

Dec. 11, 1934.

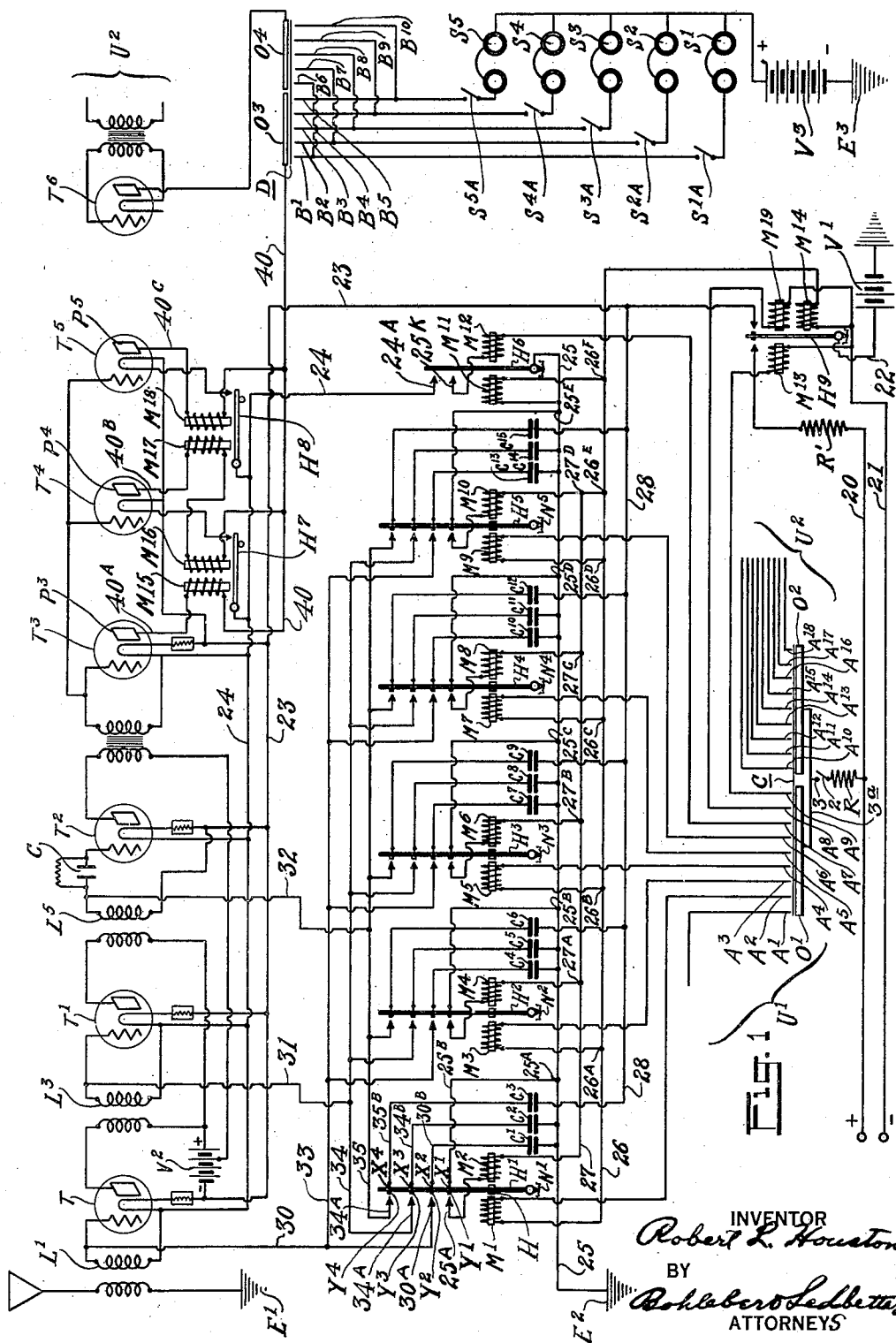
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1,983,759

AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

Filed May 3, 1926

7 Sheets-Sheet 1



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AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

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FIG. 3

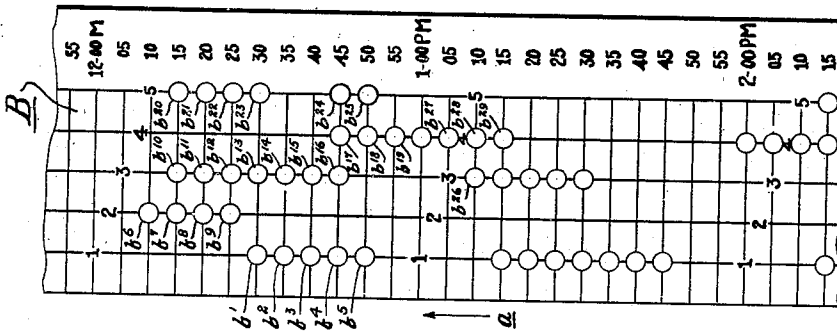
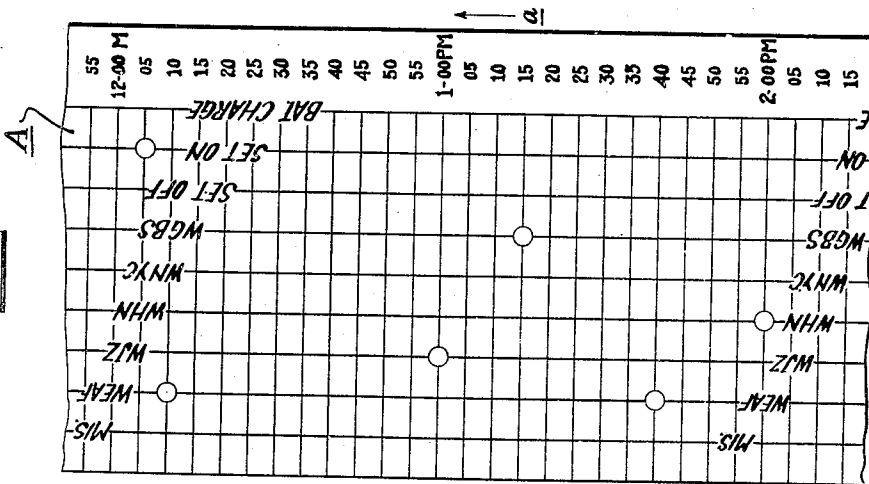


FIG. 2



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7 Sheets-Sheet 3

Fig. 5

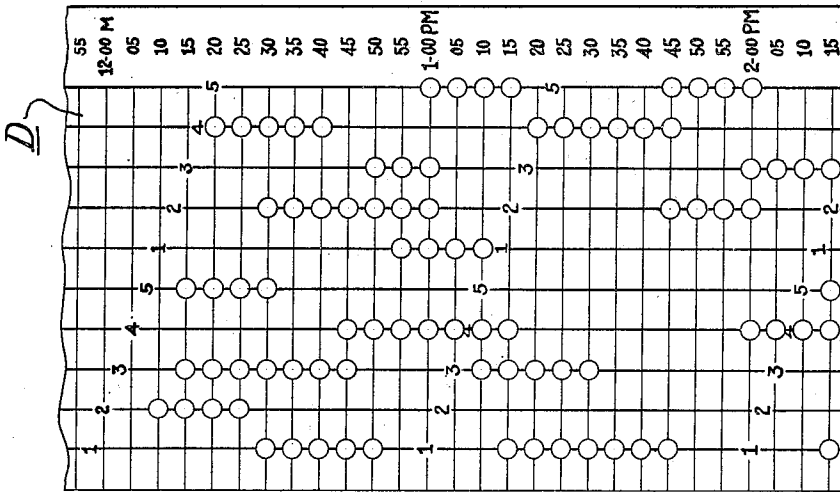
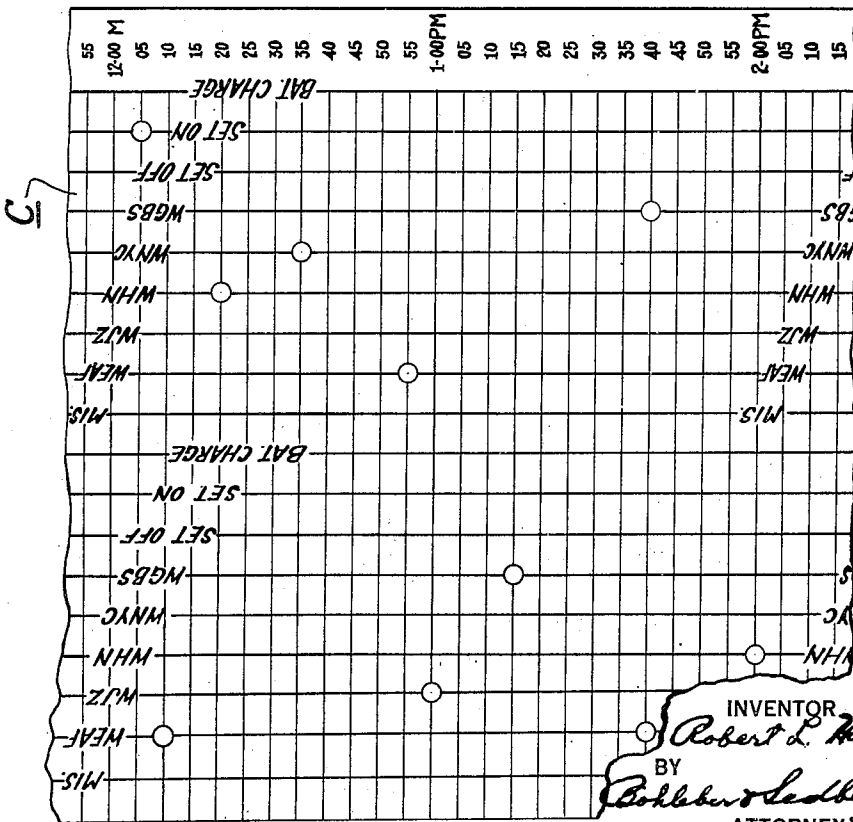


Fig. 4



Dec. 11, 1934.

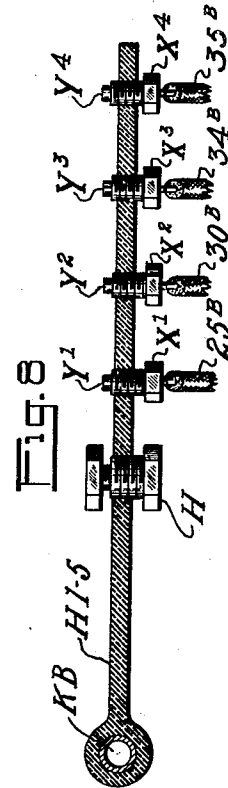
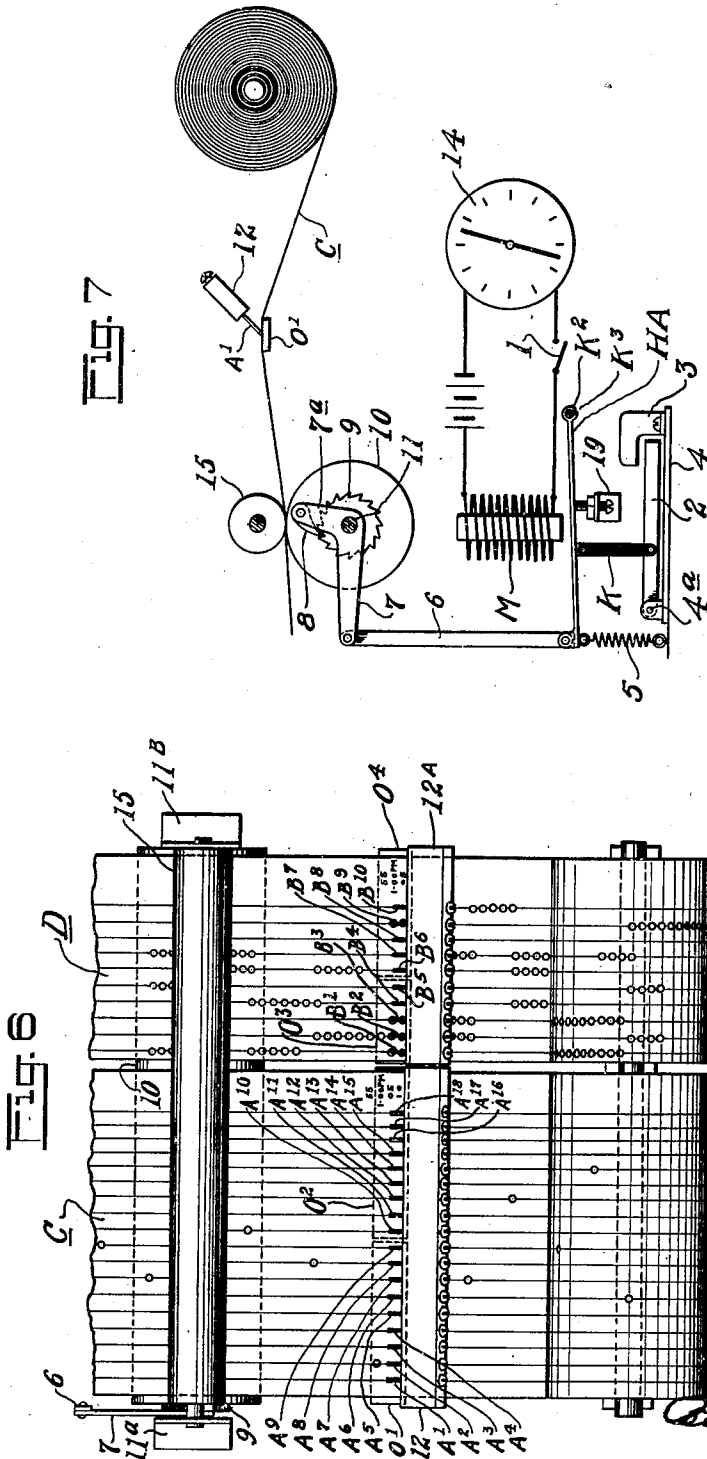
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AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

Filed May 3, 1926

7 Sheets-Sheet 4



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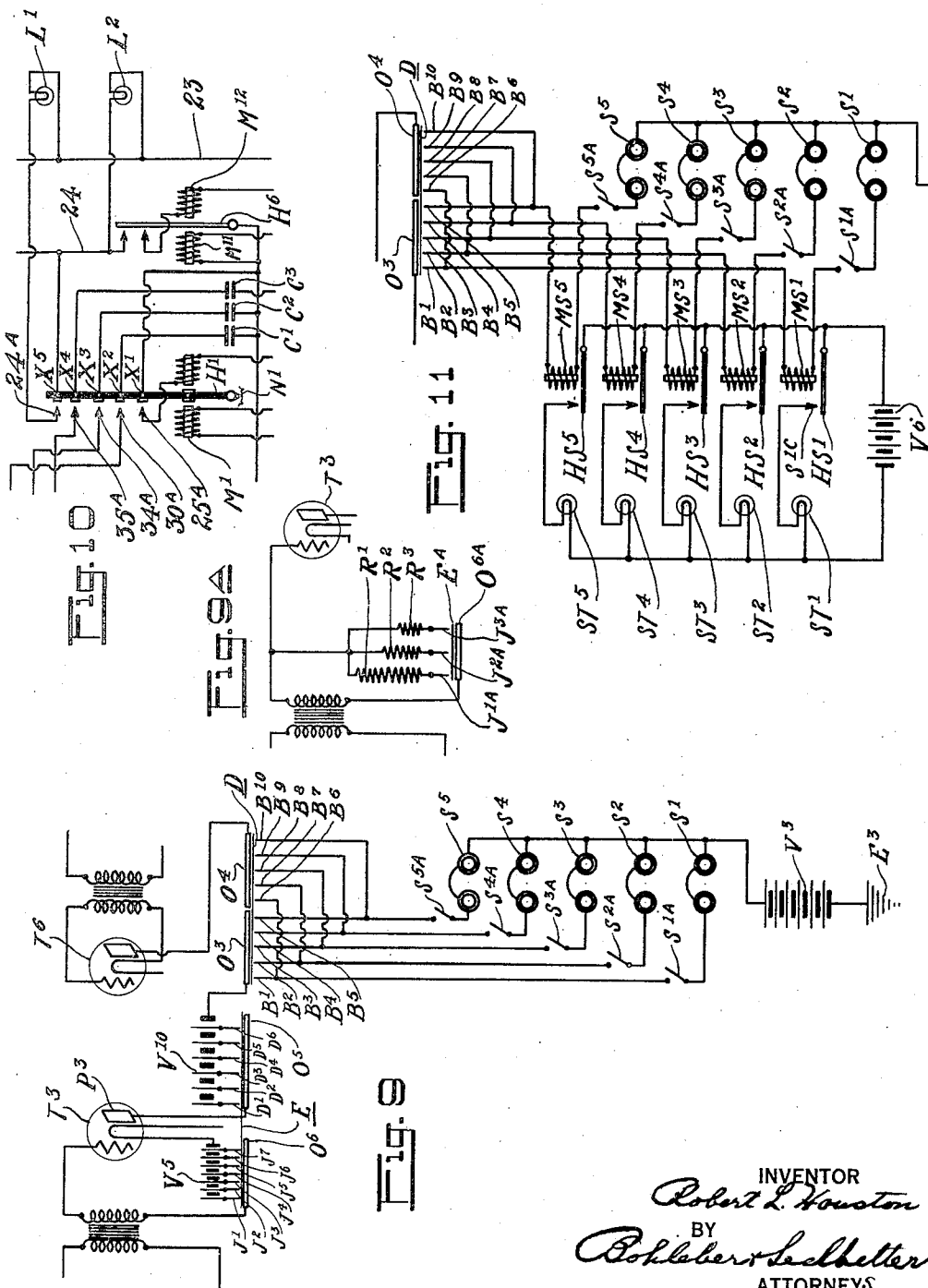
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AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

Filed May 3, 1926

7 Sheets-Sheet 5



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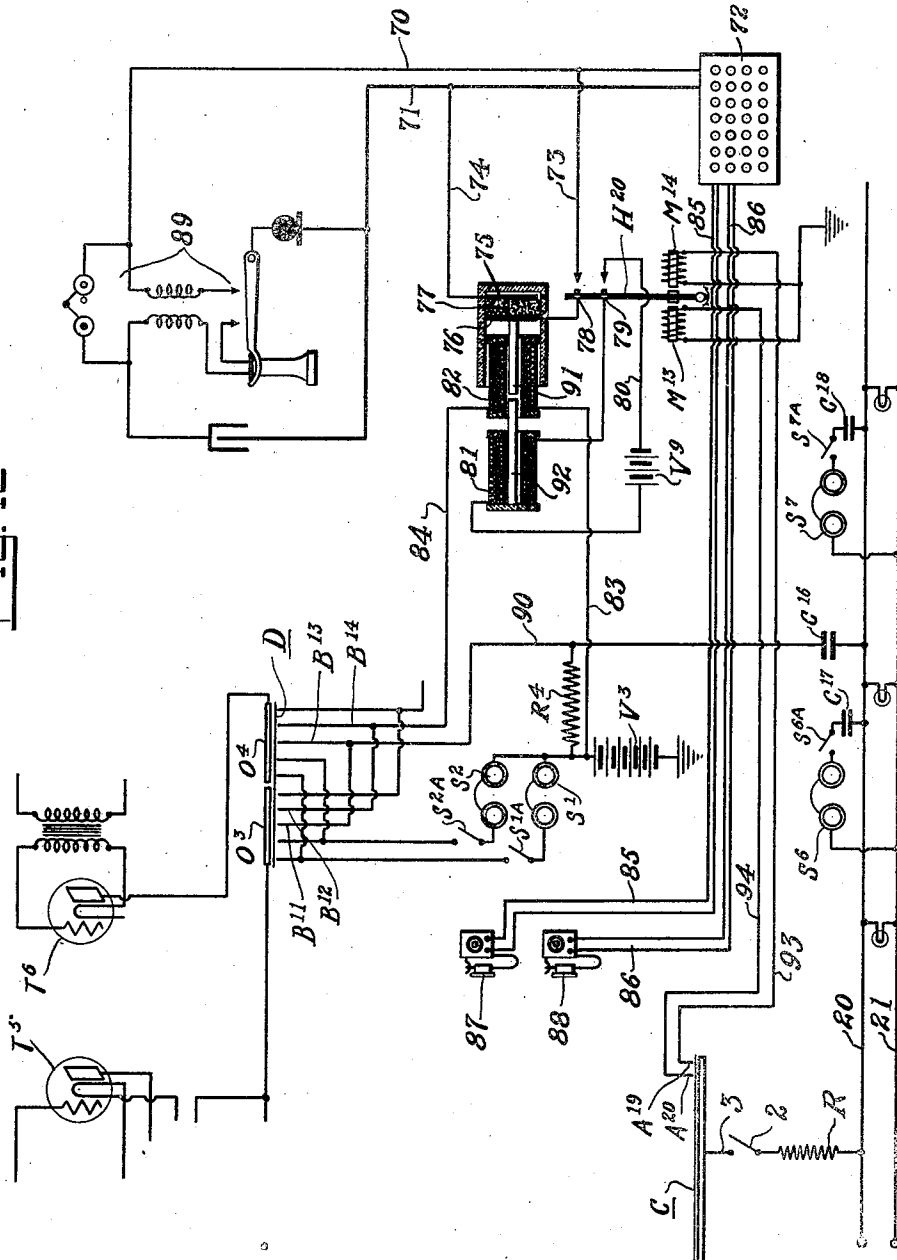
1,983,759

AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

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Fig. 12



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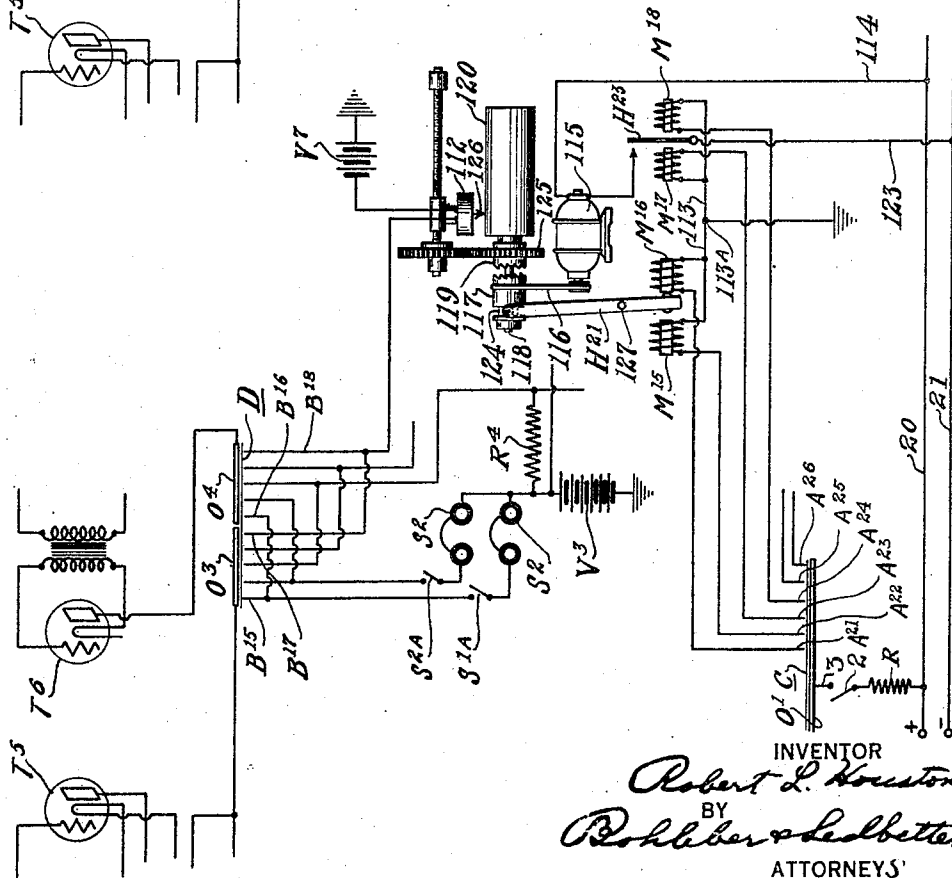
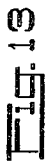
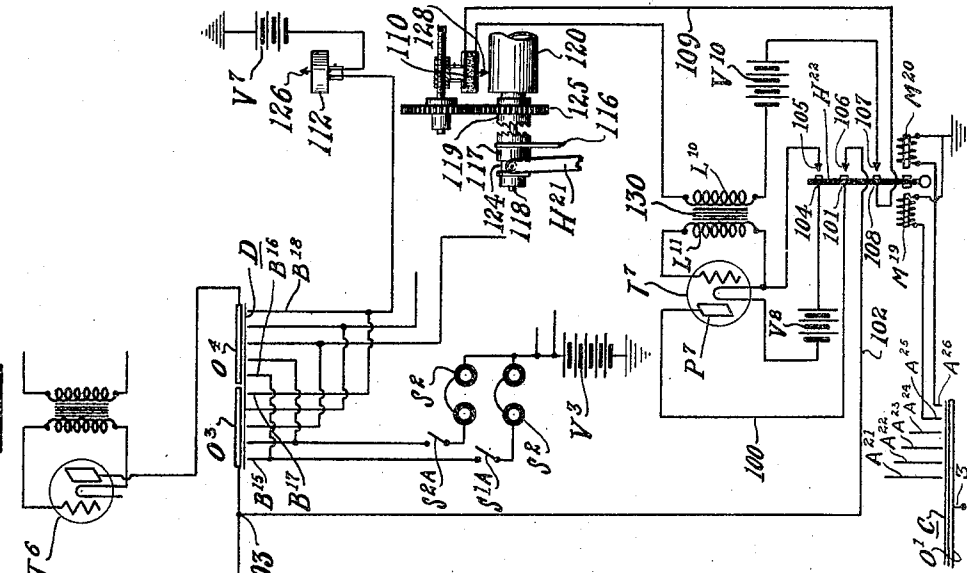
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AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

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UNITED STATES PATENT OFFICE

1,983,759

AUTOMATIC SELECTING AND DISTRIBUTING SYSTEM FOR RADIO RECEPTION

Robert L. Houston, New York, N. Y.

Application May 3, 1926, Serial No. 106,185

36 Claims. (Cl. 250—20)

This invention relates to an automatic selecting and distributing system for radio reception, suitable for use in hotels, apartment houses, public service corporations, hospitals and other places where a central receiving system is desirable, or any place in fact where selection in advance of programs to be received may be of advantage.

One of the more important objects of the invention is to automatically select at will from many sending stations one desired program, receive and amplify such program and distribute it together with other programs available from similar or other sources to various listening stations or subscribers at the time desired, in accordance with any schedule which has previously been prepared as by perforations in code on a strip or tape of paper or other suitable material.

A further object of the invention is to provide means for automatically regulating the amount of electrical energy supplied by the output section of the receiving set in proportion to the amount required to operate the devices in circuit with the set.

A further object of the invention is to include in a system of the character referred to means for automatically turning on the radio receiving set and tuning in or otherwise selecting the desired broadcasting station.

A further object of the invention is to provide in a system of the character referred to means for automatically rendering such system inoperative, with a result that when service is no longer required from the receiving station due to idle periods or otherwise the latter will be automatically turned off until some subsequent operation of the control system turns it on, that is render it operative to receive and distribute one or more programs.

A further object of my invention is to provide with the means for automatically selecting one or more programs and distributing the same to listening stations or subscribers, means for automatically charging the operating battery or batteries employed therewith.

A further object of my invention is to automatically record any desired program or portion of a program received and to reproduce the same to a subscriber or subscribers at a later time.

A further object of my invention is to provide means for automatically varying the amount of amplification for signals from different broadcasting stations, as by controlling the signal potential impressed on the grid of the tube, or by

varying the anode potential of the amplifying tube, and also to provide means for simultaneously varying the normal grid bias potential in order to maintain satisfactory acoustic quality at all times.

A further object of my invention is to provide means for automatically switching in at will outside telephone or other service lines into communication with programs being received and capable of performing similar functions subsidiary to automatically receiving and distributing programs; also to provide means for automatically selecting programs and distributing the same to ordinary commercial telephone lines without materially altering the wiring of such lines or impairing their capacity to perform their ordinary function as telephonic apparatus.

Further objects, advantages and features of construction will more fully appear from the detailed description below taken in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view of the preferred form of electrical circuits employed in the operation of the receiving units of the system. Various mechanical parts are diagrammatically illustrated so that the electric wiring of the system will be more readily understood.

Fig. 2 illustrates a portion of a code tape A employed to control the selection of the broadcasting station to be heard at any given time by a receiving unit and also to control other desired operations.

Fig. 3 illustrates a portion of a code tape B which controls the distribution of programs within the repertoire of a central receiving unit.

Fig. 4 illustrates a portion of a code tape C employed to control the selection simultaneously of programs from a plurality of broadcasting stations, as where one subscriber desires to hear a program from one station and a second subscriber at the same time desires to hear a program being broadcasted from another station; also to control other operations which the machine may be called upon to perform at any given time.

Fig. 5 illustrates a portion of a code tape D which simultaneously controls the distribution of programs being broadcasted by a plurality of broadcasting stations.

Fig. 6 is a top view of the preferred form of code tape feeding means equipped with brushes and conducting plates between which the tape perforations pass and other parts cooperating therewith.

Fig. 7 is a side elevation of the tape feeding

means showing magnetically and automatically operated means for controlling the movement of the tapes.

Fig. 8 is an enlarged detail view in longitudinal section of one of the armatures H^1 , H^2 , H^3 , H^4 and H^5 illustrated in Fig. 1.

Fig. 9 is a diagrammatic view of one form of mechanism for controlling the output or audio frequency section of the receiving circuit shown in Fig. 1, when local conditions cause the strength of signals received from some sending stations to be much greater than those from other stations and accordingly it becomes desirable to decrease the normal amplification for strong signals and increase the amplification of weaker signals, to maintain consistent quality and volume of signals.

Fig. 9A is a diagrammatic view of another form of mechanism for controlling the output section of the receiving circuit of Fig. 1, when local conditions cause the strength of signals from different stations to vary.

Fig. 10 is a diagram of the preferred form of electrical circuit equipped with suitable means for controlling visible signals, to indicate when the radio receiver is in operation and the particular sending station which has been selected.

Fig. 11 is a diagram of the electrical circuit equipped with suitable means for controlling visible signals indicating the listening stations which are receiving service at any time.

Fig. 12 is a diagram of the preferred form of electrical circuit equipped with improved means for automatically delivering at will any program being received by the central receiving station to the subscribers of any ordinary telephone system, and also improved means for automatically placing programs on a commercial electric power line in addition to performing the functions shown in Fig. 1.

Fig. 13 is a diagram of the preferred form of electrical circuits employed in automatically selecting certain numbers of a program to be temporarily or permanently recorded, and a preferred form of means for making a record thereof. Various parts of the machine are shown to make more clear the wiring, though it is not my purpose to limit myself to this particular form of recorder.

Fig. 14 is a diagram of electrical circuits similar to Fig. 13 except that a reproducing device is shown in operation instead of the recorder.

The radio receiving device, which is employed in connection with my invention, may be of any form that depends for the selection of the signals to be received upon the selective adjustment of one or more electric circuits. The number and variety of these systems is legion, but for illustrative purposes I prefer to show a system employing two stages of tuned radio frequency amplification in cascade, followed by a detector or rectifier circuit and one stage of audio frequency amplification, the tuned circuits being adjusted to resonance at the frequency of the desired incoming signals by inserting condensers of the proper capacity in parallel with the inductive elements of the tuning circuits. The operation of this system is well-known to those familiar with the art, and as this invention is concerned with means for automatically selecting and automatically distributing the audio frequency currents to the desired reproducing devices and other separate as well as combined functions after the radio receiving system has performed its func-

tion, a detailed explanation of the action of the radio circuit will be unnecessary to an understanding of the invention.

To facilitate an understanding of my invention I will first refer briefly to the code tapes A and B illustrated in Figs. 2 and 3 respectively. The code tape A controls the selection of the broadcasting station to be heard at any given time. Each vertical row of perforations represents some broadcasting station within the range of the receiving station or some special function or operation that the machine may be called upon to perform automatically at any given time. At the right hand margin of this tape, in the form shown, are numerals indicating the time at which the program from the station represented by the perforation in horizontal alignment therewith is to be selected or at which time some other function of the machine is to be automatically performed. These indicia need not actually appear on the tape when used for commercial purposes, and it will be readily apparent that other than five minute periods indicated may be employed. The code tape B serves to control the distribution of programs within the repertoire of a central receiving station. As illustrated the tape B takes a form which may be conveniently employed when two or more programs are being received at different times at the central receiving station and five subscribers or listening units are being served, it being understood that to serve additional listening units a corresponding number of additional vertical columns are provided. Each of the five vertical lines represents a separate listening station as indicated by the numerals shown on the vertical lines. The perforations in relation to the numerals at the side represent the time that the program will be delivered to the listening station represented by the vertical line upon which such perforation occurs. A "receiving station" as herein employed refers to one or more radio receiving units located at some central point, as in the basement of an apartment house under the control of the superintendent. A "subscriber" or "listening station" as herein employed refers to a place to which the programs are distributed as to an apartment, and may consist only of a loud speaker or of ear pieces, or telephone receivers, etc.

As will more fully hereinafter appear suitable mechanism or time controlled means is provided to advance tapes A and B simultaneously in the direction indicated by the arrows a or move them at a fixed rate of speed which may or may not be uniform, as desired. The mechanism is provided with master controlling means to render the same operative. Let it be assumed that one or more subscribers to the service wish their listening stations to be connected with a program to be broadcasted by WEAJ beginning at 12:10 P. M. on a certain day. Accordingly, a perforation is made at such a point on the tape A that the latter when advanced by the machine, assuming the same together with tape B to have been properly adjusted to the machine, as shown in Fig. 6, will enable a brush to pass through said perforation to cause that particular broadcasting station to be tuned in at that particular time, a clock controlled or other mechanism being provided to advance the tape A to bring the perforation therein in alignment with the particular brush at the time desired. In the case

illustrated by tape B it will be noted that subscriber No. 1 desires to listen in on the program for a continuous period of twenty-five minutes beginning at 12:30 P. M. as indicated by the perforations b^1 and b^5 ; that subscriber No. 2 desires to hear the first portion of the program for a period of twenty minutes as indicated by perforations b^6 to b^9 ; that subscriber No. 3 desires to listen in on the program for thirty-five minutes beginning with the second period of five minutes as indicated by perforations b^{10} to b^{16} ; that subscriber No. 4 desires to listen in on this program for a continuous period of fifteen minutes beginning at 12:45 P. M. as indicated by the perforations b^{17} to b^{19} ; and that subscriber No. 5 desires to listen in for a continuous period of twenty minutes beginning at 12:15 P. M. as indicated by perforations b^{20} to b^{23} and again for a period of ten minutes beginning at 12:45 P. M. as indicated by perforations b^{24} and b^{25} . It will be observed from tape A that a program to be broadcasted by WJZ starts at 1:00 P. M. It will be noted from tape B that subscribers No. 1 and No. 2 do not desire to listen in on the WJZ program; that subscriber No. 3 desires to listen in on this program for the last period of five minutes only as indicated by perforation b^{26} ; that subscriber No. 4 desires to listen in on this program for the period of fifteen minutes as indicated by the perforations b^{27} to b^{29} ; and that subscriber No. 5 is not interested in this program. It will be understood that with only one radio receiver, as soon as WJZ is tuned in the program being rendered by WEAF will be automatically cut off. WGBS is tuned in at 1:15 P. M. for a period of twenty-five minutes and this in turn automatically cuts off WJZ etc.

Each perforation of the code tape and its cooperating brush form an actuating member and a cooperating member. The members are spaced from each other a distance proportional to a predetermined time interval which is the time that the perforation is made in advance of the program desired to be heard by a particular receiving station. If now one of the members is moved at a fixed rate of speed, which may be a uniform rate of speed or may be advanced at intervals as shown herein, the two members will come into cooperating relation upon the predetermined time interval having elapsed, whereupon the program is selected and/or distributed to the desired listening station.

It is believed that the description just given will clearly indicate how the tapes function without further description of the additional perforations therein. It is to be understood however that the perforations in tape A are not necessarily indicative of the length of the programs being broadcasted but rather what portions of the programs are desired by the subscribers to the service.

From the foregoing it will be apparent how the code tapes A and B function in practice. Tapes A and B are adapted to so control a receiving unit that a program may be received from one broadcasting station, or from a number of broadcasting stations in succession, and transmitted to a plurality of listening units. When it is desired to receive and transmit a plurality of programs simultaneously to different subscribers, as in the case where one subscriber desires at a particular time to listen in on one program and another desires at the same time

to listen in on a second program, a corresponding number of additional receiving units are set into operation and controlled by a corresponding number of code tapes A and B or code tapes which are duplications of code tapes A and B. In Figs. 4, 5 and 6 I have, by way of example, shown code tapes C and D the former of which is adapted to control the selection simultaneously of programs from two broadcasting stations and the latter of which simultaneously controls the distribution of such programs one to one or more subscribers and the other to one or more other subscribers. In this case two receiving units are employed. Where three subscribers desire to listen in simultaneously, one on one program, the second on a second program and the third on a third program being broadcasted from three different stations then three tapes A or their equivalents, three tapes B or their equivalents and three receiving units are employed, and so on as will be understood. Or in lieu of three tapes A the same combined into a single tape may be employed, and likewise with respect to tape B.

It has been previously stated that a receiving station comprises one or more receiving units. These units, where more than one is employed, are preferably, though not necessarily, duplicates of one another. In the drawings, see Fig. 1, I have illustrated two of such receiving units and they are generally designated by the reference letters U^1 and U^2 . As U^2 is a duplicate of U^1 I have only illustrated a few parts of the former. For controlling by these units of the selection of the broadcasting stations it will be seen that I employ the code tape C which is adapted to be advanced over the current conducting plates O^1 and O^2 (see also Fig. 6) which, of course, are separated from one another. Arranged over the conducting plate O^1 of receiving unit U^1 are a plurality of brushes A^1 to A^9 which are adapted to pass through the perforations at the left hand side of tape C into contact with the plate O^1 as the tape is advanced to control the selection of broadcasting stations. And arranged over the conducting plate O^2 of receiving unit U^2 are a plurality of brushes A^{10} to A^{18} which are adapted to pass through the perforations in the right section of tape C into contact with conducting plate O^2 as the tape is advanced to control the selection of the same (or other) broadcasting stations. It will of course be understood that in lieu of tapes C two separate tapes A might be employed to equal advantage, and as stated above two or more receiving units are employed where two or more subscribers of the same receiving station desire to listen in at the same time to programs being broadcasted simultaneously from two or more broadcasting stations. For controlling by the receiving units U^1 and U^2 of the distribution of programs from the broadcasting stations to the listening stations it will be seen that I employ code tape D which is adapted to be advanced simultaneously and synchronously with tape C over the current conducting plates O^3 and O^4 which are also separated one from the other. See also Fig. 6. Arranged over the conducting plate O^3 on the receiving unit U^1 are a plurality of brushes B^1 to B^5 which are adapted to pass through the perforations in the left section of tape D into contact with the conducting plate O^3 as the tape is advanced to control the distribution from the receiving unit U^1 to the listening stations S^1 to S^5 of the programs being broadcasted. And

arranged over the conducting plate O⁴ of the receiving unit U² are a plurality of brushes B⁶ to B¹⁰ which are adapted to pass through the perforations in the right section of tape D into contact with the conducting plate O⁴ as the tape is advanced to control the distribution from the receiving unit U² to the same or other listening stations S¹ to S⁵ of the programs being broadcasted.

As will more fully hereinafter appear the code tape B or D may be employed to automatically distribute programs or messages from sources other than those received by the receiving station from space radio broadcasting stations, as so-called "wired broadcasting", telephone messages and previously recorded programs, or even ordinary photograph records.

The reference characters H¹, H², H³, H⁴ and H⁵ of Fig. 1 designate similarly constructed armatures a longitudinal section of one of which is illustrated in Fig. 8 and designated H¹⁻⁵. These armatures are composed of arms made of moulded bakelite or any other suitable insulating material and provided with magnetizable metallic members H projecting from both sides of the armature to enable the armature to be moved in one direction or another by the electro-magnets M¹, M², M³, M⁴, M⁵, M⁶, M⁷, M⁸, M⁹ and M¹⁰. See Fig. 1. These armatures are each constructed at one end to receive a bearing as shown at KB through which a rod may be loosely passed and properly supported to serve as a pivot upon which the armature may freely rock. Suitable resilient means N¹ to N⁵, in the nature of impositive locks, are employed to hold each of said armatures in its two operative positions against the poles of its respective electro-magnets. Metal contact members X¹, X², X³ and X⁴ are securely attached to these armatures and insulated from one another by the armature material. Conducting wires 25B, 30B, 34B and 35B are respectively attached to the metal contact members X¹, X², X³ and X⁴. These members are provided with contact points Y¹, Y², Y³ and Y⁴.

I will now describe specifically the mechanism or time controlled means which I prefer to employ to feed the code tapes C and D, or move them at a fixed rate of speed, which control the selection and distribution of programs. This mechanism is diagrammatically illustrated in Figs. 6 and 7. Referring to Fig. 7, HA is an armature plate pivoted at K² to a suitable supporting shaft K³. A link K of any suitable insulating material is pivoted at its upper end to HA and at its lower end to a brass or other metal contact element 2 which in turn is pivoted at 4a to a suitable supporting base 4 of insulating material. An L-shaped companion contact element 3, such as brass, is securely fastened to the base 4. The elements 2 and 3, as will more fully hereinafter appear, serve as make and break devices for an electric circuit. As illustrated in Fig. 1 the contact element 3 is electrically connected to the conducting plates O¹ and O² of receiving units U¹ and U² by means of a wire 3a, and also by the wiring system of receiving units U¹ and U² to the conducting plates O³ and O⁴. A tension spring 5 is attached at its upper end to armature HA and at its lower end to any rigid support located at a sufficient distance from the armature HA to give suitable tension to said spring. The armature HA is maintained on an adjustable stop 19 by the spring 5 when no force is acting through the electro-magnet M. A link

6 is pivoted at one end to armature HA and at its other end to the arm 7 of the bell crank lever 7-7a. A pawl 8 is pivoted to the arm 7a of the bell crank lever and engages a ratchet wheel 9, the latter being attached securely to the side of friction roller 10 which, in conjunction with roller 15, serves to advance the tapes C and D. The friction roller 10 revolves freely upon and is supported by shaft 11 and is of sufficient width to accommodate tapes C and D as shown in Fig. 6. It may be stated in this connection that I have illustrated in Fig. 6 mechanism which is adapted to feed the tapes C and D illustrated in Figs. 4 and 5. It will be readily apparent that it is a mere matter of mechanics to change the construction of this mechanism to feed tapes A and B shown in Figs. 2 and 3 or to feed a plurality of tapes A and B or a plurality of tapes C and D. The shaft 11 upon which friction roller 10 revolves, is suitably supported at either end as by frames 11a and 11b. A suitably supported molded block 12 of insulating material is drilled to receive and hold code brushes A¹ to A¹⁸, which brushes are normally in engagement with the paper tape C which carries the controlling perforations. The conducting plate of bar O¹ is suitably supported and arranged in juxtaposition to the code brushes A¹ to A⁹. The said brushes are adapted to make contact with the return plate O¹ through the code perforations in the left section of the tape C to close circuits not only to automatically control the selection by receiving unit U¹ of any desired broadcasting station but to automatically control some other special function which the machine may be called upon to perform at any given time. The return plate O² is suitably supported and arranged in juxtaposition to the code brushes A¹⁰ to A¹⁸. These brushes are adapted to make contact with the conducting plate O² through the code perforations in the right section of tape C to close circuits not only to automatically control the selection by receiving unit U² of any desired broadcasting station but also to automatically control some other special function which the machine may be called upon to perform at any predetermined time. The reference numeral 14 designates a clock controlled source from which electrical impulses are sent out at regular intervals, such as an electrical master clock as used in factories, schools and elsewhere to drive secondary clocks, time stamps and other equipment. Under some conditions it may be found desirable to send out impulses by manually operated means such as a push button, telegraph key, etc., and it is not my purpose to restrict myself as to sources of impulses nor as to the regularity of such impulses.

The pressure roller 15 is designed to hold the tapes C and D tightly against friction roller 10. The conducting plates O¹ and O² are located substantially in the same plane and, as previously stated, are connected by a wire or other conductive means to make and break member 2 as shown in wiring diagram illustrated in Fig. 1. The combined width of the plates O¹ and O² is preferably wider than tape C which passes between them and the brushes A¹ to A¹⁸. Conducting plates O³ and O⁴ are separated from one another electrically but located in the same plane under tape D in a manner similar to the location of the conducting plates O¹ and O² with respect to the tape C.

The various parts comprising the system may be assembled on any suitable form of support or

supports, and beyond the necessity for their presence in the relationship as shown the present invention is not concerned with the form they may take since many means may be employed for the purpose which are well known and in common use. As the novel and distinctive features of the invention relate to function and combination rather than construction I shall further describe how it operates and what the same accomplishes.

Before describing in detail the mechanism employed in conjunction with the code tapes for selecting and distributing the programs it may be pointed out in advance just what happens.

In practice the tap C is (in effect) set one period ahead of tape D. Let it be presumed that the first WEAFF perforation in the tape C is initially adjusted or set manually, or is moved automatically so as to enable brush A² to project therethrough into contact with the conducting bar O¹.

It will remain so and nothing will happen until an electrical impulse is imparted by the clock 14. This takes place at exactly 12:10 P. M. When that occurs contact is made at the switch 2—3 with a result that the circuit is closed through brush A² and conducting plate O¹ (assuming the master switch 1 to be closed). This selects station WEAFF and at the same time (simultaneously) moves both tapes forward for one period in the manner described above.

So it will be seen that the brush A² is located in the particular perforation for a whole period and that it only becomes effective at the end of such period. When once effective the mechanism remains so for that particular broadcasting station until it is desired to select from some other broadcasting station, as for instance WJZ, in which case WEAFF is cut out.

The perforation in the WJZ column arrives opposite the WJZ controlling brush A³ at the indication 1:00 P. M. on tape C but by actual time at 12:55 P. M. And again nothing happens until the end of that period or at 1:00 P. M. when an electrical impulse is received by the clock 14, the switch 2—3 closed, the circuit established through brush A³ and bar O¹ and the tapes moved forward for one period, cutting out WEAFF and cutting in WJZ.

And so on for other broadcasting stations, or back to the same broadcasting station as indicated by the second WEAFF perforation as will be understood. It will of course be understood that in practice, with one familiar with the system, the time indications on the right hand margins of the tape are not at all required.

They are placed upon the tapes illustrated herein merely to elucidate the principles and the operation of my invention. Having described the construction of the armature H¹ to H⁶, the construction of the tapes, the mechanism for feeding the tapes, and the relation of the feed mechanism with the current conducting brushes A¹ to A¹³ and B¹ to B¹⁰ and with the current conducting bars O¹, O², O³ and O⁴ I will now describe the wiring and other associated means of the receiving and distributing mechanism.

Referring to Fig. 1 condenser C¹ is adjusted to such capacity that it will tune the grid circuit of tube T to resonance at the frequency of the emitted wave of some desirable sending station, say station WEAFF, when placed in parallel with inductance L¹ of the radio receiving set.

Condenser C² is set at such capacity as will tune the grid circuit of tube T¹ to the same station when connected in parallel with coil L³. Condenser C³ is adjusted to such capacity as will,

when in parallel with coil L⁵, tune the grid circuit of tube T² to the same station. In like manner condensers C⁴, C⁵ and C⁶ are adjusted to tune the grid circuits of tubes T, T¹ and T² respectively to some other desired stations when similarly placed, and like provision may be made for optionally tuning in any one of as many other stations as may be desired by providing sets of condensers of proper capacity. The diagram of Fig. 1 shows provisions for selecting any one of five stations as indicated by capacity elements C¹ to C¹⁵.

The tuning condensers having been adjusted in accordance with the above and the code tape C as shown in Fig. 4 having been prepared to control the selection of programs from the desired sending stations at the particular times wanted and the code tapes D as shown in Fig. 6 prepared to control the delivery of this program together with some other available program to the listening stations, the tapes are placed in the feeding mechanism as shown in Fig. 6, the forward portions of the tapes being passed between feed roller 10 and pressure roller 15 as clearly shown in Figs. 6 and 7.

Observation is made from any accurate time piece of the time of day the device is being set and the tape C is then manually positioned so that the horizontal line on the tape representing the time period, immediately following the moment of setting, is in line under brushes A¹ to A¹³.

For example, if the device is being adjusted at a time between 12:05 and 12:10 P. M. the line opposite 12:10 P. M. of tape C is placed immediately under the brushes.

Tape D is positioned so that the period corresponding to the moment of setting is under the brushes B¹ to B¹⁰ or in other words tape D is always one period behind tape C, in relation to the brushes as above explained and as indicated in Fig. 6.

This is because the brushes over the conducting bars O³ and O⁴, when in contact thru the perforations in tape D are drawing a constant current of small amperage from the conducting bars O³ and O⁴, as will be seen from further description, while a somewhat different action takes place in connection with tape C.

Here it may be stated that instead of making direct connections between the listening stations S¹ to S⁵ and P³ through the perforations (in tape D) as shown, a system of relays may be inserted in which case a majority of said perforations would be eliminated, but for simplicity of illustration, and because the amount of current that passes is small and accordingly the movement of the paper tape will break the connections without danger of serious arcing, I prefer to show the wiring as illustrated.

Adjustment is so made that the tapes C and D are taut between the brushes and the rollers 10 and 15. The master switch 1, Fig. 7, is closed thus placing electro-magnet M in position to receive the next electrical impulse sent out from clock controlled mechanism represented at 14.

Upon receiving an impulse from clock 14, which is only momentary, the electro-magnet M, see Fig. 7, is energized drawing armature HA upward against the tension of spring 5 and through link K lifting the contact element 2 against the companion element 3.

At the same time an upward motion is transmitted through link 6 to the arm 7 of the bell crank arm 7—7a which, being pivoted at 11, causes the arm 7a to move clock-wise thus allowing pawl 8 to drop into the succeeding notch on ratchet wheel 9.

Referring to Fig. 1, it will be observed that contact element 2 is connected to the power source 20 through a suitable resistance R, while the companion contact element 3 is connected by a suitable conductor to the return plates or bars O¹ and O². Thus it will be seen that while switch 2—3, Figs. 1 and 7, is closed, a current is flowing from the positive source 20 through 2 to 3 to O¹ and O² and hence through any perforation that may be in the paper tape C and into the brush which is not thereby insulated from the conducting plates O¹ and O² and against which it presses. When electro-magnet M, Fig. 7 is de-energized, which occurs immediately after receiving a momentary impulse from clock 14, spring 5 draws armature HA down carrying switch arm 2 away from switch contact 3 thus breaking the circuit between the line 20 and the conducting plates O¹ and O². At the same time the arm 7 of the bell-crank lever 7—7a is moved downward, thus forcing forward pawl 8 which carries with it feed rollers 10 and 15 through ratchet wheel 9, and thereby feeds forward tapes C and D due to the gripping action exerted upon them by the rollers 10 and 15. This brings the next horizontal line as shown on Figs. 4, 5 and 6 under the brushes. The perforations in tape C are of such size in relation to the size of the brushes that a slight forward movement of said tape may take place before the paper lifts the brushes away from and insulates them from the conducting plates O¹ and O². This distance is great enough to permit a downward motion of the switch element 2 sufficient to break the flow of current at the switch 2—3 rather than between the conducting plates O¹ and O² and the brushes. The purpose of this is to prevent any sparking, due to breaking of the circuit in proximity to code tape C.

Assuming that a perforation in the tape C has enabled brush A² to receive an impulse of current, I will trace its flow and describe the results that it accomplishes. Being positive, the impulse having come from positive line 20, through R, contact 2, contact 3, wire 3a, plate O¹ and brush A², it passes through electro-magnet M¹, energizes the same and attracts armature H¹ toward it thus closing the switches shown at 25A, 30A, 34A and 35A. The current passes on to line 26, branching at 26E, a part passing to 27D where its further course will be followed later and a part passing on to 26F where it again branches, one part passing through electro-magnet M¹⁴ which attracts armature H⁹ thus connecting line 23 to the positive side of battery V¹ through line 22 and armature H⁹. The current passing through the electro-magnet M¹⁴ then reaches the negative line 21, completing the circuit.

Returning now to point 26F another portion of the current passes through M¹¹ energizing that electro-magnet and drawing to it armature H⁶ which is grounded through line 25. This action brings the armature into contact with line 24 and grounds the negative side of the filaments of T, T¹, T² and T³ which are connected to line 24. The other side of all of the filaments are now connected to the opposite side of the negatively grounded service battery V¹ through line 23, armature H⁹ and line 22 and it will be seen that the filaments of the radio receiving tubes will light up and are ready to perform their functions in the receiver. Armature H⁶ being in the left position also grounds one side of the electromagnet M¹² and should an im-

pulse be received by it through brush A⁸ at some subsequent time while in this position such impulse momentarily has a path to ground through armature H⁶ and grounded line 25. This, however, has no bearing upon the immediate results to be obtained but will be referred to later.

Returning now to the branch of the circuit which was left at 27D: The current through this branch seeks through the windings of electro-magnets M², M⁴, M⁶, M⁸ and M¹⁰ to find an outlet to ground, which outlet is found through M² since M¹ has drawn the armature H¹ to the left and brought the grounded line 25 through point Y¹ and 25A into contact with the opposite side of the winding of M² from which the impulse comes. This action however, does not return armature H¹ to its original position because more current is flowing through M¹ than through M² since the current has been divided several times after leaving M¹ and before reaching M². Should however some other armature be in the left position thus creating a path to ground to the current flowing in line 27 but with the windings of the opposing electro-magnet receiving no current due to the absence of a perforation beneath the corresponding brush, the counter pull described in regard to M¹ and M² does not apply and the passage of the impulse from line 27 to grounded line 25 through the off winding energizes the electro-magnet thereof, momentarily attracts its armature, and thus breaks itself at this point and by drawing the armature away from the switch contacts destroys the connections between its associated condensers and conductor lines 33, 34 and 35.

Armature H¹ having been drawn to the left, one of the condenser plates of C¹ is through contact points Y¹ and 30A and line 30 connected to the grid side of circuit L¹ while the other plate is grounded through its permanent connection to line 25. This condenser having previously been adjusted to the proper capacity to tune L¹ to receive the desired station WEA¹, such station is selected by circuit L¹. In like manner condenser C² is connected in circuit with coil L³ through contact point Y³, 34A and lines 34 and 31, and condenser C³ is connected in circuit with coil L⁵ through Y⁴, 35A, 35 and 32, the slight variation shown here being that one plate of condenser C³ is connected through line 28 to the positive side of the filament lighting circuit, in keeping with the needs of many detector tubes. Condensers C² and C³ also having been adjusted to tune respectively the grid circuits of Tubes T¹ and T² to the sending station WEA² it will be understood by anyone familiar with the art that the desired station is selected.

Thus, it will be seen that the impulse passing through the perforation of the tape by brush A² has thrown the service battery V¹ into series with the receiving set, if by chance it has been otherwise connected, grounded the opposite sides of the filaments of the necessary tubes and so turned on the set and at the same time disconnected any tuning arrangement that may previously have been in service, tuned the receiving circuits to the desired station and left the parts in such arrangement that the program being sent out by the desired sending station becomes available to be delivered to the listening stations, until a subsequent perforation on the tape C changes the arrangement. In the same manner that has been described, any of

the other sending stations that have been provided for may be tuned in. A perforation in the tape C under the brush A³ would upon receiving an impulse tune in the station provided for by condensers C⁴, C⁵ and C⁶ and disconnect the condensers C¹, C² and C³ from the tuning circuits, while perforations under the brushes A⁴, A⁵ and A⁶ would perform the same function for other stations.

Having described the means which I have provided for automatically turning on the radio receiving set and tuning in the desired broadcasting station I will now describe the means I have provided for delivering the program being broadcasted by the station selected, together with another program available from some other or similar source, to listening stations.

The anode P³ of audio frequency amplifying tube T³ is connected by wire 40A to one of two windings of a relay which at its opposite side is connected to line 40 of the latter in turn being connected to the conducting plate O³, Figs. 1 and 6. From some other source, which I have represented at T⁶, is the output section of receiving unit U² of another three element vacuum tube amplifier similar to T³ but which may be any device capable of translating audible sounds into corresponding electrical impulses of the proper value. The output of T⁶ is connected by a suitable conductor to the conducting plate O⁴ which, as before described, is a brass or metal plate similar to and for practical reasons in the same plane with conducting plate O³ but not connected electrically thereto. B¹ to B¹⁰ are brushes similar to A¹ to A¹⁸, and, as shown in Fig. 6, are insulated from the conducting plates O³ and O⁴ by the code tape D except at such times as perforations in tape D allow the brushes to make contact with said conducting bars O³ and O⁴. S¹ to S⁵ represent telephones or other reproducing devices capable of translating audio frequency electrical circuits into audible sounds. S^{1A} to S^{5A} are switches which make and break the contact between the reproducing devices S¹ to S⁵ and their respective wires leading to B¹ to B¹⁰. V³ is a power source whose negative side is grounded and whose positive side is connected to one side of each of the reproducers or listening stations S¹ to S⁵. It will readily be understood that separate power sources may be provided for each reproducer or a single power source may be placed elsewhere in the circuit as for example in line 40 without changing the sense of the invention, but for simplicity of explanation I prefer to locate it as shown.

Brush B¹ representing reproducer or listening station S¹ is connected by wire to brush B⁶ and in like manner all other listening stations are connected to one brush located over the conducting plate O³ and also to a corresponding brush located over the conducting plate O⁴. The object of this is to enable one or more subscribers through unit U² to listen in on a second program being broadcasted by another station, as will be understood from the detailed description given above in connection with the constructions, functions and operations of the code tapes.

A perforation in tape D, Fig. 5, on the first horizontal line permits brush B¹ to come into contact with the conducting plate O³ and the circuit is completed from P³ through magnet winding M¹⁵ to wire 40 to conducting plate O³

to brush B¹ and (assuming switch S^{1A} is closed) through the windings of the reproducing device S¹ through V³ and to ground. As previously shown the filaments of T³ are grounded so the circuit is now complete and a listener at S¹ may hear the program being sent out by the selected broadcasting station. When the perforation in tape D occurs on the first vertical line on the right hand section of D, (the sixth actual line from the left, Fig. 5, but the second line from left which bears the numeral 1,) then brush B⁶ will come into contact with conducting plate O⁴, while the absence of a perforation under B¹ causes the tape to insulate that brush from the conducting plate O³, and instead of the listener at S¹ hearing the program being supplied to the conducting plate O³ of receiving unit U¹ he will hear some other program being supplied to conducting plate O⁴ from another source or receiving unit U² represented by T⁶.

In the same identical manner the reproducers or listening stations S² to S⁵ are automatically supplied the program which has been arranged for them by the perforations on the code tape D.

Since each reproducing or listening unit as indicated by S¹ to S⁵ will require a given amount of electrical energy within certain limits to operate it satisfactorily the amount of energy supplied by the conducting plate O³ must in a general way vary within corresponding limits proportionate to the varying number of reproducers being supplied if comfortable volume of sound is to be maintained at each reproducer. I have accordingly provided means for automatically accomplishing this and which I will now describe. M¹⁵ Fig. 1 is one winding of a relay which, as previously stated, is in series with anode P³ of tube T³. H⁷ is the armature of the relay connected through line 24, armature H⁶ (which it will be recalled is closed against 24, while the radio receiver is in operation) to grounded line 25. The armature H⁷ is adjusted away from the winding M¹⁵ so that it will not lift when sufficient current is passing to supply as many reproducing units as tube T³ is capable of supplying comfortable and without distortion of the audio frequency waves. When however, a greater number of reproducers or listening units are cut in, in parallel P³ the impedance from the conducting plate O³ to ground that is, the impedance of the plate circuit external to the tube decreases due to the additional paths that have been opened and more current flows through winding M¹⁵ and enough pull is ultimately exerted on H⁷ to lift it. It is to be noted that tube T³ must be so chosen that it is working sufficiently below saturation and has such internal impedance that Ohm's law applies at least as an approximation. This action through the armature H⁷ grounds one side of the filament of amplifying tube T⁴ whose other side is permanently connected to positive line 23, thus an additional tube is thrown into operation. As indicated on the diagram the grid element of the amplifying tubes T³ and T⁴ are connected in parallel and accordingly T⁴ serves to increase the amount of energy available provided the anodes also are joined by conductors. Connection is made from anode P⁴ through winding M¹⁷ of a second relay back through winding M¹⁶ which cooperates with winding M¹⁵ of the first relay. The purpose of this is to strengthen the lifting force which holds armature H⁷ in closed position and thus prevent any fluttering of ar-

mature H⁷ which might otherwise occur due to its delicate balance.

When enough additional reproducing or listening units are thrown into circuit with the conducting plate O³ to cause still more additional current to flow from P³ and P⁴ and the amount flowing from P⁴ through the winding M¹⁷ becomes great enough it lifts the armature H⁸ and grounds the filament of tube T⁵ in a manner similar to that described in connection with tube T⁴. The anode P⁵ is connected through winding M¹⁸ which cooperates with winding M¹⁷ to hold armature H⁸ firmly in closed position and passes on to line 40 and thence to conducting plate O³. The grids and anodes of tubes T³, T⁴ and T⁵ now all being in parallel, and with the filament heated the three tubes are operating co-operatively to supply current to the larger number of reproducing or listening units.

The condition described having once been attained, prevails until the tape D causes the brushes B¹ to B⁶ to be momentarily insulated from the conducting plates O³ while that portion of the tape which lies between the perforations on the horizontal lines is passing beneath the brushes. During this interval there being no outlet for the current from the anodes of tubes T³, T⁴ and T⁵ no current is flowing in the windings M¹⁵ to M¹⁸ with the result that armatures H⁷ and H⁸ drop thus cutting tubes T⁴ and T⁵ out of the circuit and they will be returned to operation again only if the number of reproducers or listening stations in circuit with the conducting plates O³ during the next time period is sufficient to require them and cause the cycle previously described to repeat itself. In the event that the number of reproducers is not changed while brushes B¹ to B⁶ are so insulated, tubes T⁴ and T⁵ will almost instantaneously be reenergized, so that no interruption of the program will be evident.

Other systems of placing relays may also be used to accomplish the above result, without changing the spirit of the invention; for example, the indicator lamps ST¹ to ST⁵ of Fig. 11 may in fact be three element tubes whose grids and anodes are connected in parallel with tube T³ of Fig. 1 in which case an additional tube is thrown into operation each time an additional reproducer or listening station comes into operation.

It will be seen from the foregoing that I have provided novel means for automatically distributing, in accordance with a prearranged schedule, one or more programs being received, to a multiplicity of listening stations, in such manner that each listening station is independent of each or all of the other listening stations as to what it may receive and when it may receive it.

It will also be seen that I have provided means for automatically regulating the amount of current available, from the radio receiving set, within general limits, proportionate to the requirements of the varying number of reproducer or listening units which are to be served.

Referring now to A⁷, Fig. 1, and the seventh vertical line from the left of the tape C illustrated in Fig. 4: When service is not further required from the radio receiving set due to idle periods or otherwise, a perforation on the line marked "set off" will serve to automatically turn the set off in the following manner. The impulse reaching brush A⁷ as described in connection with A², passes through windings M¹² which

is grounded through armature H⁶ and line 25 as previously described. The current passing through M¹² draws armature H⁶ away from contacts 24A and 25K thus breaking its own path to ground at 25K and breaking the ground connection from the filament of all tubes connected to line 24. The tubes are now out of operation and will remain idle until some subsequent operation of the control system turns them on in the manner previously explained.

When a perforation occurs in the tape C beneath brush A⁹ and an impulse is received the current passes through the winding of the electro-magnet M¹³ and thence to the grounded line 21. The magnet thus energized attracts armature H⁹ and throws the positive side of storage battery V¹ into contact, through resistance R¹, with high potential line 20 of a commercial circuit. Resistance R¹ is of such value that the battery V¹ will be recharged at the desired rate. H⁹ in its movement also breaks the connection between V¹ and line 23 supplying the filaments of T¹, T², T³, T⁴, and T⁵ and while the battery is charging no connection exists between it and the radio tubes. When it is desirable to have the battery again disconnected from power line 20, and no perforation occurs in tape C at the desired time which will cause the electro-magnet M¹⁴ to be energized and function as described in tracing the path of current from A² to disconnect V¹ from line 20, then a perforation on the horizontal line marked "Battery Discharge" coming under brush A⁸ will, upon receiving an impulse, cause current to flow through the winding of M¹⁹, energize the magnet and draw armature H⁹ away from contact with line 20 and end the charging period and set up a connection between the battery V¹ and line 23 without otherwise effecting the adjustment of the system.

It is well known to those familiar with radio reception that signals from nearby powerful broadcasting stations are in some localities received with such intensity that the normal amplification provided to build up the signals from other desirable stations sufficient for good reception is too great in the case of the stronger signals, and accordingly some regulating means are desirable to enable the amplification to be varied for the different broadcasting stations to be received. Accordingly, I have provided automatic means for accomplishing this and in connection with my system by providing when required, a third code tape E (see Fig. 9) similar to that shown in Fig. 5 and operated by mechanism similar to that shown in Figs. 6 and 7, heretofore described. This may, in fact, be taken care of by a mere widening of the rolls and shafts shown in Figs. 6 and 7 sufficiently to accommodate the third tape and in any event it moves forward synchronously with tapes A and B or tapes C and D as the case may be.

Referring to Fig. 9 in detail, the tube T³ is the same as tube T³ in Fig. 1. The variation of the circuit from that shown in Fig. 1 is as follows. The negative side of a high voltage battery V¹⁰ is connected by a suitable conductor to the conducting plate O³, and taps are taken from this battery at points of varying potential. Each of these taps is connected to one of the brushes D¹ to D⁶. Conducting plate O⁵ is connected to the anode P³ of tube T³ by suitable conductors and is insulated from brushes D¹ to D⁶ by the paper tape. When a perforation occurs say under brush D¹, the current flows from V³ through

such listening stations as are in operation through switches S^1A to S^5A , through those brushes B^1 to B^5 which project through such perforations in tape D as occur beneath said brushes, through conducting plate O^3 , and through the entire battery V^{10} through brush D^1 , thus putting V^{10} into series with V^3 and through the perforation in the third tape E to the conducting plate O^6 and to anode P^3 . The voltage of V^3 thus being augmented by V^{10} places a higher potential on P^3 than when V^3 alone is in the circuit. When a perforation occurs in the third tape E beneath any of the other brushes only a part of V^{10} dependent upon the tap represented, is thrown into circuit with V^3 , and a correspondingly lower potential is placed on the anode P^3 . The amplification is thus varied by varying the anode potential of the amplifying tube.

It is also well known that to achieve satisfactory amplification with three element tubes, grid biasing means should be provided to maintain the proper normal potential on the grid in its relationship to the other elements of the tube, and that as the normal anode potential varies the normal grid potential should also be varied within general limits. I achieve this result automatically, still referring to Fig. 9, by placing a grid biasing battery in the positions shown at V^5 . Taps are taken off and connected to brushes J^1 to J^7 in a manner similar to that described for battery V^{10} . When it is desirable to put a lower negative potential on the grid of the tube T^3 as a higher positive potential is placed on anode P^3 , the positive side of the biasing battery is connected to the negative side of the filament of tube T^3 , and the conducting plate O^6 is connected to the grid return wire from tube T^3 . When a perforation in the tape E occurs say beneath brush J^1 the full voltage of the battery V^5 is in effect and the grid potential is lowered in its relation to the filament in accordance with the voltage of V^5 . When the perforation occurs beneath any of the other brushes the difference of normal potential between the grid and filament is less in accordance with the voltage represented by the tap to which the brush is connected.

It may be found desirable to control the signal potential impressed on the grid of tube T^3 , either as an alternative to the method just described, or in addition thereto to prevent overloading of the tubes and the resultant distortion. For this purpose I may provide a plurality of resistances R^1 , R^2 , R^3 as shown in Fig. 9A connected at one end to the grid of tube T^3 and at the other to brushes J^1A , J^2A and J^3A normally held out of contact with return plate O^{6A} by tape E^A . As will be understood the stronger the signal and the less amplification desired the smaller will be the value of resistance R to be cut in. Preferably no resistance will be used when maximum amplification is desired, and, the use of resistances controlled by the record may be in addition to that shown in Fig. 9 in which case the plate voltage, grid bias, and signal potential would all be controlled, or it may be an alternative to the arrangement of Fig. 9.

When a perforation is provided in the tape C, Figs. 4 and 6, in such position as to tune in a sending station whose signals are known to be received with great intensity perforations are also placed in the third tape E in such position as will, during the time the station is to be on,

place a low value of V^{10} in series with V^3 , and other perforations are placed in the third tape E in such positions as will put the desirable negative bias on the grid. When stations are to be received the signals from which are known to be weaker perforations are placed in the third tape E in such position as will give higher potential to P^3 and lower the normal potential of the grid; thus the movement of the third tape E will automatically regulate the amplification and also vary the potential of the grid in accordance with the schedule in code previously prepared, as by perforations in tape E.

Referring to Fig. 10 the armature H^1 is similar to armature H^1 of Fig. 1 the only variation being that an additional contact point Y^5 with corresponding connections X^5 and 24a are provided. The reference numeral 23 indicates the positive side of some suitable electrical source the negative side of which is grounded. The characters L^1 and L^2 indicate lamps or any electrically operated signal devices. When the armature H^1 is in closed position, its armature having been attracted by the electro-magnet M^1 , a circuit is prepared from 23 through L^1 , 24A, Y^5 and X^5 to line 24. When armature H^6 is in closed position against the electro-magnet M^{11} line 24 is connected through H^6 to grounded line 25, and the current from 23 having a path to ground operates L^1 and so indicates in a suitable manner that the broadcasting station represented by H^1 is tuned in. A similar path having been provided through L^2 an indication is given by L^2 that 24 is in contact with 25 and the negative side of the filaments of T^1 to T^3 (see Fig. 1) is grounded, and, provided current is being supplied to the other side of the filament, that the receiving set is in operation.

In Fig. 11 is shown a diagram of the electrical circuit equipped with suitable means for automatically controlling visible signals to indicate the listening stations which are receiving service at any time. The reference characters ST^1 to ST^5 designate signal lamps or other electrically operated indicating devices and MS^1 to MS^5 the windings of relays. When the switch S^1A is closed and current is flowing in the circuit through listening station S^1 winding MS^1 and brush B^1 the electro-magnet MS^1 is thereby energized and attracts armature HS^1 which closes the circuit through battery V^6 , armature HS^1 , contact S^1C and signal ST^1 and operates the latter indicating that the reproducer or listening station S^1 is being served. In the same identical manner indications are provided for each of the other reproducers or listening stations.

Referring to Fig. 12, B^{11} , B^{12} , B^{13} and B^{14} are brushes whose relationship to the conducting plates O^3 and O^4 are identical to that of B^1 to B^{10} , Fig. 1, but which are connected to means for delivering the programs represented by conducting plates O^3 and O^4 in somewhat different manner than directly to the reproducers or listening stations, as previously described and shown at S^1 and S^2 . The characters A^{10} and A^{20} are brushes similar to A^1 to A^9 of Fig. 1, and in the same relationship to conducting plates O^1 . A high resistance unit R^4 is provided one side of which is connected to the positive side of V^3 and the other side of which is connected to a wire or other suitable conductor 90 which is joined at one terminal to brushes B^{11} and B^{13} and at the other to one plate of a condenser C^{10} of sufficient capacity to readily pass electrical waves of audio frequency. The reference nu-

meral 20 designates the ungrounded side of an ordinary commercial light or power circuit, or any circuit in fact which is constantly or occasionally used for some purpose other than supplying audio frequency currents to reproducing devices; 21 the second wire of the same circuit; 5 S⁶ and S⁷ telephones or reproducers; C¹⁷ and C¹⁸ by-pass condensers in series with S⁶ and S⁷ respectively; and S⁶A and S⁷A are switches which 10 bridge listening stations S⁶ and S⁷ respectively across the power line 20, 21 through condensers C¹⁷ and C¹⁸.

When a perforation occurs under brush B¹¹, current from V³ passes through resistance R⁴ 15 and to conducting plate O³. In accordance with the well known principle that currents divide inversely as the impedances of their paths, the audio frequency currents from tube T⁵ and conducting plate O³ instead of following the path 20 of the direct current from V³ through R⁴ to conducting plate O³, pass through condenser C¹⁶ and are superimposed upon any current that may be flowing in line 20.

When telephones or other reproducers are 25 bridged across the line 20—21, if 21 be grounded, or from line 20 to any ground, the audible frequency currents coming from conducting plate O³ through line 90 pass through the by-pass condensers and the reproducing units and are 30 thus made audible to the listener. Other well known systems of transferring audio frequency currents to line 20, such as direct connection or through transformers or otherwise, may be utilized, but as the novel feature of my invention 35 is concerned with the means for automatically controlling the selection or distribution or both of the programs to be superimposed upon a line or lines simultaneously utilized for some other purpose, rather than the method of utilization 40 of such lines for the purpose, I show only this preferred form of connection.

The reference numerals 75, 76, 77, 81 and 82 45 designate the essential parts of an ordinary mechanical repeater such as were extensively used by telephone companies for amplifying currents on long distance lines prior to the development of vacuum tube repeaters; 75 being 50 one terminal of the microphone button; 76 being the diaphragm; 77 being the button; 81 being the magnetizing winding of the repeater; 82 being the winding of the receiving circuit of the repeater; and 91 and 92 being the sections of the core of the repeater. 70 and 71 are the 55 wires of an ordinary commercial telephone circuit. 72 represents the central switchboard of the telephone system with which 70 and 71 are connected. 87 and 88 represent ordinary commercial telephone sets connected through 85 and 86 to the central switchboard 72 and through 60 such switchboard capable of being placed into communication with lines 80, 71. And H²⁰ is an element similar to the part H¹⁻⁵ shown in Fig. 8 but with only two contacts.

When a perforation occurs in tape C beneath 65 the brush A¹⁹ and an impulse is received the current passes through line 93 through winding M¹⁴ and to ground, energizing the magnet of M¹⁴ and so attracts armature H²⁰, and closes the circuit through contact 79, wire 80, battery V³ 70 and winding 81 of the repeater allowing current to energize core 92, in accordance with the well known requirements of the repeater. At the same time the circuit through 70, 73, 78, 76, 77, 75, 74 and 71 is closed putting the microphone 75 of the repeater across the telephone line circuit

70, 71 and thereby performs all the functions normally associated with the lifting of the receiver from the hook of a telephone, the wiring of which is similar to that shown diagrammatically at 89.

As will readily be understood by those familiar with present day manually operated telephone switchboards, this through various means 5 notifies the operator at the switchboard that the particular line represented by 70—71 is in 10 operation.

When a perforation occurs in tape D beneath either of the brushes connected to line 84 the audio frequency currents flowing from line 84 15 through the receiving circuit winding 82 of the repeater and through line 83 to V³ operates the microphone 75, 76, 77 in the manner well understood, and with the microphone bridged across the lines 70, 71 causes the program being 20 delivered to line 84 to be made available to the switchboard operator at 72 who may cause it to be further transmitted to subscribers stations represented at 87 and 88.

It is not my purpose to limit myself to this 25 particular means of communicating the programs to the telephone lines, but as the novel features of my invention lie in the automatic selection and distribution of programs to ordinary commercial telephone lines, I have shown 30 simple effective and readily understood means for effectively connecting my system to an ordinary telephone line without materially altering the wiring of the line or impairing its capacity to perform its ordinary function as a telephonic 35 device.

When a perforation occurs in tape C beneath the brush A²⁰ and an impulse is received, the current passes through line 94, winding M¹³ and to ground. The core of M¹³ is thereby energized and draws the armature H²⁰ away from 40 M¹⁴ breaking the circuits set up by the previous impulse from A²⁰ and so disconnects the microphone from 70—71 and notifies the operator at 72, by such means as may be provided at the switchboard, that the program for the time 45 being is concluded.

In Fig. 13 I have illustrated the preferred form of mechanism and electrical circuits employed in automatically selecting a program or a 50 portion of a program to be temporarily or permanently recorded. Referring to the same in detail the characters O¹, O³, and O⁴ are the same as those illustrated in Fig. 1, and brushes B¹⁵ and B¹⁶ bear the same relationship 55 to O³ and O⁴ as do B¹ and B⁸ and therefore are capable of selecting the program from either O³ or O⁴ in accordance with the position of perforations on the code tape D. The reference numeral 115 designates an electric motor; 117 a notched clutch as shown which revolves freely 60 upon the shaft 118 and slides laterally upon shaft 118 as well; 119 a notched extension of gear wheel 125; 125 a gear wheel which revolves freely upon shaft 118 and which is securely 65 attached to any suitable mechanism for recording audio frequency waves, such as the old and well known wax cylinder of a phonograph as represented by 120; 116 a continuous belt connected between the motor 115 and clutch 117 and capable of transmitting motion from 70 115 to 117; 112 a round recording instrument; 126 a needle or point attached to the diaphragm of 112; and H²¹ an armature loosely pivoted at 127, the lower end of which is attracted by either electro-magnet M¹⁵ or M¹⁶ and the upper 75

end of which fits loosely into groove 124 of clutch 117 to enable lateral motion to be transmitted to the clutch 117 without preventing the latter from revolving freely upon shaft 118.

5 When a perforation occurs on tape C beneath brush A²³ and an impulse is received through the conducting bar O¹ a current passes through the winding of the electro-magnet M¹⁷ to line 113 and thence to ground through the connection 113A. This energizes the electro-magnet M¹⁷ and attracts armature H²³ which is connected through line 123 to the grounded side of power line 21, and closes the circuit through line 20, line 114, the windings of the motor 15 115, armature H²³ and to line 21, thus starting the electric motor 115, and through belt 116 causes clutch 117 to revolve.

When a perforation in the tape C occurs beneath brush A²² the latter will, upon receiving an impulse from conducting bar O¹, energize electro-magnet M¹⁵ and attract armature H²¹ thus moving clutch 117 laterally on its shaft 118 and cause the teeth on clutch 117 to engage with the teeth on 119 and so place into operation the recording device.

A perforation on tape C occurring under brush B¹⁷ or B¹⁸ permits either program supplied by O³ or O⁴, dependent upon whether the perforation is beneath B¹⁷ or B¹⁸, to pass through line 121, the windings of the recording instrument 112, line 122, V⁷ and to ground. The varying pulsations of current passing through the windings of 112 move the diaphragm up and down through the point 126 and such movements are recorded in the wax cylinder 120 in a manner well understood by those who are familiar with voice recorders.

When a perforation in the tape C occurs beneath brush A²¹ and an impulse is received, the current passes through the electro-magnet M¹⁶ and to ground through 113A thereby energizing the core of M¹⁶ and attracting the armature H²¹, which, being pivoted at 127 throws clutch 117 out of engagement with notched extension 45 119 of gear shaft 125 and so causes the cylinder 120 to stop revolving.

When a perforation in tape A occurs beneath brush A²⁴ and an impulse is received the current flows through the windings of electro-magnet M¹⁸ to line 113 and to ground through connection 113A. This energizes M¹⁸ and attracts armature H²³ breaking the motor circuit and so stops the motor.

Fig. 14 is a diagrammatic illustration of the same mechanism described in connection with Fig. 13 but in which a microphone 110 is substituted for the telephone receiver or sound recording instrument 112 and follows the path in the wax cylinder 120 as made by said instrument 112. 128 is a point or needle similar to needle 126 and is attached to the diaphragm of the microphone 110. T⁷ is a three element amplifying tube. When it is desired to reproduce for the benefit of listeners any program that has previously been recorded on cylinder 120, the properly positioned perforations in tapes C and D will accomplish this end.

In addition to the position of perforations in the tape C as described a perforation is also located to come beneath brush A²⁶ at the same time perforation comes beneath A²². See also Fig. 13. Upon receiving an impulse at A²⁶, current passes through the winding of electro-magnet M²⁰ and to ground. This energizes the core of the electro-magnet M²⁰ and attracts

armature H²² closing three circuits as shown. The circuit through V⁷, preferably a part of the A battery system or at any rate connected thereto, 104, 105 to the filament of tube T⁷ now being closed by the action of the electro-magnet M²⁰ puts the amplifier tube T⁷ in condition to function. Current from V10 flows through 107, 108, 109, 110, 111 and L10 back to V10. The intensity of this current is varied by the microphone 110 in accordance with the indentations of cylinder 120 and is amplified through the transformer L10, L11 and tube T⁷ which is diagrammatic and represents as many stages of amplification as may be needed or desired in accordance with well known principles, and the sounds previously recorded on the cylinder 120 are thus reproduced at P⁷. When the points 101 and 106 are in contact due to the action of electro-magnet M²⁰, the program received at P⁷ from the cylinder 120, as described, is carried through wire 100 to 101, 106, 102, and joined at 103 to the line leading to the conducting bar O³, from which point it is available for distribution in the same manner as programs coming directly from the radio receiving devices previously described.

When a perforation occurs beneath brush A²⁵, and current flows into brush A²⁵, electro-magnet M19 is energized drawing armature H²² away from electro-magnet M²⁰ and breaks the circuits last described and so discontinues the program from the cylinder 120.

Thus it will be seen that I have provided means for automatically selecting any number scheduled to appear on any broadcasting station program within range of the receiving set, make a record of such number at the same time it is being distributed to listeners and at a later time automatically repeat such program for the benefit of other subscribers.

From the foregoing it will be seen that I have devised a new system of automatically selecting and distributing radio broadcasted programs and have indicated means for carrying the same out in practice. It is to be expressly understood, however, that I do not limit myself to the exact system shown nor to the exact means indicated for practicing the same as many changes may be made in both and other modifications resorted to without deviating from the true spirit and scope of my invention.

What I claim and desire to secure by Letters Patent is:

1. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a code tape, in combination with means automatically controlled by said tape for selecting and distributing one or more broadcasted programs.

2. A machine for selecting and distributing radio broadcasted programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by one of said tapes for selecting the programs, and means controlled by another tape for distributing the programs selected.

3. A machine for selecting and distributing radio broadcasted programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by one of said tapes for automatically selecting one or more programs, and means simultaneously controlled by another tape for automatically distributing the program or programs selected.

4. A system for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of listening stations, in combination with means including a prearranged control means constituting a record of said programs to be rendered for automatically selecting and distributing said programs to said listening stations at predetermined times.

5. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of movable code tapes, in combination with means automatically controlled by the movement of said tapes for successively receiving and simultaneously distributing a plurality of said broadcasted programs.

6. A machine for selecting and distributing radio broadcasted programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by one of said tapes for simultaneously selecting a plurality of said programs, and means controlled by another tape for simultaneously distributing the programs selected.

7. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, means for feeding said tapes, in combination with means automatically controlled by the movement of said tapes for simultaneously receiving and distributing a plurality of said broadcasted programs.

8. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by said tapes for receiving and distributing one or more broadcasted programs, said means including means for automatically turning on the radio receiving set and tuning in the desired broadcasting station.

9. A machine for receiving and distributing radio broadcasted programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by one of said tapes for selecting the programs, and means controlled by another tape for distributing the programs selected, said first mentioned means including means for automatically turning on the radio receiving set and tuning in the desired broadcasting station.

10. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, in combination with means automatically controlled by said tapes for simultaneously receiving and distributing one or more broadcasted programs, said means including means for automatically turning on the radio receiving set and for tuning in the desired broadcasting station.

11. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, in combination with means automatically controlled by said tapes for receiving and distributing one or more broadcasted programs, and means automatically controlled by one of said tapes for turning off the receiving set.

12. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, in combination with means automatically controlled by said tapes for receiving and distributing one or more broadcasted programs, said means including means automatically controlled

by one of said tapes for recharging the service battery.

13. A machine for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of code tapes, in combination with means automatically controlled by said tapes for receiving and distributing one or more broadcasted programs, and means for automatically varying the amount of amplification from different broadcasting stations.

14. A machine for selecting and distributing radio broadcasted programs, comprising a radio receiving station and a plurality of code tapes, in combination with means controlled by one of said tapes for selecting the programs, means controlled by another tape for distributing the programs selected, and means for automatically varying the amount of amplification from different broadcasting stations.

15. A system for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of listening stations, in combination with means for automatically selecting one or more programs at a predetermined future time, means for automatically and simultaneously distributing at a predetermined future time the selected program or programs to said listening stations, and means for controlling visible signals to indicate the listening stations which are receiving service at any particular time.

16. A system for the selection and distribution of radio programs at a predetermined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, a plurality of listening stations, distributing mechanism including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting and of the distributing mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to tune the radio receiving station to the desired program and to distribute the program to the desired listening stations.

17. A system for the selection and distribution of radio programs at a predetermined future time comprising a plurality of radio receiving stations each having tuning means, means operating each of the tuning means, selecting mechanism for each of the operating means, a plurality of listening stations, distributing mechanism connecting at least one of the receiving stations to the desired listening stations, the selecting and distributing mechanism including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism and of the distributing mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to tune the receiving stations and to distribute the programs to the listening stations.

18. A system for the selection of radio programs at a predetermined future time comprising a radio receiving station having tuning

means, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, amplifying means for the receiving station, mechanism controlling the amplifying means including at least one actuating member and a cooperating member spaced therefrom a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism and of the controlling mechanism at a fixed rate of speed into cooperating relation with the other member at predetermined future times to tune the radio receiving station to the desired program and amplify the program.

19. A system for the selection and amplification of radio programs at a predetermined future time comprising a radio receiving station, having an amplifying tube with an anode, selecting mechanism for the radio receiving station to automatically select the desired station at the predetermined future time, means supplying a plurality of electrical potentials, mechanism for connecting a desired potential to the anode of the amplifying tube including at least one actuating member and a cooperating member, the two members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the potential connecting mechanism at a fixed rate of speed into cooperating relation with the cooperating member to amplify the desired program.

20. A system for the selection and amplification of radio programs at a predetermined future time comprising a radio receiving station having tuning means and an amplifying tube having an anode, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and a cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, means supplying a plurality of electrical potentials, mechanism for connecting a desired potential to the anode of the amplifying tube including at least one actuating member and a cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism and of the potential connecting mechanism at a fixed rate of speed into cooperating relation with the cooperating member.

21. A system for the selection and amplification of radio programs at a predetermined future time comprising a radio receiving station having an amplifying tube with an anode and grid, selecting mechanism for the radio receiving station to automatically select the desired station at the predetermined future time, means supplying a plurality of electrical potentials, mechanism for connecting a desired potential to the grid and to the anode of the amplifying tube including at least one actuating member and a cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the potential connecting mechanism at a fixed rate of speed into cooperating relation with the cooperating member to amplify the desired program.

22. A system for the selection of radio programs at a predetermined future time comprising a radio receiving station having tuning means and an amplifying tube having an anode and grid, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and a cooperating member, the members being spaced from each other proportional to a predetermined time interval, means supplying a plurality of electrical potentials, mechanism for connecting a desired potential to the anode and grid of the amplifying tube including at least one actuating member and a cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism and of the potential connecting mechanism at a fixed rate of speed into cooperating relation with the cooperating member to select and amplify the desired program.

23. A system for the distribution and amplification of radio programs at a predetermined future time comprising a radio receiving station having an amplifying tube, a plurality of listening stations, distributing mechanism for automatically connecting the listening stations to the receiving station at the future time, means supplying a plurality of electrical potentials, mechanism for connecting a desired potential to the amplifying tube including at least one actuating member and a cooperating member spaced therefrom a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the potential connecting mechanism at a fixed rate of speed into cooperating relation with the cooperating member.

24. A system for the distribution of radio programs comprising a radio receiving station having a plurality of output sections, a plurality of listening stations adapted to be connected therewith, and means automatically increasing and decreasing the number of output sections connected to the receiving station upon a predetermined increase and decrease respectively in the amount of electrical energy drawn by the listening stations.

25. A system for the distribution of radio programs comprising a radio receiving station having a plurality of output sections, a plurality of listening stations adapted to be connected therewith, electromagnetic means in the output circuit of each output section and actuated upon a predetermined flow of current passing there-through, and switch means for each electromagnetic means controlled by each electromagnetic means depending upon the current carried thereby to vary the number of output sections operatively connected with the receiving station.

26. A system for the distribution of radio programs at predetermined future times comprising a radio receiving station having a plurality of output sections, a plurality of listening stations, distributing mechanism for connecting the listening stations to the receiving station including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, time controlled means moving one of the members of the distributing mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to distribute the program to the desired

listening stations, and means controlled by the flow of current to the listening stations for varying the number of output sections operatively connected with the receiving stations.

27. A system for the distribution of radio programs at predetermined future times comprising a radio receiving station having a plurality of output sections, a plurality of listening stations to be connected therewith, electromagnetic means in the output circuit of each output section and actuated upon a predetermined flow of current passing therethrough, switch means for each electromagnetic means controlled by each electromagnet means depending upon the current carried thereby to vary the number of output sections operatively connected with the receiving station, distributing mechanism for connecting the listening stations to the output section of the receiving station including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, and time controlled means moving one of the members of the distributing mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to distribute the program to the desired listening stations.

28. A system for the selection of radio programs at a predetermined future time comprising at least one radio receiving station having a battery, at least one listening station, distributing mechanism for connecting the listening station to the receiving station at the predetermined future time, battery charging mechanism for connecting a potential to the battery including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the battery charging mechanism at a fixed rate of speed into cooperating relation with the other member to recharge the battery at the desired future time.

29. A system for the selection and recording of radio programs at a predetermined future time comprising a radio receiving station, selecting mechanism automatically selecting a desired program at a predetermined future time, means for recording the program, mechanism operating the recording means including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the recording operating mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to operate the recording mechanism and record the program.

30. A system for the selection and recording of radio programs at a predetermined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, means for recording the program, mechanism operating the recording means including at least one actuating member and a cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of

the selecting mechanism and of the recording operating mechanism at a fixed rate of speed into cooperating relation with the cooperating member at the predetermined future time to tune the receiving station and to operate the recording mechanism.

31. A system for the selection and recording of radio programs at a predetermined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means, a plurality of listening stations, distributing mechanism connecting the receiving station with desired listening stations, means for recording the program, mechanism operating the recording means, the selecting, distributing and recording mechanism including actuating members and members cooperating therewith, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of each mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to tune the receiving station, distribute the program and to operate the recording mechanism.

32. A system for the selection and distribution of radio programs at a predetermined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means including at least one actuating member and one cooperating member, the members being spaced from each other proportional to a predetermined time interval, a plurality of listening stations, means for distributing the program to the desired listening stations, mechanism connecting the receiving station to a source of potential including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to tune the receiving station and to turn on the receiving station.

33. A system for the selection and distribution of radio programs at a predetermined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means, a plurality of listening stations, distributing mechanism connecting the receiving station to the desired listening stations, the selecting and distributing mechanism including at least one actuating member and a cooperating member, the members being spaced from each other proportional to a predetermined time interval, mechanism connecting the receiving station to a source of potential including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting mechanism and of the connecting mechanism at a fixed rate of speed into cooperating relation with the other member at the predetermined future time to tune the receiving station and to connect the receiving station to the source of potential.

34. A system for the selection, distribution and amplification of radio programs at a pre-

determined future time comprising a radio receiving station having tuning means, means operating the tuning means, selecting mechanism for the operating means, a plurality of listening stations, distributing mechanism connecting the receiving station to the desired listening stations, means supplying a plurality of electrical potentials, amplifying mechanism controlling the aforesaid means, the selecting, distributing and amplifying mechanisms including at least one actuating member and a cooperating member, the members being spaced from each other proportional to a predetermined time interval, and time controlled means moving one of the members of the selecting, distributing and amplifying mechanisms at a fixed rate of speed into cooperating relation with the other member at the predetermined future time or times to tune the receiving station, connect the receiving station to the desired listening stations and amplify the programs.

35. A system for the selection and distribution of radio programs, comprising a radio receiving station and a plurality of listening stations, in combination with prearranged means

for automatically selecting at predetermined times one or more programs and distributing the same to any of said listening stations and time controlled means for automatically turning on the radio receiving set and for tuning in the desired broadcasting station or stations.

36. A system for distributing radio programs at a predetermined future time and indicating the stations receiving same comprising, a radio receiving station, a plurality of listening stations, distributing mechanism including at least one actuating member and one cooperating member, the members being spaced from each other a distance proportional to a predetermined time interval, and time controlled means moving one of the members of the distributing mechanism at a fixed rate of speed into cooperating relation with the other member at a predetermined future time to distribute the program to the desired listening stations; a visible signal for each listening station, and means operating the visible signal at the predetermined time to indicate the listening stations receiving a program.

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