

May 6, 1941.

H. F. ELLIOTT

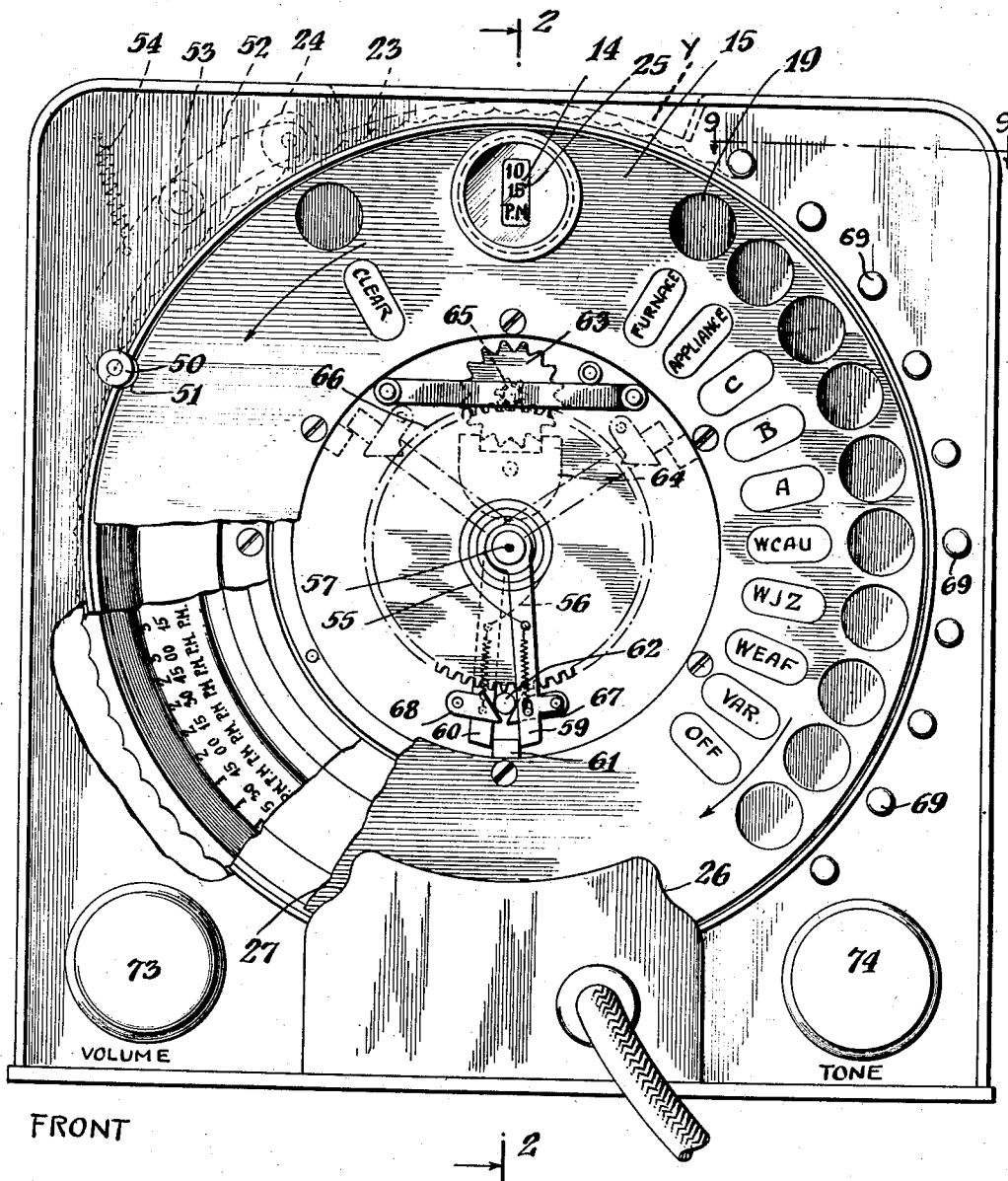
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MULTIPLE FUNCTION CONTROL CLOCK

Filed May 29, 1936

7 Sheets-Sheet 1

Fig. 1



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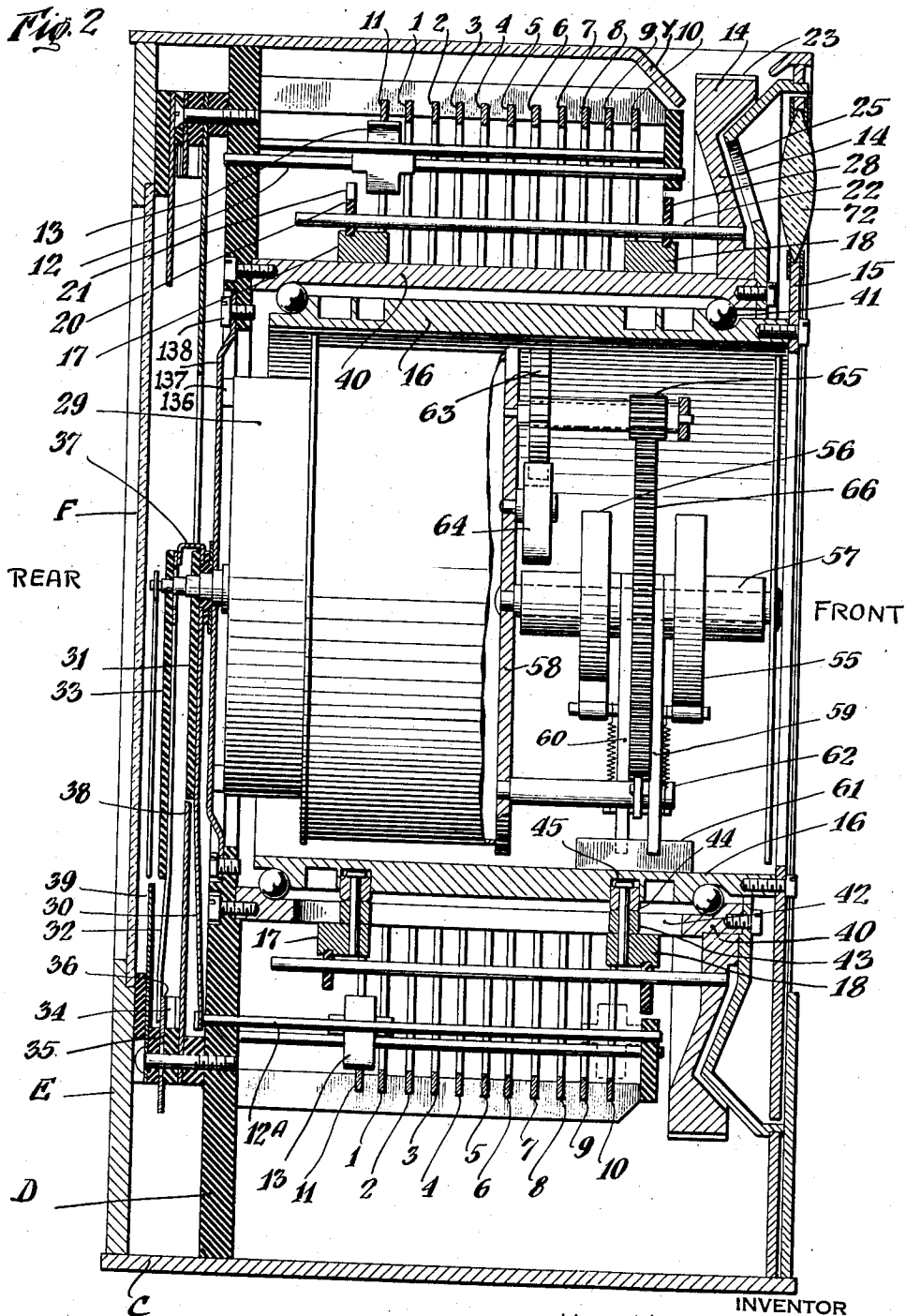
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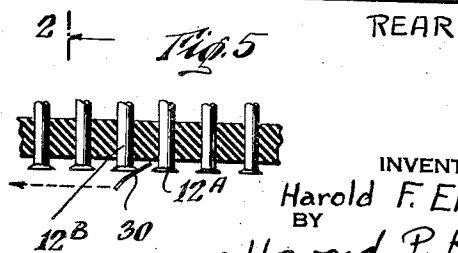
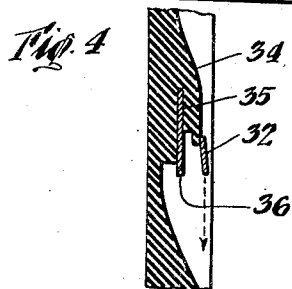
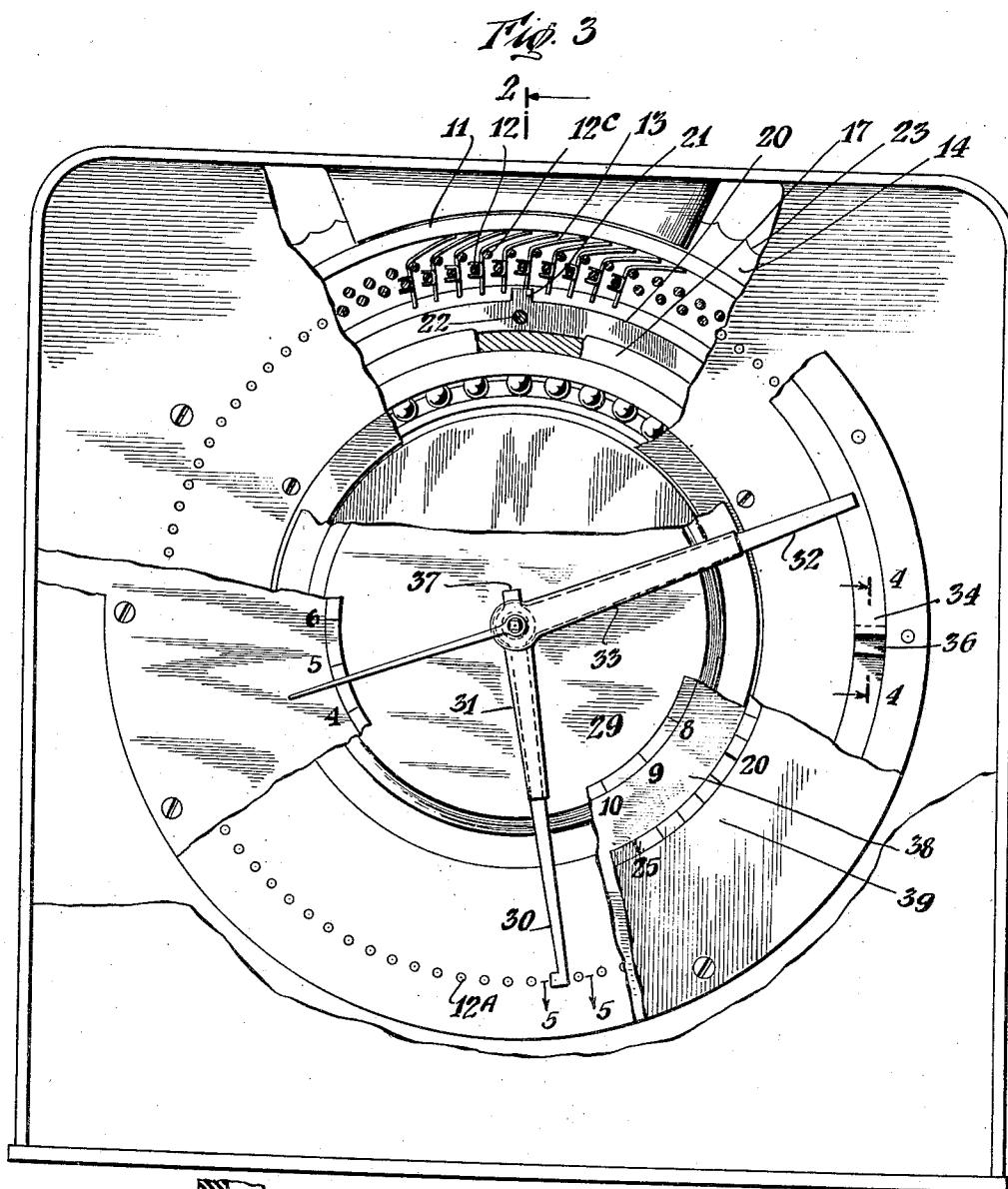
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MULTIPLE FUNCTION CONTROL CLOCK

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7 Sheets-Sheet 3



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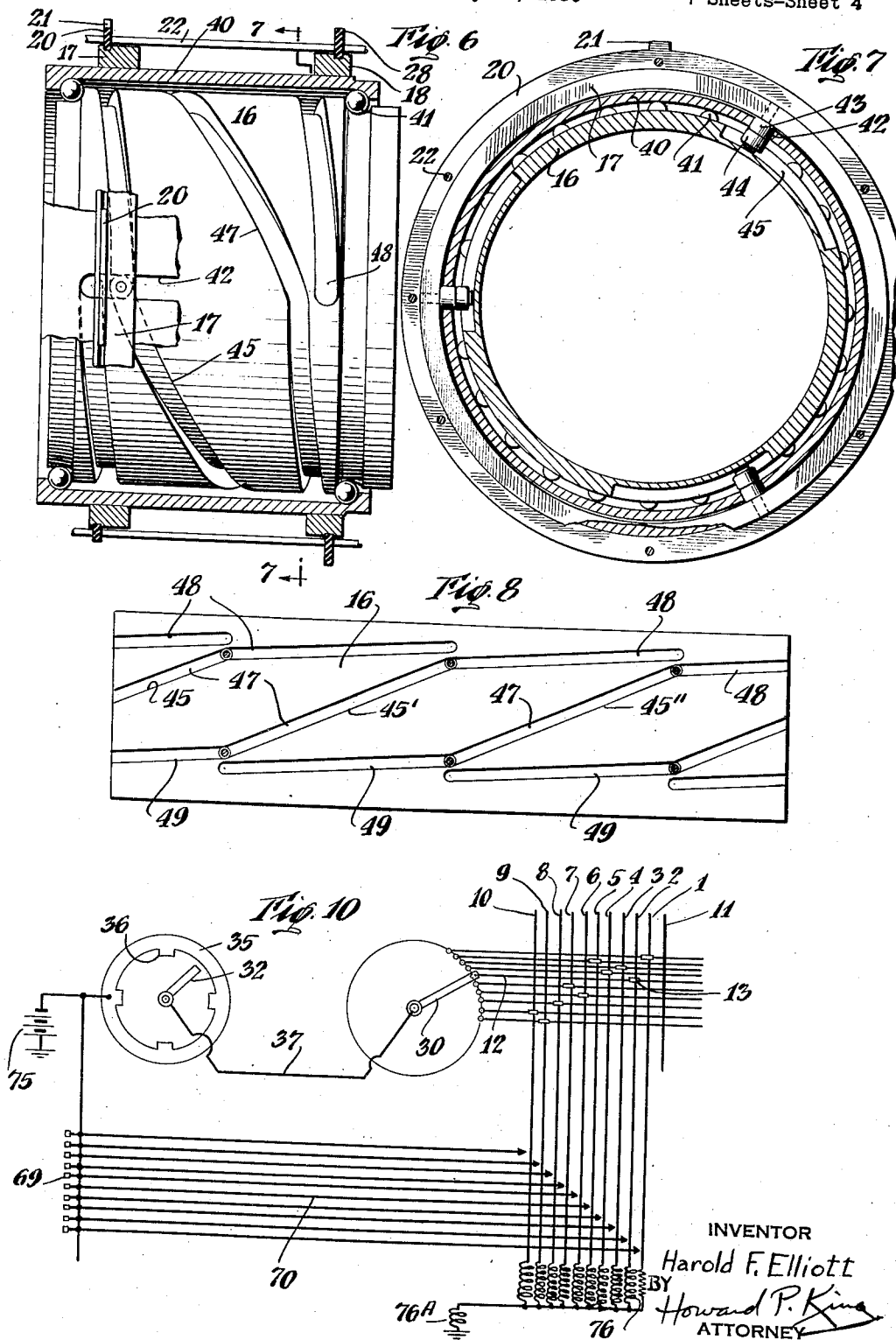
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MULTIPLE FUNCTION CONTROL CLOCK

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7 Sheets-Sheet 4



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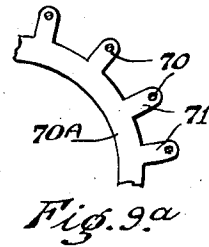
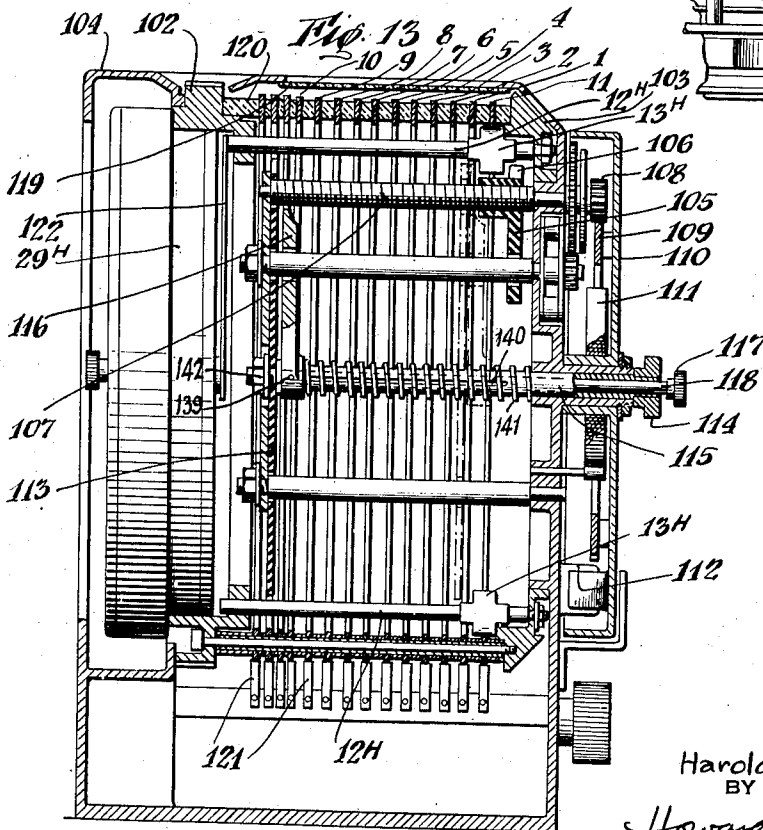
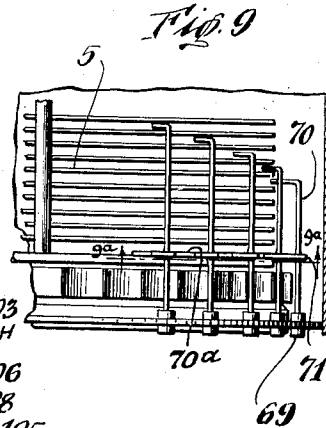
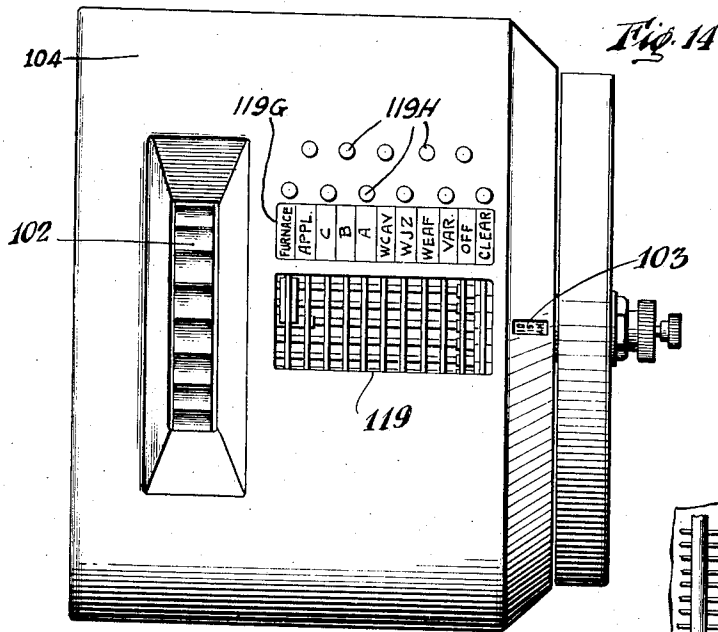
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MULTIPLE FUNCTION CONTROL CLOCK

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7 Sheets-Sheet 5



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MULTIPLE FUNCTION CONTROL CLOCK

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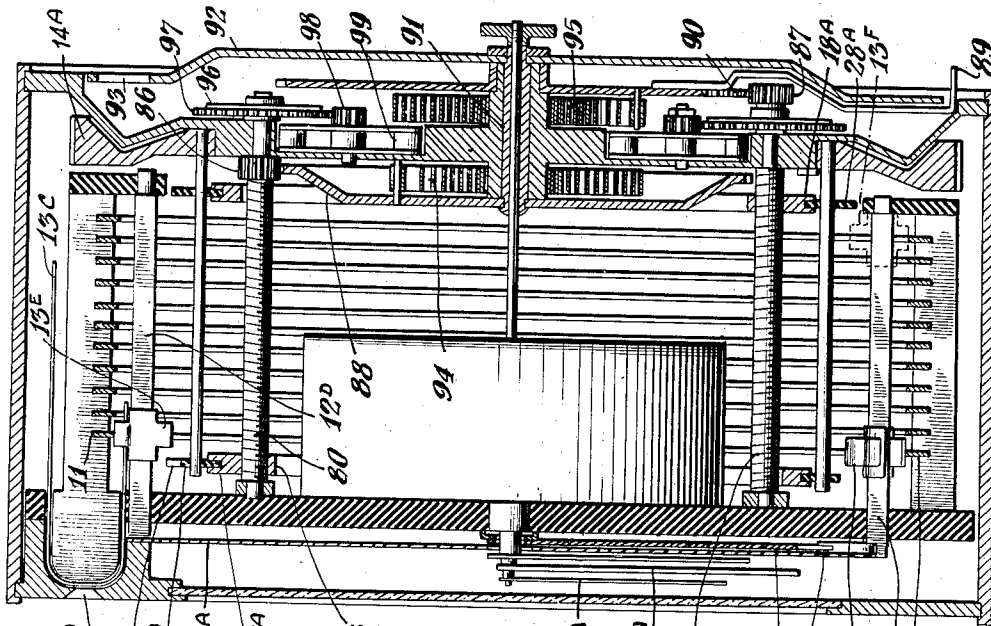


Fig. 11

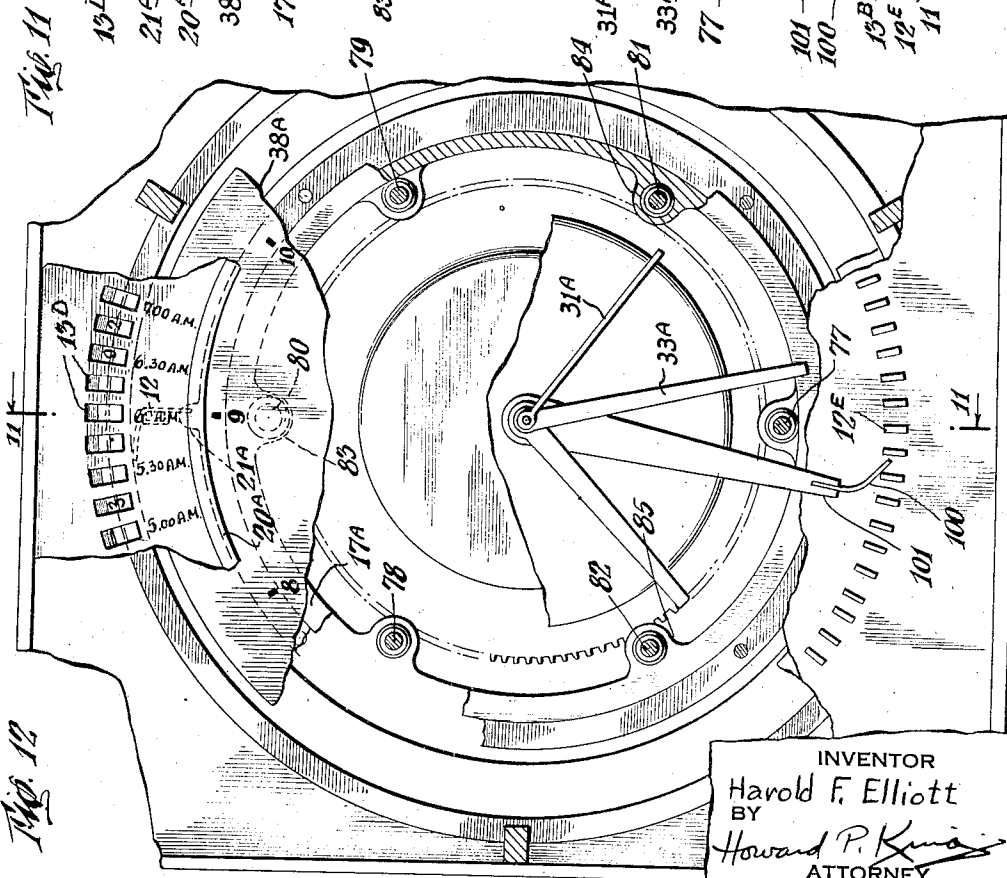


Fig. 12

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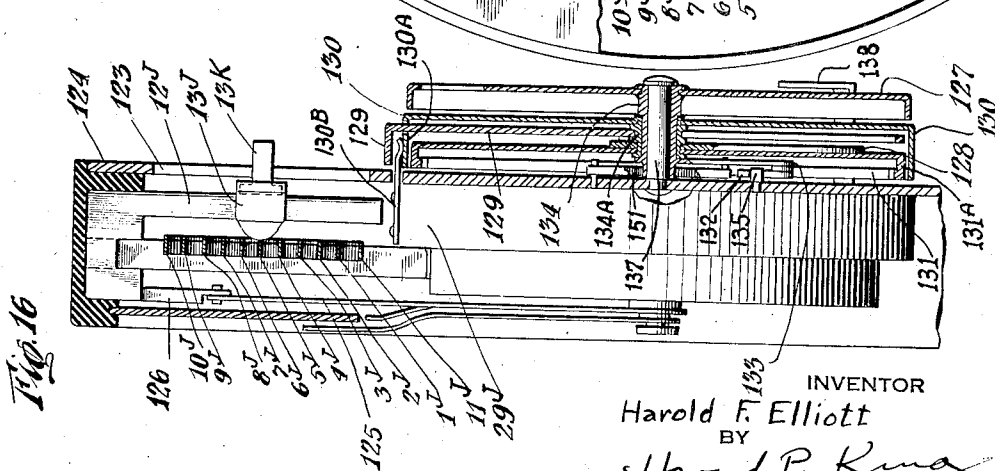
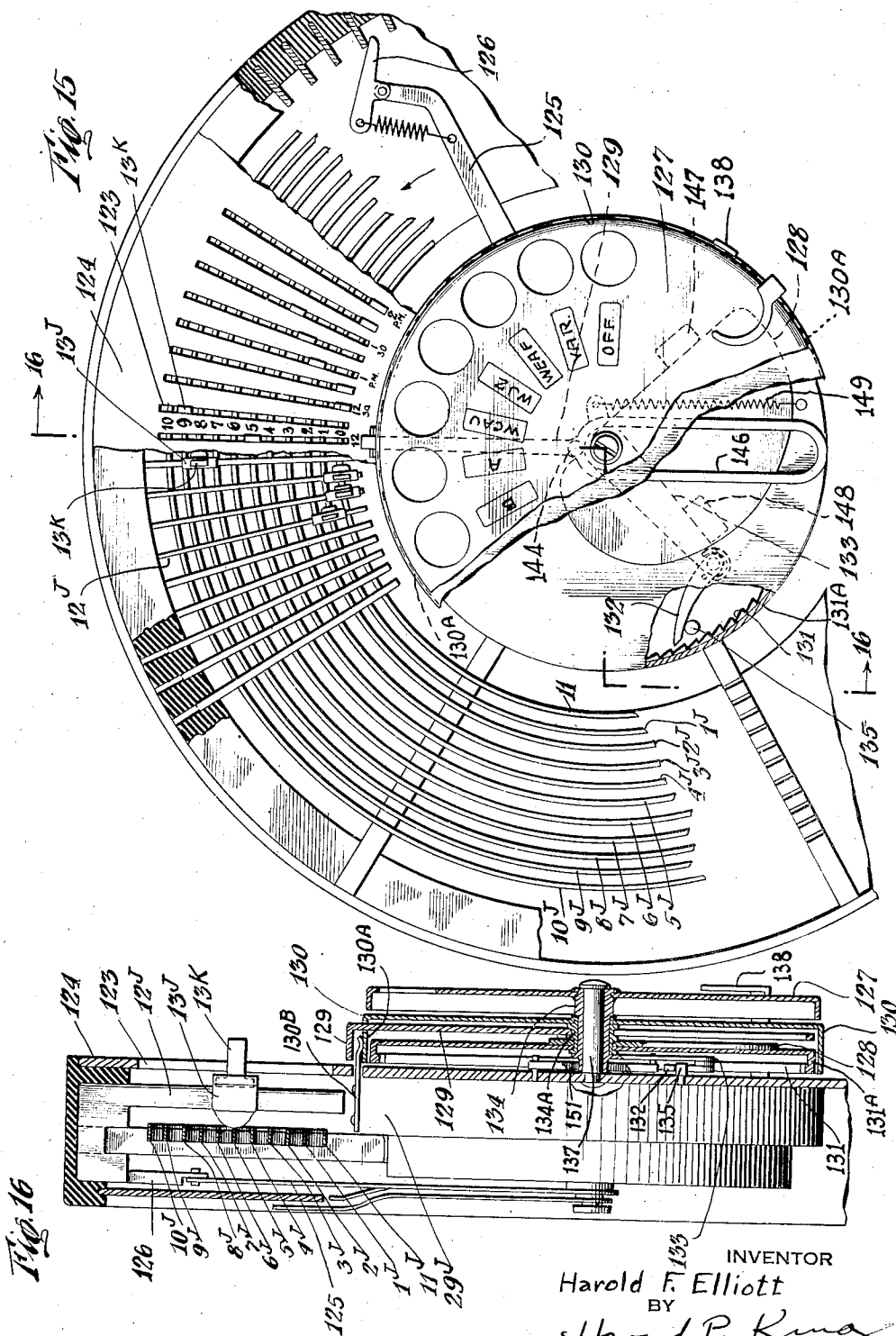
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MULTIPLE FUNCTION CONTROL CLOCK

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,240,498

MULTIPLE FUNCTION CONTROL CLOCK

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Application May 29, 1936, Serial No. 82,495

28 Claims. (Cl. 161—1)

The inventions which I have described in this and my copending application S. N. 82494 filed May 29, 1936, pertain to electric timing and control systems and applications thereof in various fields. An electric clock capable of carrying out a multiplicity of control functions for setting up and carrying out predetermined schedules and programs of operations is one of the features of my inventions and it is with this that the present patent application is principally concerned. One of the important fields of application of the clock is in the reception of entertainment programs and the like via wire, radio, television, facsimile, etc. Apparatus and methods involving new and novel features in this connection are described in my said copending application.

The clock, of which several preferred forms are described in detail hereinafter, has many marked advantages over previous developments in electric timing and control systems. It has a greater range of utility, is far more flexible, is simple and less expensive in construction. It is easier to operate, more compact, more convenient, and more attractive in appearance. These and other advantages of construction and application above outlined or which are set forth in detail in the following description comprise the objects of the present invention.

It will be understood of course, that I do not limit myself to the forms and features selected as illustrative but claim as my invention the new and novel features and methods set forth in the appended claims. It will also be understood that the field of utility is in no way limited to broadcast receivers, that this is but one important application of my apparatus and methods, and that the examples of the application of the clock to this purpose are illustrative of its mode of use in this and other fields. It will be obvious that it may be applied advantageously to electrical timing and control in industry, in the home and elsewhere.

In the accompanying drawings in which like numerals of reference indicate similar parts throughout the several views,

Figures 1 and 3 show front and back respectively of one of the preferred forms of the clock;

Figure 2 is a sectional view of the same along line 2—2 of Figure 1;

Figures 4 and 5 are fragmentary sectional views on lines 4—4 and 5—5 respectively of Fig. 3;

Figure 6 is a sectional view also on line 2—2 of Fig. 1, of the cam housing, followers and rings

and showing the cam in elevation within the cam housing;

Figure 7 is a sectional view on line 7—7 of Fig. 6;

Figure 8 is a development of the cam;

Figure 9 is a fragmentary sectional view on line 9—9 of Fig. 1;

Fig. 9a is a fragmentary portion of a conducting ring and push-button supporting structure from the apparatus of Fig. 9 with the view taken along the line 9a—9a of such figure.

Figure 10 is a circuit diagram showing the application of the clock to the operation of relays in a radio receiver or other apparatus;

Figures 11 and 12 show the assembly and details of another preferred form of the clock;

Figures 13 and 14 show an assembly and section of a third preferred form; and

Figures 15 and 16 show an assembly and section of still a fourth.

Each of the forms has certain advantages for certain applications, as will be apparent in the detailed discussion hereinafter.

Taking up details of construction, reference is made first to Fig. 2, which is a sectional view of the first form of the clock. The clock includes two sets of busses: (a) a set of "station" busses, and (b) a set of "time" busses. The "station" busses are numbered 1—11 inclusive and comprise a set of parallel rings spaced from each other on a common axis concentric with the axis of the clock. The "time" busses 12 are shown within the circular area of the set of "station" busses, parallel to the axis of the said set of "station" busses, and thus transverse to the several "station" busses. The several "time" busses are all equally spaced from each other and from the said axis of the set of "station" busses and are arranged accordingly as a cylindrical set or cage of busses. In practice there are preferably ninety-six of the "time" busses so as to have one for each fifteen minute periods of the day. This number is chosen because of the present practice of dividing radio broadcasting station time into quarter hours; obviously any other number for any other division may be substituted. For clarity, only part of the set of "time" busses is shown and numeral 12 applies as to such as are shown. A set of interconnectors, also ninety-six in number in practice are provided for making interconnections between the "station" and "time" busses. One of these interconnectors, designated by numeral 13 in Figures 2, 3 and 10, to which further reference is made for a more detailed description of the busses and

interconnectors will be made hereinafter, is provided for and remains upon each "time" bus 12. The ninety-six interconnectors 13 are mounted upon the ninety-six "time" busses 12, one interconnector upon each said bus, and mounted to ride or slide along on its respective bus 12. The several interconnectors 13 may be moved along "time" busses 12, to make electrical connections between the "time" busses and "station" busses, 1 to 11, in any desired combination. Any of the ninety-six "time" busses may thus be connected to any of the eleven "station" busses. The system of connections thus established may then be applied through relays to bring in selected radio or wire line programs at quarter hour intervals throughout the twenty-four hours of a day, or perform other operations as described hereinafter. It will be understood that the several busses of either set are electrically insulated by dielectric mounting and spacing from the other busses of the same set and that electrical connections between busses of one set to busses of the other set is through said interconnectors only.

For convenience in moving the interconnectors to positions making desired cross connections between "time" and "station" busses two dials are provided. The first of these is a "time" dial, shown at 14 in Figures 1, 2 and 3; it is graduated in quarter hours and serves to select the "time" bus and interconnector corresponding to any given quarter hour. The second dial is a "station" dial, shown at 15 in Figures 1 and 2; it is graduated in terms of stations or functions, and serves to move the selected interconnector to the desired station bus. This latter operation is carried out by a special cam 16 having two followers 17 and 18. The cam is shown in section in Figure 2 and a full view and development are given in Figures 6 and 8. Said cam is preferably a cylinder axially coincident with the axis of the sets of busses within the circular area occupied by the busses. The cam thus extends in a direction from front to rear of the clock, is longer than the distance between the extreme annular busses 10, 11 encircling it, and is rotatable upon its own axis with respect to both sets of busses. One of the followers, as 18, is, in normal position of rest, toward the front of the clock at a place somewhat in advance or forward of the most forward of said "station" busses, namely, bus 10.

The front end of the cam cylinder 16 is attached directly to "station" dial 15, so that the cam is rotated whenever this dial is rotated. In its preferred form, dial 15, as shown in Fig. 1, resembles somewhat the dial used upon automatic or "dial" telephones, providing near its periphery a series of finger holes 19 by which the dial may be rotated varying angular distances for "station" selection just as the telephone dial is rotated for selecting various numbers. The present dial differs from the telephone dial, however, in that the dial of the present invention may be rotated either way from its normal position of rest. Principal movement of the followers 17 and 18 is not simultaneous, but only one may have its principal movement at a time, and this is controlled by the direction of rotation of the dial from its normal position of rest.

When the "station" dial 15 is rotated clockwise from its position of rest at which it is shown in Fig. 1, the cam 16 moves the rear follower 17 toward the front, that is to say toward the right

from the position shown in Fig. 2. Follower 17 is provided with a ring 20 protruding circumferentially therefrom, said ring having a radial projection 21 at one part of the outer periphery just wide enough to engage one and only one of the ninety-six interconnectors 13 as illustrated in Figs. 2 and 3. When follower 17 is moved to the right, one of the interconnectors is engaged and accordingly moved with it, the others remaining stationary. Ring 20 with projection 21, may be rotated with respect to follower 17, adjusting the projection to engage any desired interconnector. This angular adjustment is obtained by rotating the "time" dial 14. Rotative connection between insulating ring 20 and said dial is obtained through the medium of slide rods 22 which are fast upon said dial and project therefrom rearwardly within the space between the cam cylinder and sets of busses. These slide rods pass through holes provided for the purpose in said ring 20, thereby enabling the rings to slide forwardly and rearwardly upon the rods, but requiring that the ring rotate in unison with the dial. The dial is thus adapted to obtain desired registration of the projection 21 with any one of the interconnectors. For obtaining exact registration, the said "time" dial 14 is provided with a convenient placement structure which is here shown as accomplished by notching the periphery of the dial (similar to gear teeth) such that a notch 23 is provided to correspond to each of the ninety-six quarter hours of a day. The notched edge is available from the top of the housing at the open cavity Y shown in Fig. 2, and by dotted lines in Fig. 1. A notching device, such as roller 24, Figure 1, is provided to snap into the nearest notch and set the "time" dial 14 so that it always stops with projection 21 opposite an interconnector. "Time" dial 14 is provided with a graduated scale upon the front surface. A part of this scale is visible through an opening 25 in the casement and serves to indicate the quarter hour for which the dial is set.

An interconnector may be set to tune in a desired program at a specified quarter hour by two simple steps: (1) rotating the "time" dial 14 to the specified quarter hour, as 10:15 p. m. illustrated in Figure 1; and (2) rotating the "station" dial 15 Figure 1 for the desired station or program. For example, if the program is to come over station WJZ, the "station" dial is operated by inserting the finger in the finger hole 19 marked WJZ in Figure 1 and rotating the dial clockwise till the finger reaches stop 26 just as in dialing an automatic telephone. This process moves the interconnector corresponding to time of 10:15 from bus 11 to bus 4, Fig. 2. As many of the interconnectors as desired may thus be moved to establish connections for selecting desired programs at given quarter hour intervals. It will be evident that such settings may, if desired be made for 24 hours in advance.

Previously made settings may be "cleared" by moving all interconnectors back to starting position, that is, in the particular showing, back to registration with bus 11. The operator performs that function by inserting a finger in the dial-hole marked "clear" in Fig. 1, and thereby turning dial 15 counter-clockwise until the finger reaches stop 27. Now this counter-clockwise rotation of course rotates the directly connected cam cylinder, and the cam thereupon functions to move the front follower 18 toward the rear, and during this principal movement of the front fol-

lower, the rear follower 17 has substantially no movement. Whereas the rear follower 17 only has means for engaging one interconnector at a time, the front follower differs in having means for engaging as many of the interconnectors at once as may be in its path of movement. It will therefore be observed that this front follower 18 has a circumferentially projecting insulative ring 28 the radius of which at any point is greater than the distance of the interconnector from the central axis. The cam is constructed to move this follower and its projecting ring rearwardly to a position where it will have slid the several interconnectors back to original or starting position in contact with bus 11 from whatever position they had been set to in the last setting of the same. This particular structure provides, it will be noted, for clearing all settings and does not permit of correcting one setting and leaving others as set. Furthermore, in this particular showing, the bus 11 engaged by all of the interconnectors at starting position is a neutral bus, but it may be given a circuit function if desired. As heretofore stated, rods 22 pass through rings 20 and 28. The rings are rotatable upon their respective followers 17 and 18, and the followers are in turn axially slidable upon but non-rotatable with respect to a cam housing 40 hereinafter more particularly described.

Closing of an operative circuit is accomplished at the several times set to the chosen station, by a clock 29 incorporated as part of the apparatus. As shown, an electrically actuated clock 29 is provided, being physically positioned in the space provided within the cylindrical cam, and mounted in fixed position by appropriate attachment to fixed parts of the casement at one or both ends of the said cam. The hands or corresponding time-controlled parts of the clock mechanism provide electric contact brushes. For convenience I prefer to use a clock in which the hour hand makes a single revolution in twenty-four hours. A different circuit may thus be completed for any desired division of the rotation of the minute hand to cover the twenty-four hour period by completing the several circuits through the hour and minute hands in series from contacts made by each. I arrange to close a relay circuit each time the minute hand passes the hour, quarter, half and three-quarter hour positions. The particular structure thus shown and described will provide for establishing circuits through the ninety-six time busses in succession.

I have arbitrarily termed the face of the device having the selector dials the front, merely for convenience. The opposite face may as well have been termed the front, because it has a glass window or crystal for visioning the clock hands and dial. However, since the device is primarily for setting the automatic switch connections and the time-telling function is of secondary importance, I shall adhere to the elected designations and refer to the time-telling hands and dials as at the rear of the clock.

The several instrumentalities heretofore described are enclosed within a cabinet or casement C which has a false back D of insulative material spaced inwardly from the rear wall E which has an opening for the time-telling face and which supports the crystal or glass window F. Between the rear wall and false back is appropriate space for a stepped or sectional dial and certain circuit closing mechanisms about to

be described, it being within said space that the time-telling hands rotate.

In the construction now being described, I prefer to provide an electric contact brush 30, shown of leaf-spring formation, this brush being attached to or otherwise made rotatable with the hour hand 31. Preferably the said hand 31 is of insulative material so as to avoid grounding the brush through the metallic parts of the time-piece mechanisms. It is appropriate to observe here that the rear ends of all of the time busses pass through the false back D to the rear surface thereof thereby providing a circularly disposed series of contacts. The outer end margin of the brush describes an orbit coincident with the circle of said series of contacts, and presses against each as it passes thereover thus briefly closing an electric circuit from brush to successive busses in turn. Said brush may have an inclined tip thereon as shown at 30 in Fig. 5 enabling it to drop off the head of one time-bus, as 12A, and ride onto the next, as 12B.

Similarly, a brush 32, also of leaf-spring formation is attached to or otherwise caused to rotate with the minute hand 33 which again is preferably of insulative material. It is a desideratum that this minute hand brush 32 function to establish a circuit connection of only a few moments duration exactly at the beginning of each quarter hour. One means of accomplishment of this desideratum is shown in Figures 2, 3 and 4 wherein is indicated an annular insulating member 34 concentric with the axis of revolution of the hands. The face of this member upon which the brush rides is a series of inclines which end abruptly to permit the brush to snap from the incline to a metallic contact 36 suitably formed as part of an annular bus 35. The abrupt ends of the successive inclines occur precisely where the brush may snap therefrom to the contact at the quarter hour. Said contact is not at the bottom of the next incline, that being lower still, so that the brush may, as it travels, snap off of the contact into the bottom of the incline. Such structure affords punctual and positive making of contact, a brief retention of closed circuit, and a quick, non-sparking break of contact. The brush then climbs the next incline during the fifteen minute advance of the hand and snaps off the end thereof as before, and so on for each quarter hour period. I deem it preferable to make the insulative annular member 34 of molded material with the bus extensions 36 partially embedded therein. However, assembled stampings or other suitable mechanically equivalent structure may be employed.

The hour and minute brushes 30 and 32 are electrically joined in series as by a U-shaped brush 37 fast to one hand, for instance the hour hand 31 and its brush 30, and rides against a metallic hub portion of brush 32 on the minute hand. It may be opportune to state here that the minute hand is closer to the glass or crystal F than the hour hand, said hands revolving in planes definitely separated by a space which will accommodate therebetween the annular insulating member with its inclined faces, bus bar and contacts. Ring-like dial sections 38 and 39 for showing the hours and minutes are mounted in substantially the respective planes of rotation of the hour and minute hands, and are of course concentric with the axis of rotation of said hands. Actuation of the hands is obtained by any suitable clock mechanism or motor 29 preferably of the synchronous type with proper means for set-

ting the hands, but as the details of structure of such clock otherwise form no part of the present invention, further description thereof is not believed necessary. The clock may be conveniently supported from panel D through the medium of pillars 136 interposed between the clock body and a plate 137 in turn situated between and projecting radially beyond the clock body and hands and shown attached to said panel D by screws 138.

A brief further description of certain mechanical details of the cam and other parts may be helpful in fully understanding the mechanism. Referring to Figs. 2, 6 and 7, the cam 16, rotates inside a fixed housing 40, upon ball bearings 41. Slots 42 are provided in and longitudinally of the housing 40. Sets of pairs of rollers, the axis of which are radial with the cam cylinder, and indicated at 43 and 44 are attached to the cam followers, 17 and 18. One roller, 43, of each set engages the slot 42 in the housing 40 and the other roller 44 of the set engages in a cam groove 45 in the surface of cam 16, causing the followers to move to the right or left as the cam is rotated. Referring to Figs. 6, 7 and 8, it will be noted that the cam here illustrated has three sets of identical grooves 45, 45' and 45'' equally spaced around the cam cylinder. This construction is advantageous since each cam follower may have three sets of rollers spaced at 120°, thus actuating the follower rings, 17 and 18, from three equally spaced points, which makes for smooth operation and avoids any tendency to bind. Each cam slot consists of three connected portions, as illustrated at 47, 48 and 49, Figure 8. The portion 47 has greatest inclination longitudinally of the cam cylinder, and is the part utilized to give to the followers 17 and 18 their principal functional movement to perform the operations of setting and clearing the interconnectors, as discussed hereinbefore. Portion 48 has but slight inclination longitudinally of the cam cylinder and permits the follower 18 to idle and slowly back away about the width of the slot when follower 17 is being actuated by clockwise operation of the dial. Portion 48 extends from one end of the greater inclined portion 47, and from the other end of that greater inclined portion 47 extends another slightly inclined portion 49 which serves a corresponding purpose of backing follower 17 away when follower 18 is being actuated by counterclockwise rotation of the dial.

In order to assure proper sequence in the operation of the "time" dial 14 and "station" dial 15, an interlock 50, Figure 1, is provided. As shown, this interlock 50 is a roller adapted to engage a notch 51 in the periphery of dial 15. Said interlock roller is on one end of a first class lever or rocker arm 52 on the other end of which is mounted roller 24 of the notching device. Said rocker arm 52 is fulcrumed at a mid point, as by pivot 53. When notching roller 24 is in any one of the ninety-six notches (in time dial 14), rocker arm 52 Fig. 1 permits interlock 50 to ride on the edge of the "station" dial 15. To change the "time" dial, the "station" dial must be at its normal position of rest in order to have notch 51 register with interlock roller 50 which is the only position at which the opposite notching roller 24 can lift up for purposes of passing over the crest between notches 23 in "time" dial 14. Rocker arm 52 is provided with a spring 54, which actuates the notching roller 24, normally to seat in one of the notches nearest to registration with the roller.

In order that "station" dial 15 and its attached cam 16 may return automatically to neutral position following rotation in either direction, a pair of spiral springs, 55 and 56, Figures 1 and 2, are provided. These springs may conveniently be of the clock spring type and are anchored at their inner ends to a fixed shaft 57 axially disposed with respect to the dial, said shaft being shown attached to the rear plate 58 of the clock motor 29. Springs 55 and 56 actuate radial arms 59 and 60 respectively which are trunnioned at one end upon fixed shaft 57 and which at their outer ends engage a key 61 which is attached to the inner surface of cam cylinder 16. A pin 62 serves as a stop for arms 59 and 60 when in neutral position. When dial 15 is rotated clockwise, key 61 carries arm 60 against the force of spring 56. When the dial 15 is rotated counterclockwise, key 61 carries arm 59 against the force of spring 55. In neutral position the arms rest against pin 62 and no spring action is applied to key 61 effective to move the cylinder either way. In order that the return motion of the dial and cam may not be so rapid as to cause excessive rebound or "bouncing," an escapement or governing mechanism is provided. This consists of escapement wheel 63 and follower 64. The escapement wheel 63 is driven by pinion 65 and gear 66. Gear 66 floats on shaft 57 but is engaged and driven by arms 59 and 60 through pawls 67 and 68 whenever the arms 59 and 60 are returning to neutral position after operation of the dial. In neutral position, the pawls are disengaged from gear 66 by virtue of resting against pin 62 which lifts them from the gear.

In order that the radio set or other mechanism under control of the clock may be actuated manually as well as automatically, a set of push buttons as 69, Figure 1, is provided. One convenient construction for these buttons is illustrated in Figure 9. The buttons as 69, actuate contacting rods as 70, to make contact with the "station" busses, as 5. A leaf spring 71 serves to hold rod 70 normally disengaged from bus 5. The leaf spring 71 is one of a series of spring fingers integral with or secured to a metal plate 70A (Fig. 9a) which is connected to the energizing source 75 as shown in Fig. 10. Each rod 70 (Fig. 9) is soldered or otherwise secured to a corresponding leaf spring or spring finger 71 and is maintained out of contact with a corresponding bus 5 by the normal positioning of the leaf spring when it is not under tension. With the buttons 69 on the rods 70, slidable in corresponding apertures in the face of the housing as shown in Fig. 1, the rods are maintained in a transverse position out of engagement with the corresponding busses, and when a button 69 is pushed, the corresponding leaf spring 71 flexes sufficiently to permit the rod on the pushed button to engage a corresponding bus, as is readily apparent from a consideration of Fig. 9.

A lens 72, Figure 2' may be provided to aid in reading the time dial indications if desired. Means for controlling volume and tone may be included as illustrated in Figure 1 at 73 and 74.

Referring to Figure 3, it will be noted that "time" bus 12 is supplemented by an adjacent auxiliary rod 12c parallel thereto, over which interconnector 13 is bent. Interconnector 13 may be a spring metal stamping having the form shown in Figures 2 and 3, or other suitable construction. One of the "station" or ring busses is shown at 11 Figure 3 illustrating the manner in which an interconnector 13 makes an electrical

connection between a "time" bus 12 and a "station" bus 11. Figure 3 also shows rod 22 in section, insulating ring 20 and the projection 21 thereon, as previously described.

Details of the supporting framework, housing, etc. will be omitted for sake of simplicity. It will be obvious that these may take many forms, depending upon production methods, installation requirements, and so forth. It may be mentioned, however, that the type of face to be employed for the clock may be of many forms, one of which is the 24 hour arrangement shown fragmentarily at 38 and 39 in Figure 3. Another form is the "revolution counter" type of dial now coming into usage for household clocks. Another suitable arrangement comprises a standard 12 hour clock face for indicating time with a two-to-one reduction gear for driving the brush 30, which may if desired be provided with an auxiliary 24 hour hand and dial. Alternatively other means of differentiating the a. m. from p. m. time setting of the clock hands and attendant contact brushes may be provided. Obviously the bus, dial and cam mechanism illustrated may be applied to a standard 12 hour clock rather than a 24 hour clock but the limitation thus imposed renders such an arrangement less preferable. The arrangement of clock face and dials to be used for any specific purpose is obviously subject to many variations.

Figure 10 shows schematically one manner in which electrical circuits may be established through the busses, interconnectors and brushes for operating relays, electrical communication receiving apparatus with electrically controlled channel selecting means, or other electrically controlled devices. Electrical energy from a source 75, which may be a battery, transformer or other suitable source, is conducted to bus 35, thence through projections 36 to minute hand brush 32, thence through U-shaped brush 37 to hour hand brush 30, thence through "time" bus 12 to interconnector 13, and thence to "station" bus 2 and associated relay coil 76, or other device to be operated. The return circuit may go directly back to source 75 or further relay coils or other apparatus may be included in the return circuit as illustrated at 76A. Coil 76 may represent the closing coil of a relay which serves to establish connections for tuning the circuits of a radio receiver to receive a given station, and coil 76A may represent a trip coil for opening previously closed relays. Numerals 69 and 70 represent push buttons and contact making rods such as were described in connection with Figure 9.

Brief reference will be made now to Figures 11 to 16 inclusive which show several alternative constructions for the assembly and details of the multiple function control clock. Figure 11 shows a horizontal section through an alternative assembly in which the cam mechanism hereinbefore described for actuating the interconnectors is replaced by two sets of lead screws together with followers, gears and other parts for actuating the same. Follower 18A and insulating ring 28A, which performs the function of moving all interconnectors 13E from an operating position such as illustrated in dotted lines and indicated by reference character 13B, rearwardly to the left-hand side of the apparatus as shown in Fig. 11 for "clearing." The follower is supported upon three lead screws, 77, 78 and 79, spaced at 120° as illustrated. Follower 17A, with its insulating ring, 20A, having projection 21A for moving the interconnectors individually forward, is mounted upon three other parallel but

intermediate lead screws, 80, 81 and 82, Figures 11 and 12. These three intermediate screws are also spaced 120° apart and occupy positions preferably half-way between the first mentioned screws. Follower 17A has three threaded projections 83, 84 and 85 directed radially inwardly which engage screws 80, 81 and 82 and follower 18A has three corresponding threaded projections directed radially inwardly engaging screws 77, 78 and 79 as shown in Figure 12. The lead screws 77, 78 and 79 of the first mentioned set project nearer to the dial than the second mentioned set of lead screws 80, 81 and 82. Toward the forward end toward the dial of each of the screws of this latter set is fixed a pinion 86, the several pinions being in a common plane. Likewise, at the forward end toward the dial, the lead screws 77, 78 and 79 each have a pinion 87 in a common plane and parallel with the plane of the first mentioned pinions.

A gear 88 is in mesh with all three pinions of the set of pinions 86 more rearward from the dial so as to operate all three simultaneously. The other three pinions 87 are operated in unison by a lever 89 attached to another gear 90 in mesh with the several pinions of this set, namely, the pinions 87 actuating lead screws 77, 78 and 79. Gear 88 is connected via a shaft 91, to dial 92 which is provided with finger holes as 93, similar to a telephone dial. When dial 92 is rotated clockwise, gear 88 drives lead screws 80, 81 and 82 counterclockwise and follower 17A advances frontward. When lever 89 is rotated counterclockwise, gear 90 drives lead screws 77, 78 and 79 clockwise and follower 18A moves rearward. Interconnectors 13E, may thus be moved singly forward by action of dial 92. They may be moved in unison and rearward by lever 89 which is the "clearing" or "resetting" lever.

A pair of spiral springs 94 and 95 serve to return the dial 92 and lever 89 with associated gears, screws and followers to neutral positions after operation. Suitable stops (omitted for simplicity) will, of course, be provided, these features being substantially as described in connection with the preceding figures. In order to prevent rebound suitable retarding means may be provided where this refinement is deemed desirable. One form of retarding mechanism is shown by numerals 96—97—98 and 99. A disk type of ratchet mechanism, 96 is attached to the lead screw 80. This ratchet engages gear 97 during the return motion of dial 92. Gear 97 drives pinion 98 to which is attached a centrifugal governor 99. During the forward motion of dial 92, ratchet 96 slips over gear 97 and the governor is inoperative. A second retarding device duplicating that just described may be provided for the lead screw 77 and the associated mechanism actuated by lever 89.

The time busses and interconnectors illustrated in Figs. 11 and 12 show an alternative construction of these items. As shown, the 96 time busses as 12D and 12E, are in the form of small rectangular bars and the 96 interconnectors as 13E and 13B comprise metal stampings formed to slide along the bars. Each interconnector comprises a body portion which is wrapped around the bus, clinging thereto by spring action, an extension which springs against the station busses as 11, and a second extension which engages with projection 21A on follower ring 20A or ring 28A on follower 18A. The clock and contact-making mechanism may be similar to that described for Figures 1, 2 and 3, or one of the alternative ar-

arrangement shown in Figures 11 and 12 may be used. The showing of Figures 11 and 12 includes a clock dial 38A and hour and minute hands 31A and 33A respectively for indicating time. A brush 100 attached to a 24 hour hand 101 may drop from the head of one time bus to the next as illustrated in Figure 12. Alternatively, spring 100 may be replaced by a small rigid contact arm pivoted upon the ends of the hand 101 and arranged to drop from the inner surface of one bus to the next. Such alternative structure is illustrated in the rigid pivoted contact arm 126 on the hand 125 as shown in Fig. 15. These arrangements provide a quick break action whereby the hour hand may be used for the timing and contact making action without the use of the minute hand, as was illustrated and described in connection with Figures 3, 4 and 5. The latter provides for an accurately timed electrical impulse of a few seconds duration. The method of Figures 11 and 12 provides a continuous circuit connection somewhat less accurately timed.

In some instances, it may be desired to provide indicating means for showing the settings of the interconnectors. This may be carried out in a variety of ways, one example of which is shown for interconnector 13E at the upper left of Figure 11. A flexible strip 13C, having printed figures or letters corresponding to the settings of the interconnectors opposite the various station busses, is arranged to slide past a window 13D. By providing such a strip and window for each interconnector, the program of settings of the interconnectors may be seen at a glance, as indicated at the top of Figure 12, which is a fragmentary front view of the clock face incorporating such an arrangement.

In the arrangement of parts described above for Figs. 11 and 12, and also for the arrangement described for Figs. 1 to 9, the time busses and station busses are supported in a fixed position relative to the framework and housing of the mechanism. The clock is also supported in a fixed position in the housing. Mounted in movable relation to the busses, clock, and housing, are the time selector dial 14 (Fig. 2) (14A, Fig. 11), selector finger 21 (Fig. 2) (21A, Fig. 11), and the station selector dial 15 (Fig. 1) (92, Fig. 11). Rotary motion of this station selector dial is translated into linear or axial motion of the selector finger in the structure of Figs. 1 to 9, as well as that illustrated in Figs. 11 and 12. In the arrangement of Figs. 1 to 9, this translation of rotary to linear motion is accomplished by the cylindrical cam 16 and associated followers 17 and 18. The original station setting of the sliding interconnectors to predetermined times is carried out by clockwise movement of the station dial 15 as previously mentioned, while the rotation of such dial in a counter-clockwise direction causes the movement of the cylindrical cam 16 and associated follower 18 to cause the insulated ring 28 to move the sliding interconnectors all to a position of rest at the rear of the housing or left-hand side, as viewed in Fig. 2. In the arrangement of Figs. 11 and 12, the sliding interconnectors such as 13E are originally moved to a predetermined position by the rotation of station selector dial 92 in a clockwise direction. Such rotary movement is translated into linear movement through the lead screws 80, 81, and 82, operated through the medium of gears such as 86 and 88 as shown in Fig. 11. The follower 83 with the insulated ring 28A and selector finger 21A thereon acts directly on the sliding interconnec-

tor. In Figs. 11 and 12, instead of utilizing the station selector dial 92 for resetting, a lever 89 is employed which acts through an associated gear 90 and pinions such as 87, to rotate lead screws 77, 78, and 79, to cause linear movement of the follower 18A with the ring 28A of insulating material thereon.

The various relatively movable parts may be grouped in a variety of ways other than that shown in Figs. 1 to 9, and Figs. 11 and 12. In the arrangement of Figs. 13 and 14 the entire group of parts comprising the clock motor 29H, a notched time setting disc 102, time dial 103, station busses 1-11 inclusive, time busses, as 12G and 12H, together with their ninety-six interconnectors, as 13G and 13H, all revolve as a unit in housing 104 as contrasted to the fixed relationship between the housing, busses, and clock, for instance, in the structures of Figs. 1 to 11. Follower 105 with insulative projection 106 for moving the interconnectors individually is actuated by lead screw 107, which is in turn driven by pinion 108, gear 109, and station dial 110, to translate rotary into linear motion. The time setting disc 102, and time dial 103 are rotatable relative to the housing 104, but are fixed to rotate with the bus assembly rather than relative thereto as in the previously described structures. The lead screws 107 are rotatably supported in a fixed position with reference to the housing 104. The station dial 110 is manually operated by the user as in Fig. 1, by insertion of a finger in the appropriate dial hole for that purpose, and while the station dial 110 is being rotated to rotate the lead screws 107, the bus assembly remains stationary. A spiral spring 111 returns the dial 110 and associated mechanism to neutral or rest position against stop 112. A centrifugal governor with associated gears and ratchets may be provided as discussed in connection with Figure 11 when this refinement is desired to minimize rebound. For "clearing" previous settings of the interconnectors an insulating disc 113 is provided. This is actuated by pulling outward on knob 114 which is attached to disc 113 through rod 115. An insulating finger 116 actuated by knob 117 through rod 118 provides means for clearing the interconnectors individually. Finger 116 is slidably mounted on hollow rod 115 and made fast to the core rod 118 by a transverse pin 139 extending from said finger to the core rod 118. This pin passes through a slot 140 longitudinal of the hollow rod enabling the inner core rod to be slid with the pin riding in the slot at such time. Disc 113 is attached to the end of hollow rod 115 by a nut 142. To clear a single interconnector, the time setting disk 102 is rotated to the appropriate setting and then the smaller knob 117 on inner rod 118 is pulled out at which time pin 139 rides in slot 140. A spring 141 on the outer rod pressing against the finger will return the finger to position shown in Figure 13 when released. If all interconnectors are to be cleared no rotation of the time setting disk 102 is necessary, as disc 113 lies behind all of them; knob 114 on the hollow rod is pulled, and since the disc is held by nut 142 from leaving the said rod, it moves forward with it and clears all interconnectors. Of course when the hollow rod 115 is pulled forward, inner rod 118 comes forward with it and the same spring 141 actuating the finger rearwardly then acts to actuate both the finger and disc 113 back to initial position when released. A window 119, Figures 13 and 14, is provided in the housing for observing the settings of the interconnectors. As shown in

Figure 14, an indicia plate 119G may be provided adjacent window 119 indicating the functions of the busses seen through the window. A set of push buttons 119H, indicated in the drawings above the indicia plate 119G, may be provided for manually closing the circuits under control of the clock in a manner similar to the showing of push buttons 69 in Figure 9. The station busses, 1 to 11 inclusive, together with three additional busses shown at the left of bus 10 (see Figure 13), are preferably supported in a cylinder 120 of transparent insulating material. This cylinder 120 is preferably transparent so as to permit seeing through the same, thereby enabling the operator to see the interconnectors within the cylinder and thus observe what settings have been accomplished. Alternatively these busses may be supported by insulated tie rods and spacers of any convenient construction. Brushes 121 illustrated at the bottom of Figure 13, sliding against the ring busses, 1-11 etc., provide connections to these when the drum assembly is rotated. The three extra busses at the left of bus 10 (Figure 13) provide connections to the synchronous clock 29 and brush 122, which contacts the heads of the time busses as 12H.

The assembly shown in Figures 13 and 14 has the advantage of simplicity, compactness and the possibility of observing the settings of the interconnectors through the window in the top of the housing. This assembly also provides separate "setting" and "clearing" means. The assembly of Figures 1, 2 and 3 provides a stationary clock face as does the assembly of Figures 11 and 12 contrasted with a rotating face in the assembly of Figures 13 and 14. The choice of these or other analogous arrangements will depend upon the specific conditions to be met, production facilities, costs and other considerations.

Figures 15 and 16 show a fourth construction for the clock. In this arrangement, the time busses as 12J are placed radially about the clock motor 29J, and the station busses comprise a set of conducting rings, 1J to 11J inclusive, concentric with the axis of the clock. The interconnectors as 13J, slide radially on the time busses as 12J, and insulating tabs as 13K, project through slots, as 123, in dial 124, to provide for moving the interconnectors by means of one's fingers or other means. This construction enables resetting of any one interconnector slide without "clearing" all settings. A twenty four hour hand 125 carrying a pivoted contact member, 126 provides means of establishing a circuit to the time busses 12J in succession. When minimizing cost is an important consideration, the arrangement above described providing for finger operation of the interconnectors via the tabs, is complete in itself. When the cost factor permits, a "telephone" type of finger index or station dial as 127 together with a time index dial as 130 may be added for selecting and setting the interconnectors in a manner similar to that already described for the other forms of the clock.

The "station" dial 127 is arranged to actuate a cam 128, and the cam in turn actuates follower 129. The latter serves as a push rod for moving the interconnectors, as 13J, from bus 11J to one of the busses numbered 1J to 10J. By rotating dial 127 various angular distances corresponding to the various finger holes, the cam 128 and push rod 129 may be made to push the interconnectors to the corresponding station busses. The push rod 129, may be set opposite any desired "time" bus, as 12J, by rotating the time index dial 130,

relative to dial 124. The dial 130 is provided in a substantially cup-shaped member having a plurality of notches 130A in the circumference thereof corresponding to the 96 time graduations. A spring member 130B appropriately and rigidly secured as to the outside of the clock 29J, rides in the notches 130A and acts to hold the dial 130 in any adjusted position. Either time index dial 130 or dial 124 may be stationary and the other rotatable, as desired. If time index dial 130 is to be the rotatable member, a rack and pawl mechanism, 131-132, may be inserted to operate between the dial 127 and cam 128. The rack or ratchet 131 portion is provided on the inside of a flange on a cup-shaped member 131A. The cam 128 is secured directly to this member 131A and is rotatable therewith. An arm 133 is connected to the dial 127 by means of a bushing 134 carried on a pin axis 137, and such arm and dial rotate together. The pawl 132 in turn is supported for limited pivotal movement on the arm 133. Dial 127 may drive lever or arm 133 and the pawl 132 through shaft like bushing 134. In operating this mechanism the dial 130 is rotated until the push rod or follower 129 slidable in an aperture therein is opposite the desired time indication on the dial 124. A connecting mounting or bushing 134A is rotatably supported on the bushing 134. This bushing 134A connects the dial 130 and the cup-shaped member 131A carrying the rack 131, and these latter two members are thereby rotated with the dial 130 upon movement of such dial. If station dial 127 is then rotated clockwise, pawl 132 will engage rack 131, which in turn rotates cam 128. The dial 127 is rotated until the operator's finger in a dial hole engages the stop 138. In the meantime the cam 128 rotating under movement of arm 133, carrying the pawl 132 in engagement with the notch in 131, acts on the pin 144 on the push rod 129 to move the latter a distance corresponding to the movement of the dial 127 to set an interconnector 13J to a station which corresponds to the finger hole in the dial. The push rod 129 is guided in the aperture in the dial 130, and the guide frame portion 146 on the push rod is slidable on the assembly at the bushing 134A. A stop 147 on the dial 130 positions the cam 128 in its retracted position with respect thereto. Another stop 148 on the dial 124 positions the arm 133 with respect thereto. The dial 130 remains stationary during movement of the dial 127 by virtue of a spring member 130B, and with the dial 127 moving clockwise to stop 138, arm 133 is moved away from stop 148 and cam 128 is moved away from stop 147. A retracting spring 149 is provided for the push rod 129, and a clock spring 151 secured at one end to the base or dial 124 and at the other end the bushing 134 assembly acts to retract the dial 127. Spring 149 pulling on follower 129 acts on the cam 128 through the pin 144. The pin is integral with or rigidly mounted on the follower 129 and because it is in engagement with the cam 128 it causes such cam to return to the rest position against stop 147 when the spring 149 pulls on the follower. When dial 127 is in rest position, as shown, pawl 132 is lifted from the rack by a stop, 135. In this condition, member 130 may be rotated freely to choose any desired time setting on dial 124 without actuating the cam 128 or follower 129. When dial 130 has been set to a predetermined angular position with the follower or push rod 129 opposite a time setting on the stationary dial 124, rotation of the dial 127 in a clockwise direction with respect to the dial 130 moves the pawl

132 over the stop 135 until such pawl engages a tooth in the rack 131. Continued rotation of the dial 127 causes corresponding rotation of the member 131A carrying the rack 131 and the cam 128 moves therewith to actuate the follower 129. The rack 131 employs a plurality of circularly disposed teeth corresponding in number to the time settings or some multiple thereof so that the pawl 132 will engage a tooth with practically no lost motion upon the initial movement of the dial 127 regardless of the angular position of the dial 130 with reference to the dial 127. With the rack and pawl construction, dial 130 connected with cup 131A through bushing 134A may be rotated independently of dial 127, and yet follower 129 actuated by cam 128 on cup 131A will be moved radially substantially simultaneously with the rotation of dial 127 for a station setting of an interconnector. As has been previously explained, the dial 130 is rotated to select a predetermined time setting while the dial 127 acts for selecting a desired station on the predetermined time setting.

If the dial 124 is rotatable while the dial 130 is stationary, as previously explained, the cam 128 may be connected directly to the dial 127 for accomplishing station settings and the rack and pawl structure 131-132 may be omitted. With this construction there is relative motion between the stationary dial 130 and the rotatable station dial 127 only when making a station selection. When making a time selection dial 127 remains stationary as well as dial 130, and it is only dial 124 which is moved to bring a time slot with an interconnector moving therein opposite to the follower 129. The construction with the dial 124 stationary and dials 127 and 130 each rotatable as to dial 124 and relative to one another, is the preferred construction over the rotatable dial 124 construction described, because the designating numerals and letters for the time slots as shown in Fig. 15 remain in the same upright position for easy reading.

To summarize the various arrangements which have been chosen for illustration in the drawings; all the mechanisms have certain essential features in common. Each comprises a clock together with means for selecting and positioning members through which operations may be carried out in terms of time, and a point of radio broadcast, or some other function. In the various forms chosen for illustration, these members comprise electrical connectors which are movable relative to two sets of coordinate electrical conductors or busses, so that the operations may be carried out by electrical means. For convenience in selecting and positioning the members relative to the busses, all of the mechanisms provide dials calibrated in terms of time and station or function. In each case the dials are rotary and in each case selection of a member to be moved is carried out by rotation of a time dial and the member is then moved to position by means of a function dial. In all of the embodiments illustrated, the latter motion is linear and means are interposed for translating the rotary motion of the dial to linear motion.

It may be helpful to summarize the relative arrangements and motions of the essential parts of the several constructions illustrated in the drawings. In the two constructions illustrated in Figs. 1 to 9, and Figs. 11 and 12, there is a cylindrical coordinated bus system which is stationary relative to the main frame structure and to the clock mechanism. The time selector dial, and the se-

lector finger indicated by reference characters 14 and 21 in Fig. 2 and 14A and 21A in Fig. 11, rotate relative to the bus system and main frame structure. In the arrangement illustrated in Figs. 13 and 14, the coordinated bus system is also of cylindrical formation, but in this case the bus system and the time dial 102 (Fig. 13) rotate together, and this assembly together with the clock 20 are rotatably mounted in the supporting frame. Since in this latter case, the whole bus system rotates relative to the supporting frame, the selector finger 106, and its associated lead screw 107 may be mounted directly upon the supporting frame, with the relative rotary motion for bringing such finger into alignment with an interconnector for setting the same being secured by the turning of the whole coordinated bus system. In the form illustrated in Figs. 15 and 16, the coordinated bus system is simpler in arrangement and the time selector finger 129 rotates in another parallel plane. In all cases selection of an interconnector member to be moved for setting up a time-function schedule is carried out by rotation of the time dial which positions the selector finger opposite a movable interconnector member. This member is then moved linearly by rotation of the second dial, the function dial. In the forms illustrated in Figs. 1 to 9, the rotary motion of the function dial is translated into linear motion as by means of a cylindrical cam. In the forms illustrated by Figs. 11, 12, 13 and 14, the rotary motion of the function dial is translated into linear motion by means of lead screws. In the form illustrated by Figs. 15 and 16, translation of rotary to linear motion in the interconnector is carried out by a flat cam. All the forms, therefore, comprise two sets of busses with relatively movable cross connectors, and two dials, with one dial adapted to select the cross connector, and another dial to position it. All forms also include a clock with contact making means for closing a circuit at intervals, and for routing a circuit directly and successively to the busses of one of the two sets of busses. The cross connectors, or interconnectors, further, route the circuit to selected busses of the other set. The relative arrangements and motions by which the parts are tied together and carry out their functions each have certain advantages as have been described. It will be obvious that a great variety of means may be conceived for carrying out the various functions illustrated and described above for the various clock assemblies. I do not limit myself to the construction and methods disclosed, but claim broadly the new and novel features and inventions set forth in the claims appended to this and my associated application when construed in the light of the prior art.

I claim:

1. A timing and control unit for apparatus performing a plurality of functions under electrical control, comprising a plurality of rod-like conducting busses radially equidistant from and circumferentially spaced around and parallel to a central axis, a plurality of spaced conducting ring-like busses concentric with the said central axis, an interconnector slidable along each rod-like bus in contact therewith for making successive contact between the rod-like bus and a selected one of the ring-like busses, a clock, contact making means operated by the clock for establishing circuit connections at timed intervals to said rod-like busses, a rotatable dial with finger index holes, means comprising a member having

a progressively advancing surface and a follower operated by the dial for mechanically moving the interconnectors one at a time to establish cross connections between the rod-like and ring-like busses, a rotatable member for selecting the interconnector to be moved by the dial operated means, and a reset member for moving all interconnectors to a starting position.

2. A control unit in accordance with claim 1 in which the means for moving the interconnectors comprises a double acting cylindrical cam with two followers, one follower being actuated by rotation of the cam in one direction for moving the interconnectors individually to establish connections between the rod-like and ring-like busses and the other follower being actuated by opposite rotation of the cam for moving them collectively to starting position, said cam being actuated by the finger index dial and said operations being effected by opposite rotations of the finger index dial.

3. In combination, a plurality of equally spaced concentric conducting rings having a common axis, a plurality of equally spaced conducting rod-like busses grouped around and parallel with the axis of the rings, a plurality of contactors movable relative to the rod-like busses and rings to cross-connect selected busses and rings, a spirally threaded member having a follower for moving the contactors individually, a rotatable finger index dial for driving said spirally threaded member, a second member having notches corresponding to the said busses for directing the follower to selected contactors, and means for moving the contactors collectively to a starting position.

4. A multiple function electric timing and control apparatus comprising two series of busses and a plurality of interconnectors for electrically connecting busses of the two series for establishing selected electric circuits, means for moving the interconnectors individually comprising a follower, lead screws, pinions associated therewith, and a finger index dial operating the pinions and lead screws, and the means for returning all interconnectors to starting position comprising a follower, lead screws, pinions associated therewith and means operating the pinions and lead screws.

5. A multiple function electric timing and control apparatus having a plurality of spaced metallic rod-like conductors arranged in cylindrical cage formation around a central axis, a plurality of function conductors comprising spaced metallic rings concentric with said axis, an interconnector for each time conductor slidable in contact therewith for contact with at least one function conductor, means for preselecting individual interconnectors, including a movable time selector and connecting mechanism extending therefrom, means for moving said preselected interconnectors individually into contact with an individual function conductor, said latter means including a function selector, connecting mechanism therefrom having a progressively advancing surface thereon and a follower movable thereby for directly moving the preselected interconnector, means for returning all of the interconnectors to starting position, and an interlock between the preselecting means and moving means for preventing the operation of the selector in one of said means when the selector in the other of said means is not in proper operating position.

6. A timing and control unit in accordance with

claim 1 with the addition of indicating means for showing the positions of the interconnectors.

7. A timing and control unit in accordance with claim 1 in which the means for moving the interconnectors comprises a spirally grooved member, with a follower for moving the interconnectors individually in one direction and a second follower for moving the interconnectors collectively in the opposite direction, spring operated means for returning the member to a starting position after operation, and retarding means for minimizing rebound when the member returns to starting position.

8. In combination, a plurality of equally spaced concentric conducting rings having a common axis, a plurality of equally spaced conducting rod-like busses grouped around the axis of the rings, a plurality of contactors movable relative to the rod-like busses and rings to cross connect selected busses and rings, an actuating member having a progressively advancing surface actuating a follower for moving the contactors individually, a rotatable finger index dial for driving said actuating member, a second member having notches corresponding to the said busses for directing the follower to selected contactors, and means for moving the contactors to a starting position.

9. Electric control apparatus comprising a plurality of function busses, a plurality of time busses, a time index member, a function index member, means controlled by the time index and function index members for establishing connections between the time busses and function busses, said means comprising a connector slidable on each time bus, a finger for moving the connectors individually, means mechanically connected with and operated by the time index member for positioning the finger opposite a selected connector, means comprising a progressively advancing surface and follower mechanically connected with and operated by the function index member for moving the finger and selected connector to a selected function bus by mechanical transmission of force applied by the operator to said function index member.

10. Electric control apparatus comprising a plurality of function busses, a plurality of time busses, a time index member, a function index member, means controlled by the time index and function index members for establishing connections between the time busses and function busses, said means comprising a connector slidable on each time bus, a finger for moving the connectors individually, means mechanically connected with and operated by the time index member for positioning the finger opposite a selected connector, means comprising a progressively advancing surface and follower mechanically connected with and operated by the function index member for moving the finger and selected connector to a selected function bus by mechanical transmission of force applied by the operator to said function index member, and means for returning the connectors collectively to a starting position.

11. Electric timing and control apparatus comprising a plurality of time busses, timing means for successively energizing the time busses, a plurality of function busses, a time dial graduated in time units, a function dial graduated according to the functions of the function busses, means operated by the time and function dials for cooperatively establishing connections between the time and function busses, said means

comprising an interconnector mounted upon and slidable along each of the time busses for cross connecting individual time and function busses, a pusher for sliding individual interconnectors along selected time busses, means operated by the time dial for moving the pusher to selected interconnectors, and means comprising a spirally threaded member actuating the pusher and itself actuated by the function dial for advancing the interconnector to a selected function bus.

12. Electric control apparatus including a system of coordinate electric conductors comprising a plurality of intercrossed conductors, a plurality of interconnectors movable on some of said conductors for interconnecting corresponding intercrossed conductors, rotary means for preselecting an interconnector in accordance with a division of time, rotary means for accomplishing the movement of the preselected interconnector to a position corresponding to a predetermined control position, with said first rotary means having a plurality of notches thereon, interlocking means for preventing the operating movement of one of said rotary means when the other of said rotary means is out of normal operating position, said interlocking means including a rocking member having a portion riding on the notched portion of said first rotary means and having another portion adapted for locking engagement with said second rotary means.

13. Electric control apparatus comprising a group of function conductors, a group of time conductors, a time index member, a function index member, means for interconnecting the function conductors and time conductors comprising a plurality of contacts slidable upon the conductors of one of said groups for engagement with the conductors of the other group, a selector member for sliding the contacts individually upon the conductors, means mechanically connected with the time index member for bringing a selected contact member and the selector member into alignment with one another, means mechanically connected with and operated by the function index member for moving the selector member and selected contact member to a predetermined interconnecting position by mechanical transmission of force applied by the operator to said function index member, said means including structure having a progressively advancing surface and a follower movable thereby.

14. Electric control apparatus for a radio receiver, including a frame, a plurality of time conductors, a plurality of station conductors extending transversely with respect to the time conductors and fixed with relation thereto, an interconnector slidable on each of the time conductors for selectively interconnecting corresponding time conductors and station conductors, means for individually slidably setting the interconnectors to predetermined positions with reference to the station conductors including a linearly moving selector, with said linearly moving selector and said time conductors being mounted in said frame in a manner as to provide one of the two movable relative to the other, a rotary station indicating member, and mechanical means intermediate said station indicating member and said linearly moving selector for operatively connecting the same comprising means having a progressively advancing surface, and means for extending an electric circuit through

said time conductors and the corresponding interconnectors and station conductors.

15. Electric control apparatus for a radio receiver, including a plurality of time conductors and a plurality of station conductors extending substantially transversely thereof, with the time conductors being fixed relative to the station conductors, a metal sliding contact on each of the time conductors having a body portion mounted on said time conductor and engaging said time conductor with sufficient friction as to remain in a selected set position on a time conductor, having a pointed contact portion for electrical engagement with only a single selected station conductor at one time and having a projecting portion thereon for engagement by a contact setting member, a linearly movable contact setting member for individual engagement with a preselected contact, rotary means for actuating the contact setting member and means mechanically connecting said rotary means and said contact setting member.

16. A control device for controllable apparatus comprising two groups of electrical conductors with the conductors in each group substantially parallel to one another and with the conductors in one group fixed relative to the conductors in the other group, an interconnector slidable upon each of the conductors in one of said two groups to electrically connect such conductor with a corresponding conductor in the other group, rotary means for setting a preselected interconnector to a predetermined electrical connection, and means operatively connecting said rotary means with said preselected interconnector for moving the latter to such predetermined electrical connection but disconnectible therefrom after such moving, including a plurality of spaced apart rotatably supported lead screws.

17. Electric control apparatus including a plurality of axially aligned ring-like conductors insulated from one another, a plurality of rod-like conductors spaced apart and extending transversely of said ring-like conductors in a cage-like formation with all of said conductors fixed with respect to one another, an interconnector on each of said rod-like conductors, and means positioned substantially within the confines of the end limits of the rod-like conductors in the cage-like formation and operable substantially therein for selectively setting said interconnectors with respect to said ring-like conductors including a selector for positioning opposite an interconnector and with said cage-like conductor formation and selector being rotatable relative to one another, rotary means at one side of said apparatus operatively connected with said selector in a manner whereby said selector moves axially upon rotary movement of said rotary means, and means for extending an electric circuit through the interconnected ring-like and rod-like conductors.

18. Electric timing and control apparatus for a control circuit comprising timing means for energizing the control circuit at timed intervals, a plurality of function conductors, a time dial graduated in time units, a function dial graduated according to the functions of the function conductors, a plurality of contact means movable to selectively interconnect the timing means and the function conductors, means movable to select a predetermined contact means and thereafter move said contact means to a predetermined interconnecting position, mechanical con-

necting means intermediate said time dial and said movable means for accomplishing preselecting of a contact means upon movement of said time dial, and additional mechanical connecting means for said function dial and said movable means to transfer the movement of said function dial to said movable means for moving said contact means to a predetermined interconnecting position.

19. An electric control device for apparatus to be controlled, comprising a plurality of time conductors, clock means for routing electric current to said time conductors in successive order, a plurality of function conductors for routing the current to apparatus to be controlled thereby, a plurality of interconnectors slidable on the time conductors for establishing connections between the time and function conductors, a time index member graduated in time intervals, a function index member graduated in accordance with the operation under control of the function conductors, a follower movable to selected positions aligned with the path of movement of any one of said interconnectors, means establishing direct mechanical connection from the time index member to said follower for movement of said follower upon setting movement of the time index member, and movable means having a progressively advancing surface thereon mechanically connected to the function index member and operated thereby and mechanically connected to said follower for operating the follower to in turn engage said interconnector with which it has been aligned to move said interconnector to a predetermined control position.

20. Electric timing and control apparatus comprising a clock with means for establishing an electric circuit at timed intervals, a plurality of time conductors for routing the circuit for each interval comprising a plurality of conductors spaced around a central axis and parallel thereto, a plurality of function conductors comprising conducting rings spaced relative to one another and to the time conductors and having an axis common therewith, a plurality of electrical interconnectors slidable upon the time conductors and movable to predetermined positions interconnecting said time and function conductors, a movable time index dial, a movable function dial, a combination interconnector-selector-and-mover member operated successively by said two dials to move in a rotary direction or linear direction depending upon the particular dial operated, means connecting said combination member with said time dial, and additional means connecting said function dial with said combination member.

21. Electric control apparatus comprising a plurality of intercrossed but insulatively separated time conductors and function conductors in a substantially cage-like formation, a contact member slidable upon each time conductor for selective connection with a corresponding function conductor, means for selecting and thereafter moving a contact member to a predetermined conductor connecting position, said means including a linearly movable supporting ring, a selector member carried on said supporting ring and rotatable with respect thereto, a time index member operatively connected with said selector member for rotatably moving the same to a preselected position, a function index member operatively connected with said ring-like supporting member for linearly moving said ring-like

supporting member and carrying therewith said selector member for moving the preselected contact member to a predetermined position with said ring-like supporting member and the selector member thereon automatically returnable to starting position after such setting operation.

22. Electric control apparatus including two groups of electric conductors with one group including ring-shaped conductors insulated from one another and with the other group including a plurality of rod-like conductors extending transversely of said ring-like conductors, interconnectors on each conductor of one of said groups selectively slidable thereon for engagement with a selected conductor in the other group, setting means for individually sliding each of said interconnectors for setting the same, and means for clearing all of said interconnectors to move the same collectively to starting position, a plurality of rotatable spirally grooved members spaced apart from one another with alternate members operatively connected with said setting means and the remaining members operatively connected with said clearing means, and means available at one side of said apparatus for selectively rotating the alternate members or said remaining members, for correspondingly setting or clearing said interconnectors depending upon the particular member rotated.

23. A time-control device for controllable apparatus comprising a group of control conductors, and a group of time conductors extending substantially transversely of said control conductors, an interconnector movable upon each conductor of one of said groups of conductors and adapted for engagement with a preselected conductor in the other group, means for selectively moving said interconnectors one at a time to a predetermined set position to establish a cross-connection with a corresponding transversely extending conductor, means for collectively moving the set interconnectors to clear the cross-connections, and a single rotary means rotatable clockwise or counter-clockwise and operatively connected with each of said moving means for rotation to set or to clear said interconnectors depending upon the direction of rotation of said single rotary means.

24. A control device for controllable apparatus comprising a plurality of intercrossed but insulatively separated conductors, a plurality of interconnectors movable relative to said intercrossed conductors to electrically connect corresponding conductors, means for moving said interconnectors individually from a starting position to set them in predetermined positions relative to the intercrossed conductors, means for moving the set interconnectors collectively to move them to starting position, a rotatable control member operatively connected with each of said means for moving one of said means upon clockwise rotation of said member, and for moving the other of said means upon counter-clockwise rotation of said member, and means for extending a circuit through the corresponding conductors and set interconnectors.

25. A time control device for controllable apparatus, said device including a group of rod-like conductors arranged in a substantially circular cage-like formation, a second group of ring-like conductors positioned in substantially cylindrical formation and extending transversely with respect to the conductors in the first group, interconnectors movable relative to corresponding conductors in said two groups, means for pre-

selecting an interconnector to be moved, means for moving said preselecting means to move the preselected interconnector to a position to electrically connect a pair of transversely extending corresponding conductors, a clock for said device supported within the cage-like conductor formation having hour and minute hands thereon, means for driving said hour and minute hands, a contact brush movable in accordance with the movement of the minute hand, a second contact brush movable in accordance with the movement of the hour hand, a plurality of contacts in the path of movement of said first contact brush adapted for engagement thereby at predetermined intervals within the total interval of one hour, with said second contact brush supported in a manner to successively directly engage an end portion of said rod-like conductors, and with said brushes electrically connected to extend a circuit through said brushes and the corresponding interconnected rod-like conductors and ring-like conductors.

26. Electric control apparatus for a radio receiver, including a frame, a plurality of intercrossed and insulatingly separated time conductors and station conductors arranged in a cage-like formation and rotatably supported on said frame, a plurality of contact members slidable on said time conductors for setting to a predetermined interconnecting position with reference to said station conductors, means for setting said contact members including a movable member for individual engagement with said contact members linearly movable but non-rotatably supported on said frame, a rotary station member for moving said movable member to a predetermined position and mechanically connected therewith, and means linearly movable in said frame for collectively moving the set contact members to starting position.

27. Electric control apparatus including a fixed supporting frame, conductor means rotatably carried upon said supporting frame including a plurality of intercrossed time conductors and function conductors with said conductors being relatively fixed with respect to one another, a contact member slidably carried on each time conductor, a time index member connected with

said conductor means for rotating said conductor means to a predetermined position corresponding to an interval of time, a selector member non-rotatably but axially movably supported within said frame, with said conductor means adapted to be rotated to bring a preselected contact member into alignment with said selector member, a function index member and means mechanically connecting said function index member and said selector member for sliding a preselected contact member on a corresponding time conductor by means of said selector member upon movement of said function index member, and means for directly but collectively moving the set contact members to starting position.

28. In a control system for tuning a radio receiver, a source of electrical energy for said system, a control unit including a plurality of time conductors, a plurality of station conductors extending transversely with respect thereto, a frame for said control unit supporting said conductors, and alternately operated means for selectively extending an electrical circuit through the station conductors, one of said alternately operated means including an interconnector slidable on each of the time conductors for selectively interconnecting corresponding time conductors and station conductors, mechanically operated means for individually slidably setting said interconnectors, and means connecting said station conductors with said source of electrical energy through said interconnectors, and with the other of said alternately operated means comprising a plurality of push buttons supported on said frame and available at one side of said control unit for direct manual operation, with each of said push buttons having a conducting shank electrically common to said source of electrical energy, spring means for supporting the push button to normally retain the same out of engagement with a station conductor, and with said push button adapted to be moved to in turn move said shank against the force of said spring means for engagement with a corresponding station conductor to extend a circuit from said source of electrical energy through the engaged station conductor.

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