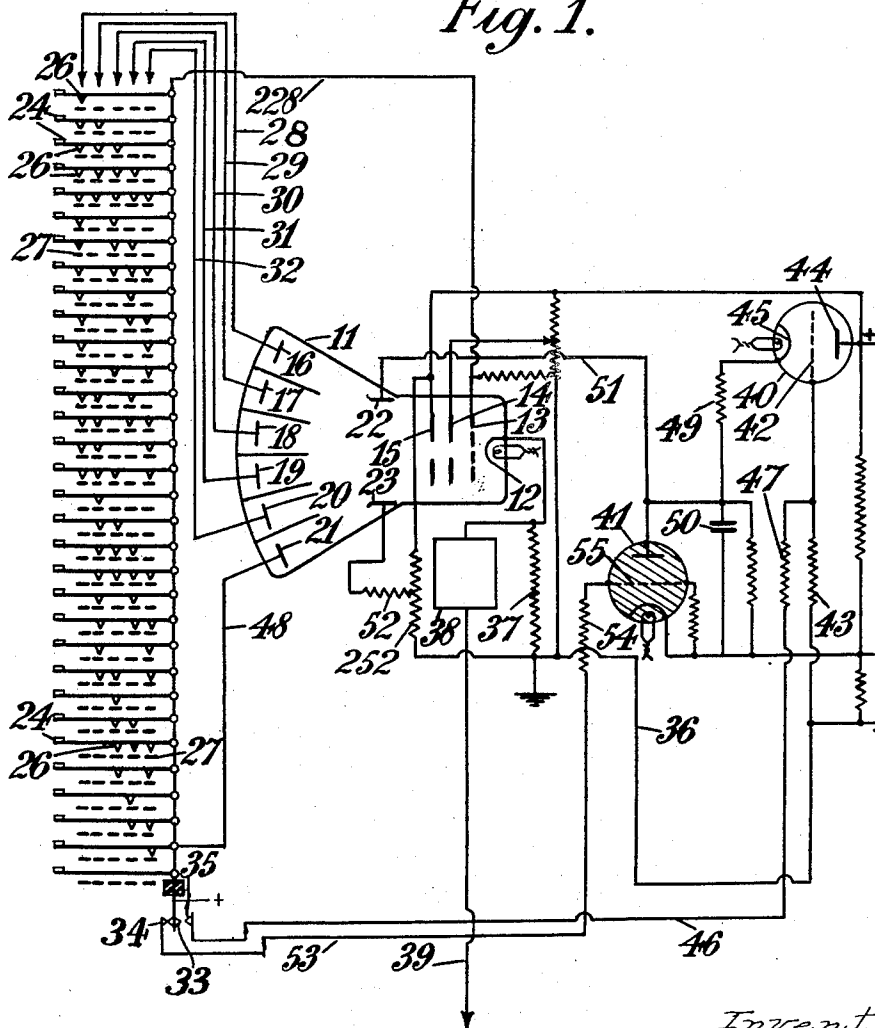
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AUTOMATIC TELEGRAPH APPARATUS

Filed June 26, 1942

5 Sheets-Sheet 1

Fig. 1.



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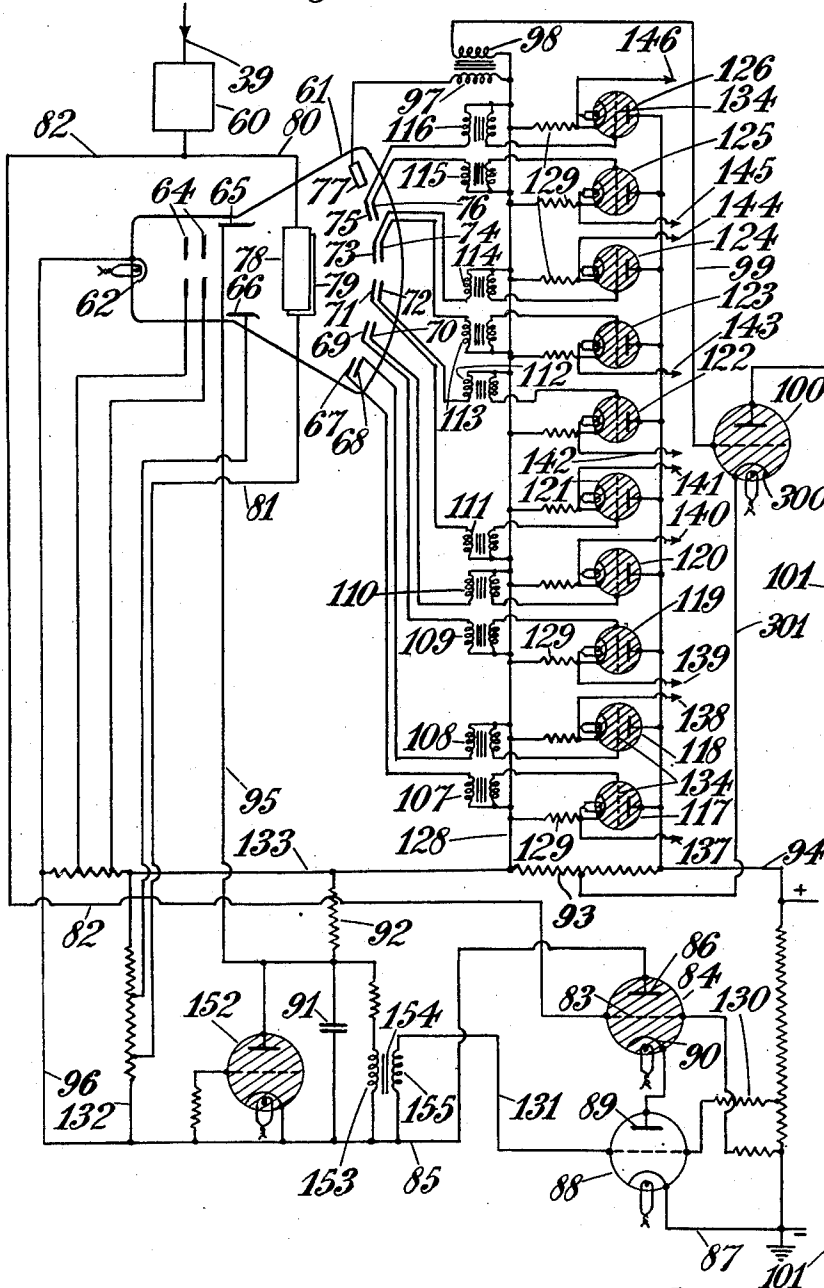
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5 Sheets-Sheet 2

Fig. 1. (CONT'D).



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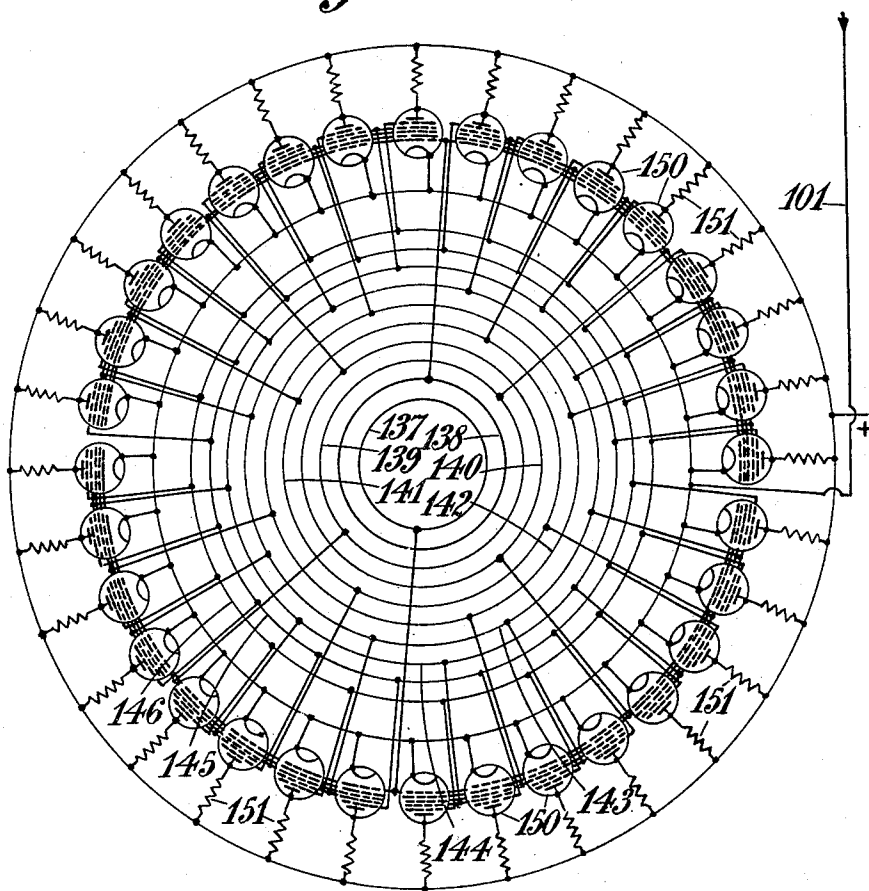
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5 Sheets-Sheet 3

Fig. 1 (CONT'D).



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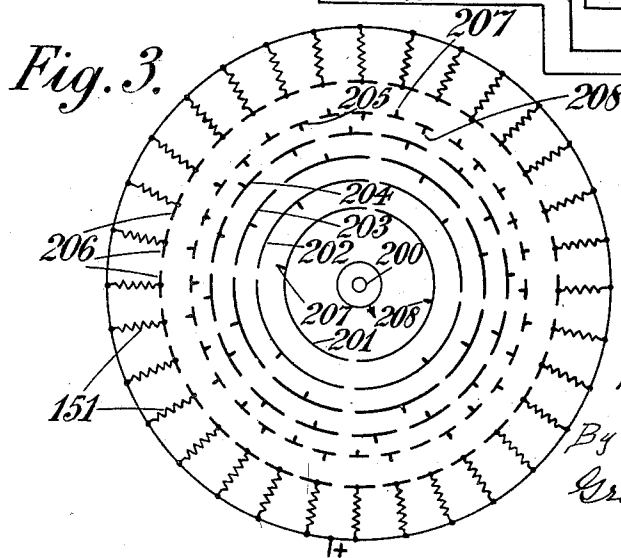
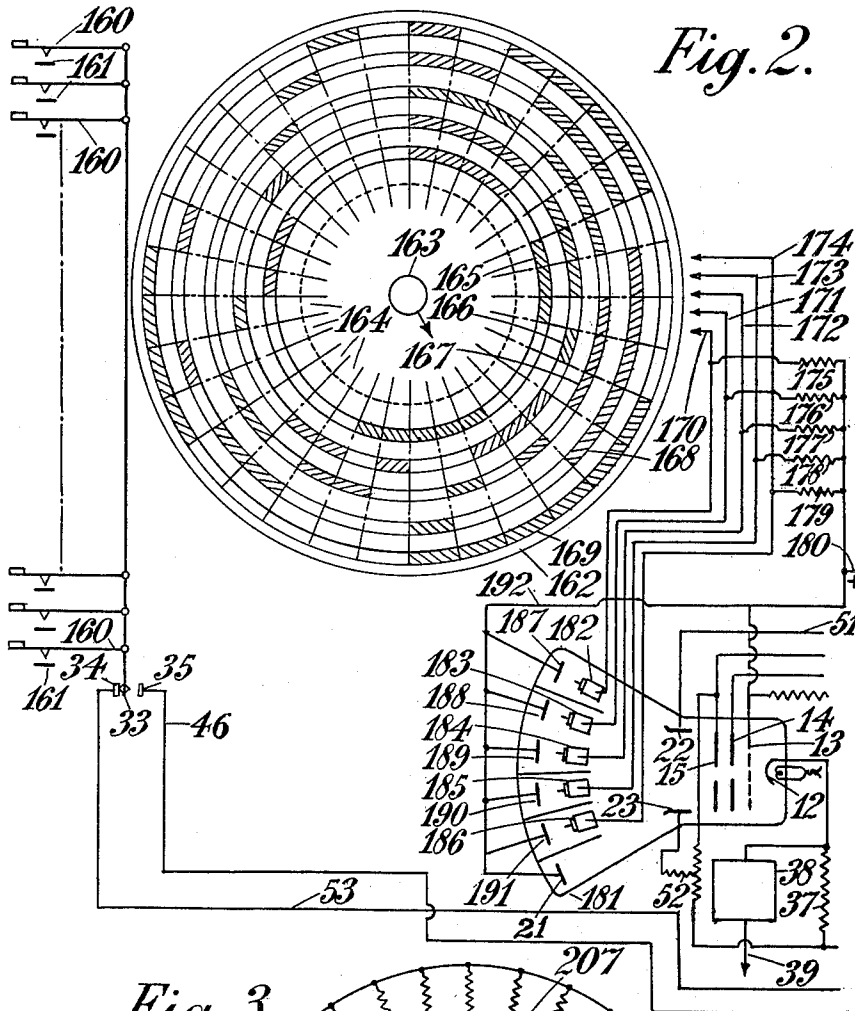
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AUTOMATIC TELEGRAPH APPARATUS

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5 Sheets-Sheet 4



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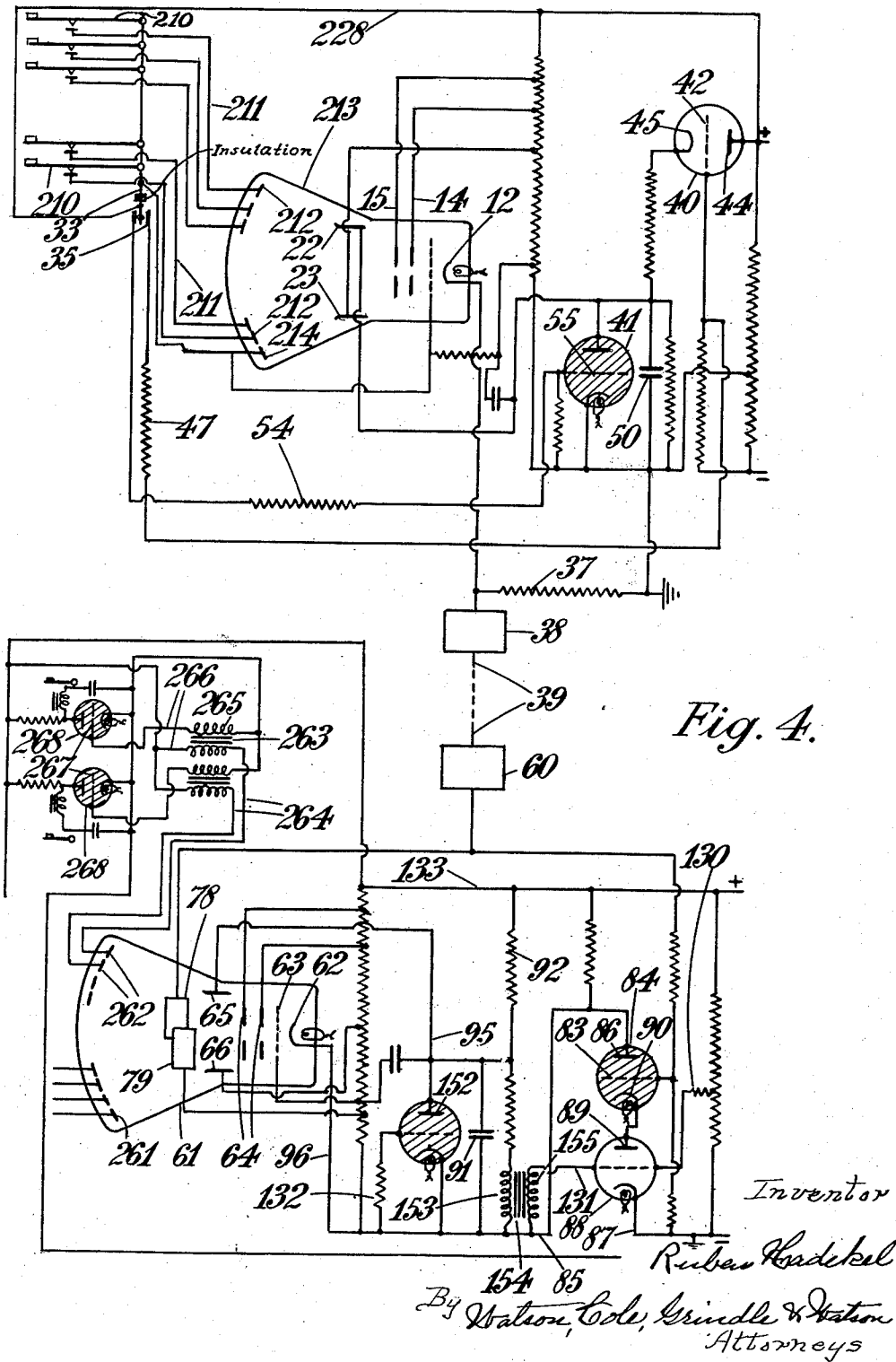
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AUTOMATIC TELEGRAPH APPARATUS

Filed June 26, 1942

5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE

2,361,766

AUTOMATIC TELEGRAPH APPARATUS

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EnglandApplication June 26, 1942, Serial No. 448,642
In Great Britain April 1, 1941

12 Claims. (Cl. 178—23)

This invention relates to automatic telegraph apparatus. In such apparatus it is usual to employ for transmission a coding device operated for instance by a keyboard in which the letters or other symbols to be transmitted are converted into a code signal consisting of a series of electric impulses of different duration or sign or amplitude, a transmitter operated by the code signals in succession to send the corresponding impulses along the transmission channel and at the receiver a distributor separating the code impulses of each signal letter or other symbol and a translator operated by each series of code impulses to indicate or print the letter or other symbol of the transmitted signal. In such apparatus it is the practice to employ mechanical and electro-mechanical devices for performing the various operations, both for transmission and reception, such devices consisting mainly of mechanically movable members operated by electromagnets. The object of the present invention is to reduce the number of mechanically movable parts and thus to enable a greater speed of transmission than in previous apparatus due to the limitations consequent upon inertia of mechanical parts, greater simplicity of the apparatus with ease of adjustment and convenient amplification of the signals at the receiving station.

According to the present invention there is provided an automatic telegraph apparatus wherein the coding, transmitting, distributing and translating devices, or any one or more of them, is or are constituted at least in part by one or more thermionic devices in which an electronic beam or space current is controlled to perform the required function in place of mechanical or electro-mechanical devices.

The invention comprises in automatic telegraph apparatus, transmitting apparatus comprising in combination a cathode ray tube having a series of code-anodes (or a long code-anode in combination with a series of deflector plates) arranged so that the cathode ray may sweep along the code-anodes or anode, means for causing the cathode ray to execute such sweeping movement, a coding device for determining which of the code-anodes (or deflector plates) is effective during a given sweeping movement and means responsive to current impulses to the cathode from the code-anode or anodes for transmitting signals to line.

The coding device for determining which of the anodes or deflector plates is effective may comprise means selectively to connect certain

code-anodes to grid (or deflector plates to positive) in accordance with the code.

Various forms of coding devices are hereinafter described in accordance with the invention.

At the receiving station there is provided a distributor for received signals and some form of translating device which is preferably of thermionic character as hereinafter described.

The invention comprises also the various forms of cathode ray tubes which constitute transmitting and receiving devices and the various forms of thermionic valve which constitute coding and translating devices as hereinafter described.

Specific examples of constructions in accordance with the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagram in three sections upon sheets 1, 2 and 3 of the drawings showing respectively, one form of coding and transmitting apparatus, a form of distributor for received signals to co-operate therewith and a thermionic translator for co-operation with the distributor, the whole comprising a complete system;

Figure 2 is a diagram of an alternative form of transmitting apparatus with a thermionic coding device;

Figure 3 is a diagram of an alternative form of thermionic translator to take the place of the translator of Figure 1;

Figure 4 is a diagram of another alternative form of transmitter and receiver.

Referring to Figure 1, 11 represents diagrammatically, a cathode ray tube comprising a cathode 12, grid 13, main anodes 14, 15 and a series of target code-anodes 16 to 20 inclusive. There is also a target starting anode 21 and deflector plates 22, 23 which, if suitably charged with a regularly increasing potential, will cause the cathode ray to scan the whole series of anodes, beginning with the starting anode 21 and terminating at the furthestmost code-anode 16. It is not necessary to describe the construction of a cathode ray tube of this kind in detail as with the knowledge at present available, given the characteristics which are set out in this specification, it is perfectly possible for a competent person to assign the appropriate dimensions and location to the various parts.

A series of keys 24 is provided, corresponding in number to the number of symbols which are to be transmitted. Each of these keys has a contact, or contacts, 26 on the movable part which closes against a corresponding contact 27 beneath it when the key is depressed. The con-

tacts 26 on the movable portions of the keys are all connected together to the grid 13 of the cathode ray tube by line 228. It will be noted that the fixed contacts 27 are arranged in five columns under one another in the drawings. The numbers of the contacts 26 which are carried by each key, and their location, are arranged in accordance with the code which is decided upon so as to close against one or more of the columns of the contacts 27, all the contacts 27 in any given column being connected together. The columns of contacts 27 are connected to five code wires 28 to 32 inclusive, which are connected respectively to the code-anodes 16 to 20 inclusive. Thus, pressing any particular key will energise one or more of the code-anodes and each key renders effective a different selection of the anodes in accordance with the code. The keys may be operated either manually or by any desired mechanism, of which various forms are known. Moreover, all the keys are disposed upon a rocking bar which carries a contact 33 insulated from the rocking bar, connected to positive and adapted to play between two contacts 34, 35 so that when the keys are raised the contact 34 is closed and when any key is depressed the contact 35 is closed. The keys, with the rocking bar and their contacts, constitute the coding device.

The cathode 12 of the cathode ray tube 11 is connected to negative line 36 through a resistance 37 and, whenever the cathode ray impinges upon a "live" target code-anode surface, (i. e. are connected to grid) the current passing is altered and causes a change of potential in the resistance 37. The resultant fluctuations of potential of the cathode 12 are connected to an amplifying circuit 38, the details of which it is not necessary to describe, and thence to the transmission line 39. The operations are regulated by auxiliary apparatus comprising the thermionic valve 40 and thyatron valve 41. The grid 42 of the valve 40 is connected by a resistance 43 to the negative line and normally serves to bias the valve so that no current passes from the anode 44 to the cathode 45. When however, one of the keys 24 is depressed the contacts 33, 35 are closed connecting the line 46 to the positive of the supply and this, through the resistance 47, is connected to the grid 42 thus reversing its polarity. At the same moment the starting anode 21 of the cathode ray tube 11 is rendered effective through the line 48 to grid 13 and a starting signal is despatched to the transmission line 39. The coding device is so arranged that the contacts 33, 35 do not close until after the coding contacts 26, 27 have closed and rendered effective the appropriate anodes of the series 16 to 20.

As soon as the grid 42 is reversed in polarity the valve 40 passes a current through the resistance 49 to condenser 50 and commences to charge the condenser, the potential of which rises. The positive terminal of the condenser is connected by a line 51 to the deflector plate 22 of the cathode ray tube and the opposite deflector plate 23 is connected through a resistance 52 to a potentiometer system 252. It will be appreciated that up to this time the cathode ray has been held deflected on to the anode 21, but as the condenser 50 charges up, the cathode ray begins to scan the anodes 16 to 20, one after the other. Whenever it reaches an anode which has been rendered effective by the closing of one of the contacts on the coding key which is depressed, a current impulse passes and is transmitted by the amplifier 38 to the transmission line 39. Thus,

after the starting signal a set of code impulses will be forwarded in strict accordance with the code contacts of the signalling key which has been depressed.

As soon as the key which has been depressed is released the contact 35 is broken and the contact 34 closed. This connects the line 53 to the positive of the supply and through the resistance 54 the positive potential reaches the grid 55 of the thyatron valve 41. As a consequence the thyatron valve strikes and discharges the condenser 50, thereby returning the cathode ray to its initial position where it impinges upon the starting anode 21, ready for the next signal. As will be obvious the time interval required for all these operations is extremely minute so that signals may follow one another without regard to any limitations which would be imposed if the various alterations of the circuit connections depended upon the usual electro-magnetic relay armatures and the like. Consequently the capacity of the system to transmit signals depends solely upon the speed with which the keys 24 can be operated and as these can be made very light, and if desired operated by power through an appropriately punched paper strip, or otherwise in known manner, the capacity may be made extremely high.

Coming to sheet 2 of Figure 1 of the drawings, this shows the receiving end of the transmission line 39 which delivers the received signals (which may be transmitted wireless signals) to an amplifier 60. The amplifier 60 is connected to a distributor cathode ray tube 61, the construction and operation of which is now to be described.

The distributor 61 comprises a cathode 62, main anode 64 and vertical scanning deflector plates 65, 66. The anodes are arranged in a double series, 67, 68 being the first pair and the others being numbered, in pairs, seriatim up to 75, 76. There is a terminating anode 77. Although in the diagram the pairs of anodes are shown concentric with one another in order that they may be separately seen, it is to be understood that they are in fact arranged in two series side by side at the same radius from the cathode. The cathode ray would normally strike the anodes of one series in the course of its scanning movement under the influence of the deflector plates, 65, 66, but it can be deflected onto the other series of anodes by means of two horizontal deflector plates 78, 79. The incoming impulses from the amplifier are delivered to the plate 78 by the connection 80 and the plate 79 is connected by the connection 81 to a control part of the apparatus hereinafter described. The incoming impulses from the amplifier 60 are also led by a line 82 to the grid 83 of a thyatron valve 84 which will be described as the "starting" thyatron. The first impulse which comes in over the line 39 will therefore serve to "trigger" the valve 84 and it will be recollected that this first impulse is a starting impulse effected by the closing of the contacts 33, 35, and is separate from the code signal which immediately follows. The effect is to connect the line 85 (in the diagram), which is attached to the anode 86 of the thyatron valve 84, to negative line 87 through the valve 88, the anode 89 of which is coupled to the cathode 90 of the thyatron valve. There is a condenser 91 which is connected through resistances 92, 93 to the positive line 94 and this condenser, as soon as the starting impulse is received, begins to charge, building up the potential of the line 95 which is connected to the vertical deflector plate 65 of the cathode ray

tube 61. The cathode 62 is itself connected to the negative line by the connection 96 joined to 85, and as a result the cathode ray from the cathode 62 is deflected and begins to scan the anodes of the tube 61, beginning at the bottom pair 67, 68 and moving towards the terminating anode 77. The capacity of the condenser 91 and the value of the resistances 92, 93 through which it is fed, are so regulated that the rate of charging will correspond with the rate of scanning of the anodes 16 to 20 by the cathode ray of the transmitter tube 11. Therefore, the cathode ray in scanning the anodes 67 to 76 will be in synchronism with the impulses which are coming in through the amplifier 60. In the absence of an impulse it will impinge on the series of anodes represented by the odd numbers 67 to 75, but whenever an impulse is received it will be deflected by the connection of the plate 78, 79 on to the even series of anodes 68 to 76. At the termination of its scanning movement, the cathode ray impinges on the anode 77. Current passes through the anode 77, goes to the primary 97 of a transformer, the secondary 98 of which is connected by a line 99 to the grid of a thyatron valve 100 which is connected by a line 101 to the cathodes of the translator valve arrangement which is shown on Figure 3 of the drawings, and which is hereinafter described. The cathode 300 of this valve 100 is connected by line 301 to resistance 93. This ensures that the translator valve operates a translated signal as soon as the cathode ray in the tube 61 has completed its scanning movement.

The anodes 67 to 76 are connected to the corresponding series of transformers 107 to 116, inclusive, and the secondary of each transformer is connected to a grid of a thyatron valve. These thyatron valves are numbered in the drawings 117 to 126, inclusive. The anodes of the valves 117 to 126 are connected to the positive line 94 and the cathodes are connected through resistances 129 to the line 128, which is at the negative end of the resistance 93 in use for charging the condenser 91. It will be appreciated that before the code impulse comes in to the line 39 the cathodes of the valves 117 to 126 will be passing no current and will be connected to the negative line through resistance 130 and the connections 85, 132, 133 and 128. They will therefore be at negative potential with respect to line 301, but as soon as the thyatron valves are caused to strike by impulses transmitted to their grids 134 from the anodes of the tube 61, they become positive with respect to line 301. Connections 137 to 146 inclusive, are provided from the cathodes of the thyatron valves to the translator valve now to be described and the effect is that of these connections only those are rendered positive which correspond to the code impulse received.

The connections 137 to 146 inclusive, are carried to a translator circuit which is shown on the third part of Figure 1 of the drawings (sheet 3). Here these connections appear as the circular connections, which are correspondingly numbered. Disposed in a circle around the connections there are a number of heptode valves 150, corresponding in number to the number of the keys 24 of the transmitting apparatus. Each of these valves has five grids, an anode and a cathode, the cathodes being connected to the line 101 from the thyatron valve 100, and the anodes to positive line through resistance 151. It is obvious that these valves can pass current only if all the five grids of any one valve are positive and the grids

are connected up to the lines 137 to 146 in the manner indicated in the drawings in such a way that with any given signal the whole of the five grids of only one valve of the series can be rendered positive simultaneously. With a different signal the five grids of another valve will be rendered positive and with still another signal yet another valve, and so on throughout the series. Thus, whatever the signal transmitted, one valve of the translator valve series 150 will be able to pass current, which will affect the resistances 151 which are in series with each valve and by appropriate connections, which are not shown in the drawings and which may be made to known printing or perforating apparatus, will cause the appropriate symbol which has been transmitted to be automatically printed, perforated, or otherwise indicated, at the receiving station.

To summarise the operation of the receiving apparatus, when an impulse is received through line 39 this will be amplified in the amplifying apparatus 60 and will first strike the thyatron valve 84, putting the condenser 91 in circuit and leading to the building up of potential in the line 95. This will cause the cathode ray in the cathode ray tube 61 to scan the anodes 67 to 76. Voltages are so adjusted that for a potential difference of the plates 78 to 79, which corresponds to a "spacing" part of the signal received through the line 39, that is to say a part corresponding to that part of the signal where one or more of the anodes 16 to 20 are not energised, the cathode ray beam will impinge upon one of the odd numbered anodes 67 to 75, while for a part of the signal impulse which corresponds to a live anode of the series 16 to 20, the plates 78, 79 will bear a potential difference sufficient to deflect the cathode ray on to one of the even series of the anodes 68 to 76. The ten lines 137 to 146 will therefore be selectively energised accordingly.

In the translator device the line 137 is connected to all the innermost grids of one-half of the valves 150 and the line 138 to the innermost grids of the other half of the valves. Therefore, a "spacing" impulse which immediately follows the starting impulse can only energise a valve in the lower half of the diagram, whereas a marking impulse which immediately follows the starting impulse from the transmitter can only energise valves in the upper half of the diagram. A glance at the transmitter key connections 24 will show that all the uppermost keys give a marking impulse immediately after starting and the lowermost keys of the series all give a spacing impulse.

Similarly with the lines 139 and 140; these are connected to the second grids of the valves in such a way as to sub-divide the lowermost group into two sets, one set connected to the line 139 and the other to the line 140. They are also connected to the uppermost half of the valves in such a way as to divide the grids thereof into two sets, one connected to the line 139 and one to the line 140, and a spacing impulse which follows in the second position of the signal can only energise the second grids of one-half of the valves. Similarly with the lines 141 and 142, these are connected to the third grids of the valves and sub-divide each of the four sets thus far created into two more. The lines 143 and 144 effect a further sub-classification on the fourth grids and the lines 145, 146 which are connected alternately to each of the fifth grids finally divide between individual adjacent valves.

Thus any given signal, with its spacing and marking impulses, is automatically caused to operate one valve only, which precisely corresponds to the signal, and as soon as the cathode ray of the tube 61 has finished scanning the anodes 67 to 76, it will impinge upon the final anode 77, discharge the thyatron valve 100, and thus cause the particular one of the valves 150, which has been energised in all its five grids by the signal, to pass a current from the line 101 to positive line and print or otherwise give an indication of the signal which has been transmitted.

The rate of building up of the condenser 91 which has produced the scanning effort of the plates 65, 66 is such that immediately after the cathode ray has impinged upon the anode 77 the voltage will be sufficient to "fire" a thyatron valve 152 which is in parallel with the condenser 91, so as to discharge the condenser and thereby bring the cathode ray in the tube 61 back to normal. At the same time this will produce a current surge in the primary 153 of transformer 154, and the secondary 155 of this transformer will, through the line 131, apply a negative cut-off voltage to the grid of the valve 88, thereby momentarily interrupting the current through the thyatron valve 84 and extinguishing the passage of current therethrough. This re-sets all the valves instantaneously ready for the next signal.

Figure 2 shows diagrammatically an alternative coding arrangement from that of Figure 1. In Figure 1 each of the keys 24 makes a number of contacts which serve to render effective, directly, appropriate anode plates in the cathode ray tube 11. In Figure 2 each key 160 makes one contact only, 161; and for coding purposes a thermionic coding valve 162 is provided which has a cathode 163 and a considerable number of grids 164 which are located in a circle about the cathode. One of each of the contacts 161 is connected by lines, not shown in the drawing, directly to one of the grids 164 so that when any key is depressed one of the grids becomes positive and any anode which is in line with the grid which has been thus rendered positive, will be energised. Five anodes are provided which are numbered in the drawings 165 to 169 inclusive. Although these are shown in the drawings as concentric circles, it will be appreciated that they must be grouped about the grids 164 in such a way that each of them is exposed directly to the cathode electron emission, the natural arrangement for which is that the five anodes should each be formed as a cylindrical surface and put together end to end, the grids 164 occupying a cylindrical surface inside them and the cathode 163 being constituted by a wire or small cylinder inside the grids, but the valve is laid out as shown in the diagram, in order that all the parts may be more easily seen.

It will be noted that each of the anodes 165 to 169 is drawn shaded over certain sections of its periphery. These shaded portions merely indicate diagrammatically, the active portions of each anode. The portions which are unshaded are covered with insulating material or cut away, or otherwise blanked off so that they are inoperative. Each of the anodes 165 to 169 is connected respectively to one of the lines 170 to 174, but the connections are not shown as extending up to the anodes, in order to avoid unduly complicating the diagram. The lines 170 to 174 are connected to resistances 175 to 179, the other terminals of which are coupled to line 180 which

extends from the positive supply of the apparatus. The lines 170 to 174 are also connected to a cathode ray tube 181. Each of the lines is connected to one of five pairs of horizontal deflector plates, the second plate of each pair being connected to a suitable positive potential; the deflector plates are arranged in a series 182 to 186 inclusive, in such a way as to deflect the beam opposite five target anodes 187 to 191 respectively. The target anodes 187 to 191 are connected by a line 192 to grid 13. There is a starting anode 21 which corresponds to the anode 21 of Figure 1 and is also connected to grid 13. A contact 35 closed by contact 33 whenever any one of the keys 160 is depressed is connected to line 46 which corresponds to line 46 of Fig. 1. On the other hand when the key is raised the contact 33 engages a contact 34 on line 53 which also corresponds to line 53 of Fig. 1.

Deflector plates 22, 23 are provided similarly to the correspondingly numbered plates of Figure 1 and, again similarly, there is a cathode 12, grid 13 and main anodes 14, 15; also an amplifying circuit 38 connected to outgoing line 39. The other parts of the circuit exactly correspond to Figure 1 of the drawings and do not need further description.

In operation, when any key 160 is depressed, it renders positive the particular grid 164 to which it is connected in the valve 162. As a consequence the anode or anodes of the series 165 to 169 which are in line with the grid so rendered active are able to pass current and therefore the potential of the deflector plate or plates of the series 182 to 186 which are directly connected to these anodes, will be modified.

As in the case of the apparatus of Figure 1 the cathode ray in the cathode ray tube 181 commences to scan the end of the tube beginning with the anode plate 21 as soon as any one of the keys 160 is depressed and a starting impulse is sent to line. The cathode ray is arranged to be directed so as to be just off impingement on the anodes 187 to 191 but when it passes any one of the deflector plates 182 to 186 which has been energised by the coding valve 162, the cathode ray is deflected on to the corresponding anode of the series 187 to 191 and a current impulse will pass which is amplified by the apparatus 38 and transmitted to line 39. The remainder of the operation is as described in relation to Figure 1.

Figure 3 shows a decoding valve or translator to take the place of the series of heptode valves 150 of the third sheet of Figure 1. The principle of this valve is exactly similar to that of the valves 150 but all the parts are within a single envelope. There is a cathode 200, a series of five concentric grid structures 201 to 205 inclusive, and a set of anodes 206 outside all the grids. The number of the anodes 206 is equal to the number of the different symbols which are to be decoded and they are connected to a series of resistances 151, corresponding to the resistances 151 of sheet 3 of the drawings. The grids 201 to 205 are subdivided, the innermost one 201, into two parts, the next 202 into four parts, the next into eight parts and then into sixteen and the outermost into thirty-two parts, one grid to each anode in the last case. These series of grids are coupled to the lines 137 to 146 in a way which precisely corresponds with the coupling of the five grids of the heptode valves 150. In order to avoid complicating the figure, the connections 137 to 146, which would show as concentric circles between

the grids, have not been drawn in Figure 3, but it will be obvious how these connections are made to the little alternate lateral projections 207, 208 which are shown projecting from the grids. In this valve, at the expense of making a single very big valve, some of the complication of connections of Figure 1 is obviated. The operation is exactly as already described.

Figure 4 shows an alternative circuit in which the coding and decoding arrangements are somewhat different, although the principle of the employment of cathode ray apparatus in place of mechanical coding and decoding devices is retained. A number of keys 210 are provided corresponding to the number of symbols to be transmitted, which are connected by lines 211 directly to anodes 212 in a cathode ray tube 213. In addition there is a starting anode 214 connected to grid 13. An insulated contact which has been numbered in the drawing 35, as it corresponds closely with the contact 35 of Figure 1, is closed by a movable contact 33 whenever any one of the keys 210 is depressed. There are deflector plates 22, 23 to cause the cathode ray, from the cathode 12, to scan the anodes 212, beginning at the anode 214, and the effect is that as soon as a key is depressed a starting signal is sent to line and at a time interval later, which time interval depends upon the key depressed, there is a second signal sent to line. The duration of this time interval determines the significance of the signal. As far as possible the rest of the parts of Figure 4 are numbered correspondingly to Figure 1, and the operation may be regarded as being in other respects similar so far as the transmitting end is concerned.

Coming to the receiving end, the line 39 delivers signals to an amplifying apparatus 60 and the general means for initiating the scanning operations of a receiving cathode ray tube 261 by means of thyatron valves 84 and 152 and condenser 91, are the same, the corresponding parts being similarly numbered. However, in place of the pairs of anodes 67 to 76 there are a series of anodes in the valve 261 which are numbered 262 in the diagram. Each of these anodes is connected to one of a series of transformers 263 by a line 264, and the secondaries 265 of the transformers are connected by lines 266 to the grids 267 of thyatron valves 268. Only the first two of the series of valves 268, and their corresponding transformers, are shown in the drawings, the rest being merely duplicates. The result is that when a signal is received from the line 39 the cathode ray is caused to commence to scan the anodes 262, but at the commencement of its movement it is arranged to be projected in such a direction as just to miss the anodes. It will be noted that the cathode ray will be moving over the anodes 262 in precise synchronism with the ray in the tube 213 which is moving over the anodes 212 of the transmitter, and thus synchronism is re-effected for every symbol which is transmitted. As soon as the cathode ray of the tube 213 impinges upon an anode which has been rendered "live" by the depression of the corresponding key 210 at the transmission station, it will send an impulse to line 39 and this impulse will energise the deflector plates 78, 79 of the receiving tube 261, thereby deflecting the cathode ray on to the corresponding anode of the tube and firing the corresponding thyatron valve 268. This serves to operate appropriate means for printing, punching or otherwise indicating the symbol which has been thus transmitted. It is not necessary to describe again

in detail the remainder of the connections, which are similar to Figure 1.

Although the invention has been described with reference to certain specific embodiments, it will be understood that many variations could be made within the scope of the invention, one outstanding advantage of which is that it practically eliminates, for those parts of the apparatus which employ cathode ray tubes and valves, time lag in response, thereby speeding up the transmission. Moreover the automatic synchronisation which is effected and the speed of the actual transmission in code of any signal, render the transmission largely proof against erroneous signals being transmitted and proof against ready decoding by unauthorised sources.

I claim:

1. In a telegraph system the combination of a transmitter comprising a cathode-ray tube having a series of code-anodes, a cathode, and means to move the electronic cathode-beam to cause it to sweep over the code-anodes seriatim, a coding device to render any desired selection of the code-anodes effective and means, responsive to current impulse to the cathode from the effective code-anodes to transmit a signal by a set of impulses in accordance with the selected code-anodes as the electronic beam sweeps thereover, a receiver comprising a cathode-ray tube having a series of signal-indicating anodes, a cathode, and means to move the electronic cathode-beam to cause it to sweep over the signal-indicating anodes seriatim, means at both transmitter and receiver to set in action each of said electronic beams simultaneously by an initial current impulse at the beginning of each signal so as to cause said beams to perform their sweeping movement and thereafter to return to a predetermined initial position to await the next signal, whereby separate synchronizing means is rendered unnecessary, and means associated with the receiver to indicate to an operator the signal so received.

2. A telegraph system as claimed in claim 1 wherein the means comprised in the transmitter to render any desired selection of the code-anodes effective include a set of keys each having a selection of contacts connected to some of the code-anodes so that each key completes circuits to a selection of the code-anodes peculiar to the key.

3. A telegraph system as claimed in claim 1 wherein the cathode-ray tube of the transmitter comprises a series of code-anodes each connected to an individual key so that the differences between signals depend upon the time interval which is required for the cathode-beam to reach a particular code-anode which has been rendered live by depression of the key corresponding to the signal in question.

4. A telegraph system as claimed in claim 1 wherein the means associated with the receiver to indicate to an operator the received signal comprise a decoding valve device in the form of a plurality of heptode valves.

5. In automatic telegraph apparatus, transmitting apparatus comprising in combination a cathode-ray tube having a long code-anode, means to cause the cathode-beam to sweep a path in the same direction as that of the code-anode, a series of deflector plates disposed adjacent to said path, a coding device for selectively energizing deflector plates of the series so that when the cathode-beam sweeps said path the energized deflector plates deflect it, whereby for part only of its path it strikes the code-anode, and

means responsive to current impulses from the code-anode to the cathode for transmitting signals to line.

6. Transmitting apparatus as claimed in claim 5 wherein the coding device comprises means selectively to connect certain deflector plates to positive in accordance with the code.

7. Apparatus as claimed in claim 5, wherein the coding device comprises a series of keys corresponding in number to the symbols which it is desired to code and each key is adapted to close a plurality of circuits corresponding to the deflector plates which are to be energized.

8. Apparatus as claimed in claim 1 wherein the coding device comprises thermionic valve-means, having a cathode-beam emitting-means, a series of grids each arranged opposite a different area of the beam-emitting means and corresponding grid-by-grid to the symbols which it is desired to code, and a plurality of coding-anodes corresponding to the deflector plates, said coding anodes being disposed in sections codewise, that is to say so that opposite to each of the grids there is located a section of the coding-anodes corresponding to the deflector plates which it is desired should be rendered effective.

9. Apparatus as claimed in claim 1 wherein the cathode-ray tube of the transmitter comprises one anode for each signal to be transmitted, in combination with a starting anode, so that the code signal is constituted by a starting impulse and a second impulse the import of which is determined by the time interval between the two impulses.

10. In automatic telegraph apparatus, receiving apparatus, comprising in combination a cathode-ray tube having a series of signal-indicating anodes arranged so that the cathode-beam may sweep along the signal-indicating anodes, means responsive to an initial signal for each code group transmitted for initiating sweeping movement of the cathode-beam and for returning it thereafter to initial position, deflector plates energized by code signals received for deflecting the cathode-beam laterally to its path on to particular indicating anodes of the series during its sweeping movement, and means responsive to current impulses from the indicating anodes for indicating the anodes thus impinged upon by the cathode-beam.

11. Receiving apparatus as claimed in claim 10 wherein the means for indicating which anodes are impinged upon by the cathode-beam, comprises a series of thyatron valves allocated one to each indicating anode and each connected to appropriate indicating means.

12. Receiving apparatus as claimed in claim 10 wherein the indicating anodes are connected through the thyatron valves to a thermionic decoding device which comprises a plurality of symbol anodes shielded from the cathode-beam by grids and the grids are so connected to the thyatron valves that only one symbol-anode is rendered active for any given combination of code signal impulses received.

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