F. F. LANDIS.

PROGRAM CLOCK APPARATUS.

APPLICATION FILED SEPT. 12, 1906.

1,130,091.

Patented Mar. 2, 1915.

3 SHEETS—SHEET 1.

Fig. 1.

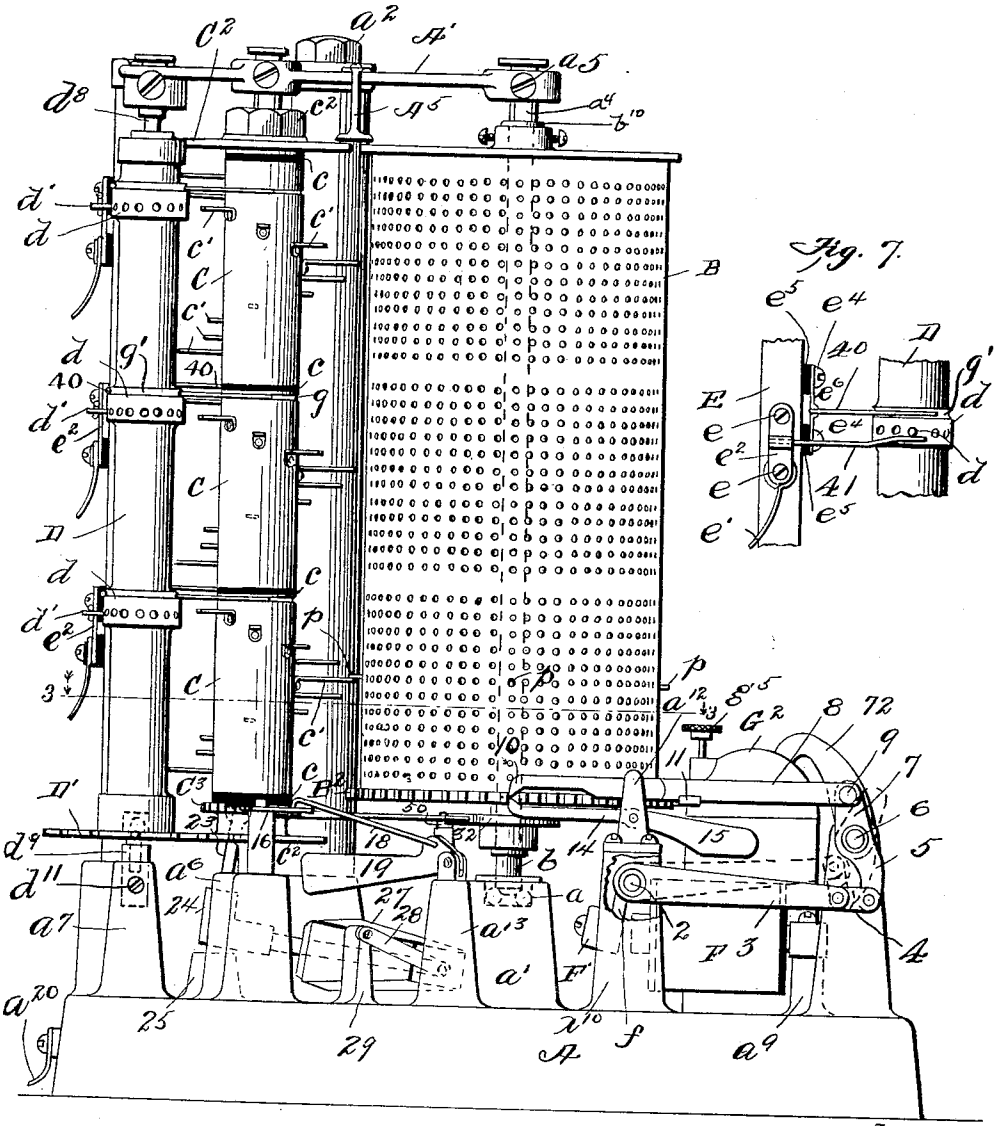


Fig. 7.

Witnesses

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THE NORRIS PETERS CO. PHOTO-LITHO., WASHINGTON, D. C.

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3 SHEETS—SHEET 2.

Fig. 2.

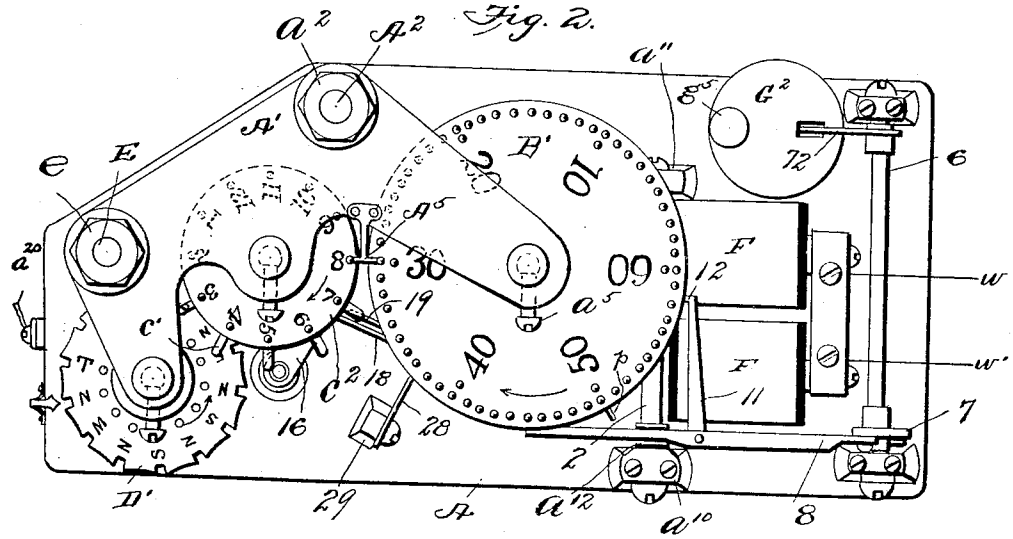
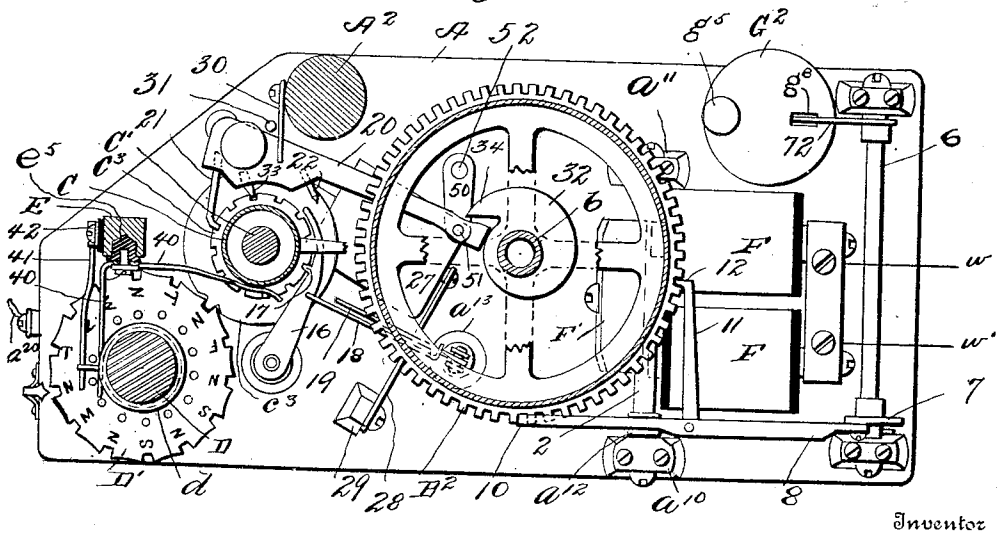


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

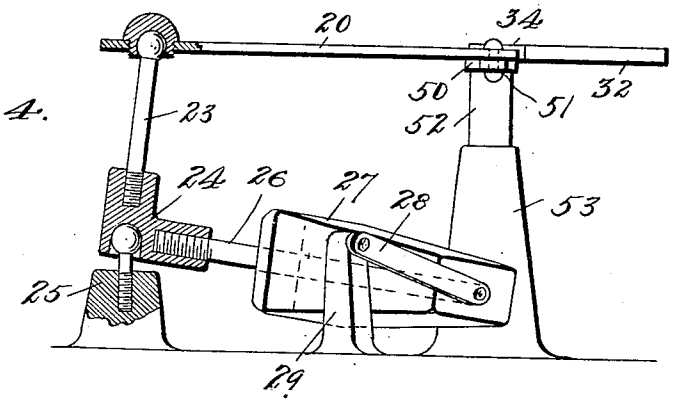


Fig. 9.

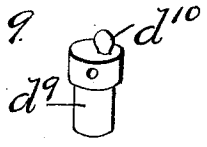


Fig. 8.

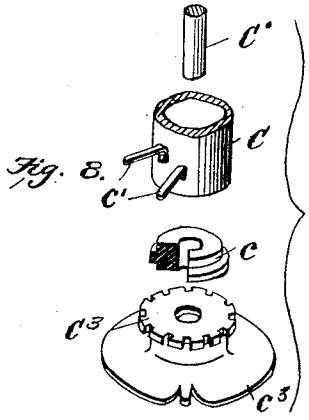


Fig. 5.

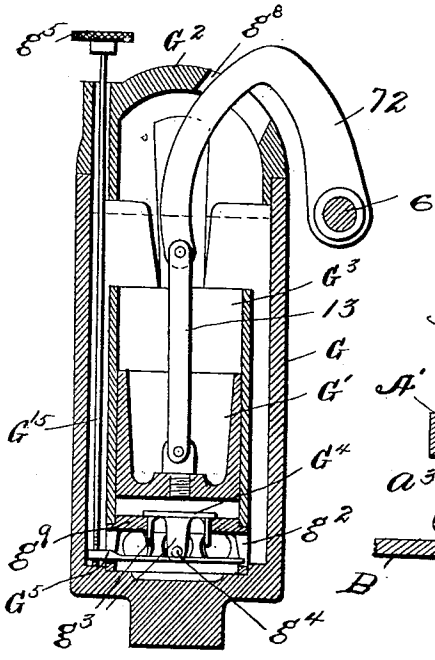
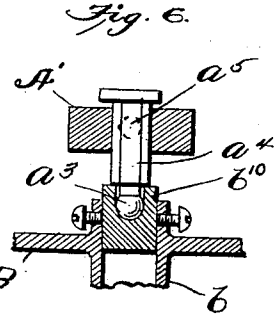


Fig. 6.



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PROGRAM-CLOCK APPARATUS.

1,130,091. Specification of Letters Patent. Patented Mar. 2, 1915.

Application filed September 12, 1906. Serial No. 334,322.

To all whom it may concern:

Be it known that I, FRANK F. LANDIS, a citizen of the United States, residing at Waynesboro, in the county of Franklin and State of Pennsylvania, have invented certain new and useful Improvements in Program-Clock Apparatus, of which the following is a specification.

My said invention consists in various improvements in the construction and arrangement of parts of a program clock apparatus, whereby the use of springs, which have been heretofore a source of trouble and disadvantage in such mechanism is entirely obviated and such an apparatus is provided of comparatively few parts, simple and durable in its construction, and positive and reliable in its operation under all conditions, all as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts, Figure 1 is a side elevation of a program clock apparatus embodying my said invention, Fig. 2 a top or plan view of the same, Fig. 3 a horizontal section looking downwardly from the dotted line 3—3 in Fig. 1, and Figs. 4, 5, 6, 7, 8 and 9 detail views illustrating different parts of the apparatus on an enlarged scale, as will be hereinafter more particularly pointed out.

In said drawings the portions marked A represent the base and supporting frame of the apparatus, B the program cylinder, C the cylinder carrying the contact arms, D an automatic program switch or calendar cylinder, E a post forming part of the frame and carrying the terminals on one branch of the electric circuit for operating the signal system through the program apparatus and G a dash-pot.

The frame comprises the base A, which is a casting of suitable size having supports for the bearings for the various parts, as will be hereinafter pointed out, and a top casting A′ carrying the bearings for the upper ends of the several journals, said top being rigidly supported at a suitable distance above said base by the posts A^2 and E, each of which is rigidly secured to the base A at the lower end and to the top piece A′ at the upper end by having a screw-threaded part extending through perforations in said top piece with nuts a^2 and e, respectively, thereon.

The program cylinder B is preferably of brass, or other material forming a good electrical conductor, and is provided with a central hollow axis b by which it is journaled in bearings in the parts A and A′ of the frame. The lower end of said axis is a solid shaft and rests upon balls a mounted in a socket in the top of a standard a' formed in an appropriate position on the top of base A. Its upper end is provided with a solid end b^{10} formed with a socket into which a ball a^3 on the lower end of a sliding pin a^4 is inserted. Said pin a^4 is adjustably secured in a perforation in the top part A′ of the frame and is adapted to be raised and lowered to vary the adjustment by means of a set-screw a^5 as most clearly illustrated in Fig. 6. Said program cylinder may be formed with as many program sections as desired. The one shown contains three. Each program consists of twelve circumferential rows of sixty holes each, arranged in vertical rows a short distance apart and adapted to receive the contact pins p. Each section of said cylinder is thus adapted to have a separate program arranged thereon so that the apparatus will be adapted for sounding signals in different places, or at different times according to different programs, as will be hereinafter more fully described. On the top of said program cylinder is provided a dial plate B′ divided into sixty parts by indicator points, each point indicating a minute and the entire dial one hour, the ten minutes divisions of which are indicated by the numerals 10, 20, 30, 40, 50 and 60. On its lower end it is provided with a ratchet wheel B^2 containing sixty cogs, each cog being arranged between the vertical rows of holes in the program cylinder.

The contact cylinder C, as shown, is formed in three duplicate sections, or one for each program section of the cylinder B. Each section consists of a brass cylinder mounted upon a central shaft C′ which is journaled at its lower end in a socket in the top of a standard a^6 on base A and at its top is connected with the top plate A′ of the frame in the same manner as shown and described for the bearings of program cylinder B. Each of said sections is insu-

lated from the shaft and from the others by an insulating plate c, as shown most clearly in Fig. 8. Each section is provided with metallic contact arms c' secured thereto and extending out therefrom a distance to enable them to contact with the contact pins p on the program cylinder B when extending toward the axis of said cylinder. There are twelve of said arms arranged in a spiral direction around each section and disposed vertically to correspond with the vertical arrangement of the twelve circumferential rows of pin holes in the corresponding program section of cylinder B. They are spaced circumferentially to divide said cylinder into twelve equal spaces representing twelve hours which are indicated by a dial plate C^2 mounted upon the top cylinder C and insulated therefrom by one of the insulating disks or washers c, said dial plate C^2 being divided into twelve equal parts indicated by points and the numerals from 1 to 12 adjacent to each point. Said dial plate C^2 is secured to the shaft C' by means of a nut c^2 mounted on the screw-threaded top of said shaft which clamps said plate against the top insulating ring c and secures the several parts of cylinder C together. A ratchet wheel C^3 is mounted on the lower end of the shaft C' adjacent to the lower end of the lower cylinder C provided with twelve teeth, each of which is arranged immediately beneath one of the contact arms c'. Said ratchet wheel C^3 is formed with a disk c^3 on its lower edge having a single gear tooth upon one side for a purpose to be presently described. Each section of cylinder C is formed with a circumferential groove g to receive one end of a spring contact arm 40.

The automatic program switch or calendar cylinder D is preferably of wood or other non-conducting material journaled in the frame by means of pivots inserted in its top and bottom, the top pivot d^8 being journaled in the part A' in a similar manner as the shaft of cylinder B is journaled, or in any approved manner, and its lower end being supported upon a standard a^7 on the base A. A short standard d^9 projects up from the top of standard a^7 and has a pin d^{10} set eccentrically in its top. Said standard d^9 may be rotated in its seat and held in adjusted position by a set-screw d^{11}. The top of pin d^{10} is spherical in form and rests in a socket in the lower end of cylinder D, or the hub of wheel D' on its lower end, thus permitting said wheel to be adjusted in relation to wheel C^3 as may be necessary to secure perfect operation. Said cylinder D is provided at intervals with metallic collars or rings d corresponding with the number of programs to be operated. Each collar is formed with fourteen equally spaced pin holes adapted to receive contact pins d'. On its lower end it is provided with a dial plate D' containing fourteen notches representing the seven days of the week and each day divided into two parts of twelve hours each, or night and day, the programs being ordinarily arranged to continue from 6 in the morning until 6 o'clock at night and then changed from 6 o'clock at night until 6 o'clock in the morning, or the signals be suspended altogether between these hours. The pins d' are adapted to contact with the outer end of spring contact arms 41 when extending in a direction at right angles therewith.

The post E has a series of binding posts e thereon, to which one wire e' of each electric signal circuit is electrically connected, said binding posts being insulated from post E. Said binding posts are preferably arranged in pairs and a metal plate e^2 is attached to each pair and each plate carries one of the contact springs 41, which projects across the side of cylinder D alongside one of the collars d thereon in position to contact with one of the pins d' in said collar when the parts are in correct relative positions. On the face adjacent to cylinder D said post E has another series of binding posts e^4, also arranged in pairs (see Fig. 7) each of which screws into a block of insulating material e^5 by which it is insulated from said post. This arrangement is illustrated in section in Fig. 3, and the same construction is used in mounting the binding posts e. A metal plate e^6 is also secured under each pair of said binding posts e^4 and carries one of the contact springs 40, each of which is in the form of a right-angle, one arm resting in the groove g in the top of the adjacent section of cylinder C and the other arm resting in a similar groove g' in the adjacent collar d on cylinder D. The other wire a^{20} of the signaling circuit is connected directly to base A, which completes the circuit through the signaling devices and the program cylinder when one of its pins p is in contact with one of the arms c', and one of the arms 41 is in contact with one of the pins d'.

The magnets F are a pair of any suitable electro-magnets mounted on suitable supports or posts a^9 on the top of base A and connected by line wires w and w' with the circuit closer (not shown) operated by the master clock (not shown).

The operating mechanism will now be described. The armature F' is mounted upon an arm f secured rigidly on a rock shaft 2 which is journaled in suitable bearings in standards a^{10} and a^{11} on the base A. A lever 3 is rigidly mounted on said rock shaft 2 and is connected by a link 4 with the lower end of a lever 5 rigidly secured on a rock shaft 6. An arm 7 is also rigidly secured on said rock shaft 6 and has the outer end of a

sliding pawl 8 connected therewith by a pivot 9. The forward end 10 of said pawl 8 is adapted to ride over the top side of the ratchet wheel B^2 and engage with the teeth thereof. Said pawl 8 is provided with an arm 11 rigidly secured to it and extending at right angles therewith which has a tooth 12 formed on its outer end which is adapted to engage with ratchet wheel B^2 but against the opposed side of a tooth that is about 90° from the tooth against which pawl 8 acts. The end of arm 11 meeting the opposed side of a tooth from that which the end of pawl 8 is in contact when it stops insures the stopping of the wheel at exactly the same position at which pawl 8 stops preventing all possibility of the wheel racing ahead of the position where the movement of pawl 8 ends. Another arm 72 is rigidly secured to the opposite end of rock shaft 6 and is formed of goose-neck shape, as shown in Fig. 5, and extends down through an opening in the top of an inclosed dash-pot G, being connected by a link 13 with a sliding piston G′ in said dash-pot. Said dash-pot consists of the outer casing G having a top G^2 inclosing the same provided with an opening g^8 through which said arm 72 extends. An internal cylinder G^3 is mounted within said casing G upon a bottom g^9 which is supported upon the bottom of the casing G by a circumferential flange provided with a series of openings g^2. Said bottom g^9 is provided with a central opening in which is mounted a valve G^4 held centered by guides g^3 upon the bottom side of the valve the guides of which extend down through said opening. A cross bar g^4 extends between the lower ends of two of said guides, said bar extending to beyond the face of said guide to limit the lift of said valve and an arm G^5 extends across beneath said cross bar, one end of which is provided with a screw-threaded perforation which engages the lower end of a screw-threaded rod G^{15} which extends upwardly through an opening in one side of the top G^2 and is provided with a hand wheel g^6 by which it may be turned. Thus, by turning said hand wheel the end of the arm G^5 may be raised or lowered to strike bar g^4 and the drop of valve G^4 thus varied to provide a greater or less opening through the bottom of the cylinder G^3 when the piston G′ is falling. The casing G is filled with a fluid of a character least affected by change of temperature, such as glycerin, and, in operation, after the piston G′ has been raised, the time of its descent may be varied as desired by adjusting the arm G^5, which varies the opening left under said valve after g^4 strikes arm G^5, as will be readily understood. The inner end of pawl 8 rests between upright fingers a^{12} on a bracket supported on the top of a standard a^{10}. A pawl 14 is pivoted between said fingers beneath said pawl 8, its forward end being adapted to engage the underside of the ratchet wheel B^2 and behind the teeth thereof with the top side of which the end 10 of said pawl 8 engages. The rear end 15 of said lever is weighted to keep said pawl normally in engagement with the teeth on said ratchet wheel.

The shaft C′ carrying the cylinder C is normally locked in a fixed position by a pawl 16 containing a tooth 17 in position to engage the notches of the ratchet wheel C^3. Said pawl is connected by a link 18 with a weighted lever 19 pivoted in a bracket on the top of a standard a^{13}, which is thus adapted to normally hold said pawl against the face of said ratchet wheel to secure its engagement. An arm 20 armed with pawls 21, 22 and 33 is mounted by means of a ball-and-socket connection on the top of a standard 23 which is connected with a right angle casting 24 supported by a ball-and-socket connection on the top of a standard 25 on the base A. From the other angle of part 24 extends an arm 26, on the outer end of which is mounted a heavy weight 27 which is connected loosely by a link 28 to a standard 29 on the base A, said link 28 being of a length to hold said weight toward the side of the cylinder in the direction of the operation of the pawls. An arm 30 secured to the side of the post A^2 prevents undue upward movement of said arm 20 and a pin 31 extending up from the base A prevents undue backward movement thereof. The inner end of arm 20 is pivoted to an arm 50 by a pivot 51 and said arm is in turn pivoted on the top of a standard 52 on a stand 53 extending up from base A. It will thus be seen that the movement of said arm 20 is permitted to be very loose, without any binding action, but at the same time it is held at all times toward the ratchet wheel C^3 and its inner end is held at all times to rest against the edge of a cam 32 mounted upon the shaft b of the cylinder B, beneath said cylinder. In the position shown in Fig. 3 the parts are in engaged position but as said cylinder B revolves said cam 32 operates to gradually force said arm 20 outward, disengaging the pawls 21 and 33 from the ratchet wheel C^3, which, during this movement, is held locked by the pawl 16 and the tooth 17 thereof engaging with the opposite side of said ratchet wheel. When said cylinder B rotates until the point 34 of the cam 32 reaches the end of said lever 20 the point of pawl 22 has been carried back to immediately behind the point of the forward end of pawl 16, while the point of pawl 33 has ridden over the face of the next tooth behind and is in position to engage with the rear face thereof. Thus when the cam 32 turns to permit the end of lever 20 to drop off the point thereof to the position shown in Fig. 3, the weight 27 operates immediately

to throw said arm 20 forward and toward the cylinder C, the pawl 22 striking the forward end of lever 16 releasing the tooth 17 from engagement with the ratchet wheel C^3, but at the same time engaging pawl 33 with the rear side of the tooth on the opposite side of said ratchet wheel, and, through said pawl, forcing said ratchet wheel and the cylinder C around one notch, the pawl 21 falling into the next notch in said ratchet wheel, to arrest the movement, and the tooth 17 into a notch on the opposite side to lock said ratchet wheel during the next operation.

The master clock being arranged to close the circuit through wires *w* and *w'*, in the usual or any approved manner at each minute period, magnet F will be energized each minute, the armature F' attracted to the poles of said magnets, which will operate to rock the shaft 2, and, through the link 4, draw the lower end of the arm 5 inward rocking the shaft 6 and throwing the upper end of the arm 7 outward, which will pull the pawl 8 to drag its point 10 over the top of the tooth on the ratchet wheel B^2 next behind the one with which its forward end has just been engaged, so that said point 10 will drop behind said next tooth. The cylinder B is held from being moved backwardly during this operation by means of the pawl 14 which is held into engagement with said ratchet wheel by its weighted end 15. The arm 11 with the pawl 12 on its outer end is also withdrawn by this motion of pawl 8 from engagement with the edge of the ratchet wheel and said wheel and cylinder B thus left free to rotate in a forward direction. During this operation the arm 72 has been drawn upwardly by the movement of shaft 6 which through the link 13 lifts the piston G', the fluid in the surrounding casing passing through the valve opening under valve G^4 freely into the cylinder G^3 beneath said piston during this operation. The electric circuit then being broken and the magnets deënergized, the weight of said piston G' operates to cause the same to fall, forcing the fluid beneath it in cylinder G^3 out through the space between said piston and cylinder and through the opening under valve G^4, said opening being adjusted by the screw rod G^{15} to time the descent of said piston as desired. As said piston descends it rocks the shaft 6 forward, carrying with it the arm 7 and pawl 8, the forward end of which is engaged with the rear side of one of the teeth of ratchet wheel B^2 and operates to push cylinder B forward. As said pawl 8 advances the arm 11 advances therewith, carrying the pawl 12 on its outer end into the space between the next two teeth of the ratchet wheel B^2 and stops the forward movement of said cylinder when it has advanced exactly the space of one tooth. The pawl 14 is, at the same time, passing under the tooth which was back of it and will fall behind said tooth by reason of the weighted end 15 as soon as said cylinder is advanced one space, thus preventing any backward movement of said cylinder. Any "racing" or "back-lash" of the cylinder is thus effectually prevented. The cylinder is thus locked in both directions until the magnets F are again energized at the completion of the next minute of time and the operation repeated. By adjusting the valve G^4 it will be seen that the time required for advancing cylinder B one space will be regulated to cover as many seconds of the minute as desired. Thus the forward movement can be continued over a space of fifty seconds or even fifty-five seconds without interfering with or endangering the results of the operation of the program apparatus. The movement being thus made gradual and steady, the strain and wear upon the parts is reduced to a minimum. At each minute movement of the cylinder B the cam 32 on the lower end of its shaft operates to push the arm 20 outward until said cylinder has completed a revolution covering the space of one hour, at which time the weight 27 operates as before described to advance cylinder C one space, which, as shown in Fig. 2, would bring 9 on the dial C^2 to the position shown for 8 and would indicate nine o'clock. The arm *c'* just in use would also be thrown out of contact position and the next arm be brought into contact position, which arm would be opposite the next lower circumferential row of holes in the program cylinder and this row would have pins arranged at the periods of time during the hour between 9 and 10 o'clock when it is desired to have signals sounded. The operation thus continues throughout the period of twelve hours. At the completion of each twelve hour periods, or at six o'clock in the evening and again at six o'clock in the morning, the tooth on the wheel C^3 is brought to the position shown in Fig. 3 in engagement with one of the notches in the disk D' of the bottom of switch or calendar cylinder D and as said cylinder C makes the next movement of one notch said disk D' and cylinder D is also moved a period of one notch, which will serve to change the circuit through the signal apparatus from one program to another, according as the pins *d'* are arranged in the collars *d* to connect one or the other of said programs with the signaling system.

The operation of my said invention may be further recapitulated as follows:—The contact pins *p* being arranged in the different program sections of the cylinder B so as to contact with the contact arms *c'* on the cylinder C at the times desired for sounding the signals, and each of the sections C being electrically connected in the

circuit of the signaling device to be operated by the program, said signals will be sounded as the program cylinder B revolves to bring the contact pins *p* into contact with the contact arms *c'*, as will be readily understood. In order to arrange the contact pins *p* in the respective program sections as desired, the dials B' and C^2 are to be consulted. By referring to Fig. 2, it will be seen that when cylinders B and C are in the relative position shown it is 8:30 o'clock, either at day or night. The hour being indicated by the dial C^2 and the minutes by the dial B'. The pointer A^5 supported on the top A' of the frame with an arm extending across the space between the edges of said dials will mark the relative positions. If it is desired to sound a signal at 8 o'clock and fifty minutes a contact pin *p* is placed in the same circumferential row of holes in the program cylinder immediately beneath the indicator point 50 on the dial B' and when said cylinder B is rotated to bring this point in the same relation to cylinder C as shown in Fig. 2 for the point 30, said point will contact with the arm of said cylinder C and close the circuit which will sound the alarm. An alarm may thus be sounded at any minute between 8 and 9 o'clock, or any other hour, by placing a contact pin *p* in the proper hole of the circumferential row opposite the contact arm *c'* which registers in vertical position with said row and under the hour indicated by the dial. As each of the sections is electrically connected by the contact spring 40 with one of the metal collars *d* on the cylinder D and each of said collars *d* is electrically connected with the signals which it is desired shall be operated at any period of time, it will be understood that the program can be adjusted to operate as many different programs or signals as there are program sections on the cylinders B and C or the programs can be arranged so that they will be operated one, two, or more at the same time. Thus a program for the day for five working days of the week, run from six in the morning until six o'clock at night, can be arranged on the lower section of cylinder B, another program for Saturday to run from six o'clock in the morning until twelve o'clock noon can be arranged on the middle section, and another program for Sunday to sound only a few signals, or none whatever, can be arranged on the upper section of said cylinder B. Or each section may take care of a separate signaling circuit and as many programs as desired be operated simultaneously, the number of sections being multiplied or diminished to suit the work for which each apparatus is especially designed. The pins *d'* of the cylinder D can be arranged in the perforations in the collars *d* to contact with the contact springs 41 leading to the binding posts *e* on the post E and connecting with one wire of the circuit operating said signals so that any one of the programs can be thrown into the circuit at any time, either night or day, of any day of the week. Thus the adjustment of the pins *p* in cylinder B and the pins *d'* of switch cylinder D may bring about any arrangement or program of signals desired.

By referring to Fig. 1 it will be seen that in their normal positions the pivots connecting link 4 with the lever 3 and arm 5 are in line with the axis of the armature shaft 2, the link 4 being directly in line with lever 3. A toggle connection is thus formed between lever 3 and arm 5 which enables said arm to be started on its movement to the position shown by dotted lines with the least expenditure of power, or, when the field between magnet and armature is widest and the current must be most heavily taxed to start the load, the leverage between lever 3 and arm 5 is greatest, and as the leverage decreases by the shortening of the angle of the toggle the field narrows and the power becomes stronger to take care of the increased load. Great economy in the power required to operate the apparatus is thus secured.

The use of springs, which vary in tension with variations in temperature and require much care and attention, is thus entirely obviated in such an apparatus and constant and positively operating power through the medium weights employed.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In an electric program apparatus, the combination, of a frame, a program cylinder, adjustable contact pins therein, a contact cylinder, contact arms thereon extending into the path of said contact pins, a program switch cylinder, said several cylinders being mounted to rotate, electric contact devices for connecting said contact and switch cylinders, means for automatically making and breaking said electric connections and operating the switch cylinder by the movement of said program cylinder, and means for operating said program cylinder, substantially as set forth.

2. In an electric program apparatus, the combination, of a frame, a program cylinder, means for operating said program cylinder comprising a weight for forcing it forward and electro-magnets for reversely operating said weight, a contact cylinder, an automatic switch cylinder, signaling circuit terminals adjacent to said switch cylinder, adjustable contact pins in said switch cylinder for closing the circuit when desired, and gearing connecting the program cylinder with said other cylinders for operating them, substantially as set forth.

3. In an electric program apparatus, the combination, of a frame, a program cylinder carrying contact pins, a contact cylinder having contact arms, a switch cylinder, an electric connection between said contact cylinder and said switch cylinder, a post adjacent to said cylinders, terminals of one side of a signaling circuit on said post, contact arms projecting from said terminals adjacent to said switch cylinder, adjustable pins in collars on said switch cylinder arranged to be adapted to contact with said contact arms, said collars electrically connected to the contact cylinder, means for operating said program cylinder, and gearing connecting said program cylinder to operate the contact cylinder one notch at each revolution of the program cylinder and the switch cylinder one notch at each revolution of the contact cylinder, substantially as set forth.

4. In an electric apparatus, the combination, of a frame, a program cylinder, a contact cylinder and a switch cylinder electrically connected by adjustable contact arms and pins arranged to contact with each other to make and break said connection as desired by the operation of said program cylinder, means for forcing said program cylinder forward on its axis step by step comprising a weight, and electro-magnets for reversely operating said weight, substantially as set forth.

5. An electric program apparatus comprising a program cylinder formed with a series of rows of holes in its periphery equal to the number of hours to be covered by the program and each row comprising a number of holes equal to the sub-divisions of the hour desired to be denoted by said program, contact pins formed to be inserted in said holes in such relative arrangement as may be desired, a contact cylinder mounted parallel with and adjacent to said program cylinder, and contact arms arranged in a spiral direction around said contact cylinder opposite the rows of holes in the program cylinder, and extending into the path of said contact pins, substantially as set forth.

6. In an electric program apparatus, the combination, of a frame, a program cylinder, means for operating said cylinder comprising a ratchet wheel, a sliding pawl engaging with said ratchet wheel and pivoted to an arm on a rock-shaft, said rock-shaft journaled on said frame, an armature shaft, an armature operated lever thereon, said armature, and a magnet adjacent to said armature, the connection between said armature lever and said rock-shaft embodying a toggle arranged with its pivots normally in line with the axis of the armature shaft, substantially as set forth.

7. In an electric program apparatus, the combination, of a frame, a program cylinder, means for operating the same comprising an armature mounted on a shaft, said shaft having an arm connected to a rock-shaft, a sliding pawl connected to an arm thereon and engaging with a ratchet on said cylinder, the connection between said lever and said rock-shaft comprising a toggle the parts of which are normally in line, and the magnet for operating said armature, substantially as set forth.

8. In an electric program apparatus, the combination, of a frame, a program cylinder, means for operating it, a cam carried by the shaft thereof, a contact cylinder, a ratchet wheel on the lower end thereof, a locking pawl engaging with one side of said ratchet wheel, an arm mounted on a wabbling support and carrying fingers or pawls engaging with said ratchet wheel, said wabbling support, a weighted arm on one side of said support normally holding said pawls toward said ratchet wheel and the inner end of said arm against the edge of said cam, said parts being arranged so that after said cam turns with the cylinder to the shoulder therein the end of the arm will fall off said shoulder and the pawls will engage one behind the point of the holding pawl, one behind a tooth on the ratchet wheel and operate to throw out said holding pawl and turn the cylinder one notch, when the other pawl will engage the ratchet wheel and arrest the movement, substantially as set forth.

9. In an electric program apparatus, the combination, of a frame, a program cylinder, means for operating it, a contact cylinder, weighted pawls and arms for operating it from said program cylinder, a switch cylinder, and a gear connecting said switch cylinder with said contact cylinder, substantially as set forth.

10. In an electric program apparatus, the combination, of the frame, a program cylinder, the operating mechanism therefor comprising a weight for forcing it forward, a contact cylinder, means connected with the program cylinder for operating said contact cylinder comprising a weight for forcing it forward, and a switch cylinder geared to be operated from said contact cylinder, substantially as set forth.

11. An electric program apparatus comprising a program cylinder, weight operated mechanism for rotating said cylinder forward, electrically operated means for reversely operating said mechanism, a contact cylinder adjacent to said program cylinder, contact arms and pins carried by said program and contact cylinders respectively arranged to contact with each other, and a switch cylinder geared to said contact cylinder and also electrically connected therewith, substantially as set forth.

12. In a program apparatus the combination of the program cylinder and means

for operating said program cylinder step by step in a forward direction comprising a ratchet wheel on said cylinder, a bar mounted to reciprocate horizontally between guides and formed with arms extending at right angles to each other with a pawl on the outer end of each arm, one of said pawls being arranged to ride over the top face of said ratchet wheel on one side of said cylinder and engage behind the teeth of said ratchet wheel from the top to push said cylinder forward, and the other being arranged to engage with the peripheral face of said ratchet wheel and in front of the teeth to arrest the forward motion of the cylinder as said bar completes its forward movements, a rock-shaft having an arm fixed thereon and projecting each way therefrom, one end of which is pivoted to said sliding bar and the other end of which is pivoted to means for operating said rock-shaft in one direction, and means for operating said rock-shaft in the reverse direction, substantially as set forth.

13. In a program apparatus the combination of the program cylinder and mechanism for operating said program cylinder step by step comprising a dash-pot having a piston connected with the mechanism and adapted to operate said mechanism in one direction by gravity, electro-magnets, and a rock-shaft in a plane below the top of said dash-pot adapted to be operated by said electro-magnets to lift said piston, the connection between said piston and said rock-shaft including a goose-neck arm extending through the top of said dash-pot, substantially as set forth.

14. In a program apparatus the combination of the program cylinder and mechanism for operating the same step by step comprising a rock-shaft, an operative connection between said rock-shaft and said program cylinder, electro-magnets, a connection between said electro-magnets and said rock-shaft for operating it in one direction, a dash-pot, a weighted piston in said dash-pot, and a connection between said piston and said rock-shaft whereby the weight of said piston operates said rock-shaft reversely to said magnets, substantially as set forth.

15. In a program clock apparatus, the combination, of the several cylinders, mechanism for rotating the same comprising weights for imparting the forward driving power, electromagnets for lifting said weights into a driving position, one of said cylinders being connected through a loosely mounted arm with pawls to a weight hung to hold said pawls into engagement with the ratchet wheel and at the same time force said ratchet wheel forward, said arm, and said weight, substantially as set forth.

16. A program clock apparatus comprising a switch or calendar cylinder composed of non-conducting material having a metal ring thereon for each program electrically connected with the switch-cylinder and provided with adjustable contact points adapted to be placed in position to contact with one side of a signaling circuit to close the same, substantially as set forth.

17. In a program apparatus, the combination of a wabbling arm mounted on a tilting support and carrying driving and stop pawls for moving and stopping a ratchet wheel, said ratchet wheel, said tilting support, a weight for controlling and moving said arm in a direction so that said weight acts to turn said ratchet wheel and keep said pawls in engagement therewith to effect the movement, substantially as set forth.

18. A program apparatus comprising a driving ratchet wheel, a locking pawl for holding said ratchet wheel, an operating pawl having three contacts, one contact for driving said ratchet wheel, one to stop said ratchet wheel, and one for disengaging a locking pawl holding said ratchet wheel from turning in either direction during all of the time the driving pawl does not act to move said ratchet wheel, and means for operating said pawl, substantially as set forth.

19. A program apparatus comprising a program cylinder, a circular rack on said cylinder, a weight operated pawl engaging with said rack for operating said cylinder in a forward direction, electrically operated devices for returning said weight operated pawls to operative position, a contact cylinder adjacent to said program cylinder provided with a circular rack, a pawl for engagement with said rack to normally hold said contact cylinder in fixed position, a weight operated pawl for engaging with said circular rack on the contact cylinder for disengaging the locking pawl and operating said contact cylinder in a forward direction, said locking pawl, a connection between said pawl and the program cylinder for timing its operation, a program switch cylinder connected to be operated at stated intervals by said contact cylinder, and electrical contacts adapted to connect with several cylinders, substantially as set forth.

20. A program apparatus comprising a program cylinder, a contact cylinder, and a switch cylinder, means for establishing electric contacts between said cylinders, weight operated mechanism for forcing said several cylinders forward, and electrically operated mehanism for returning said weight operated mechanism to operative position, substantially as set forth.

21. A program apparatus comprising a program cylinder, a weight mounted in a dash-pot for operating said cylinder in a forward direction, means for regulating the time of the fall of said weight, electric

mechanism for returning said weight to operative position, a contact cylinder and a program switch cylinder, weight operated devices for forcing said cylinders forward, and a connection between said weight operated devices and the program cylinder for timing their operation, substantially as set forth.

In witness whereof, I, have hereunto set my hand and seal at Washington D. C., this 28th day of August, A. D. nineteen hundred and six.

FRANK F. LANDIS. [L. S.]

Witnesses:

E. W. BRADFORD,

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."