C. B. HALE.

PROGRAM CLOCK.

APPLICATION FILED SEPT. 15, 1909.

1,027,202.

Patented May 21, 1912.

6 SHEETS—SHEET 1.

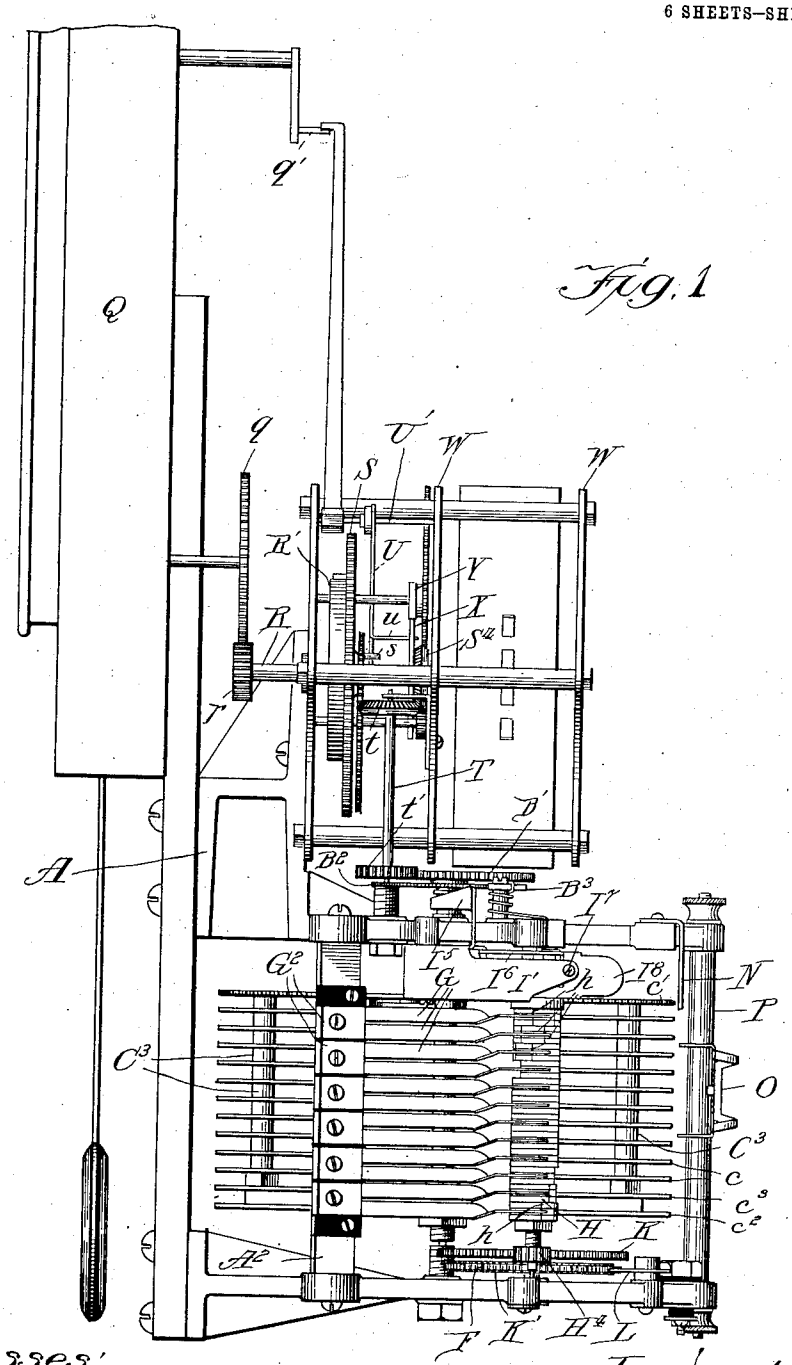

Fig. 1

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6 SHEETS—SHEET 2.

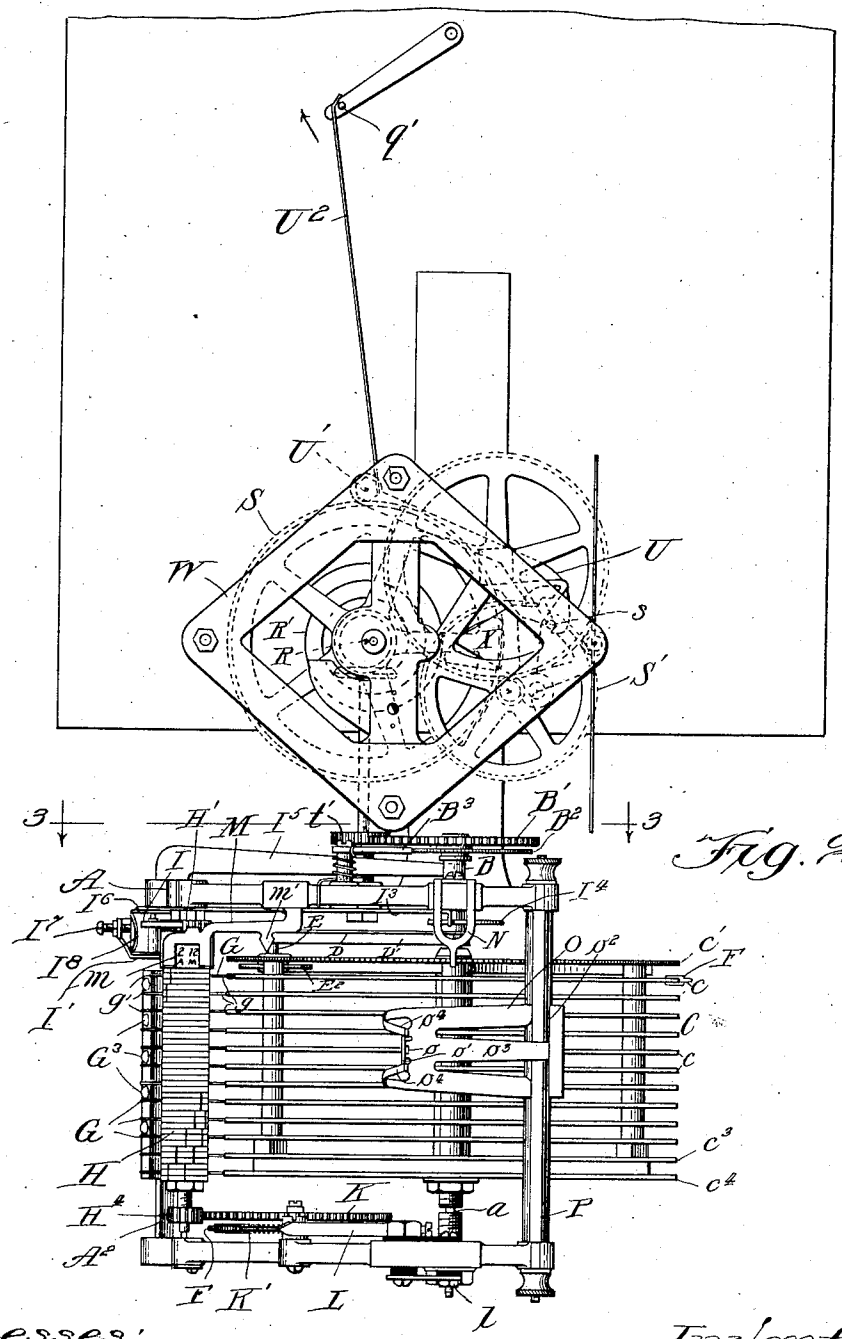

Fig. 2.

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6 SHEETS—SHEET 3.

Fig. 3.

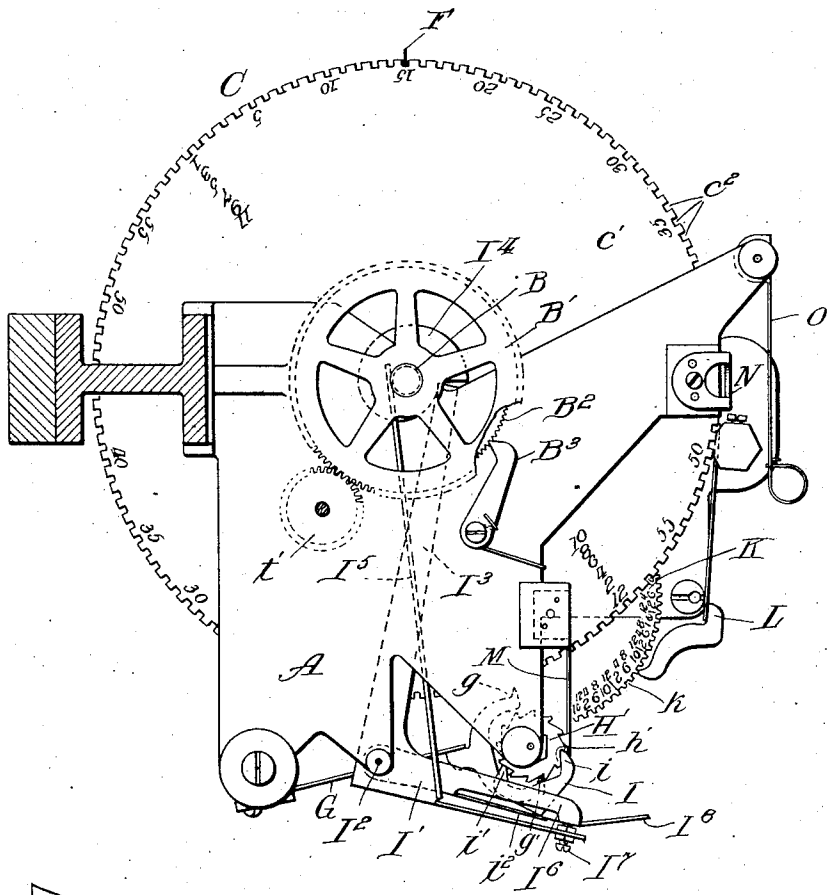
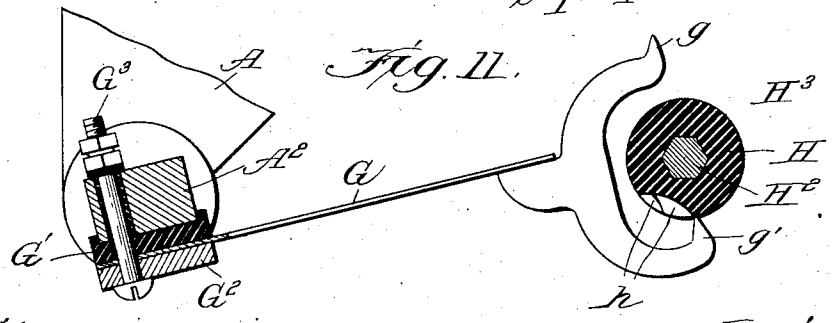


Fig. 11.



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6 SHEETS—SHEET 4.

Fig. 4.

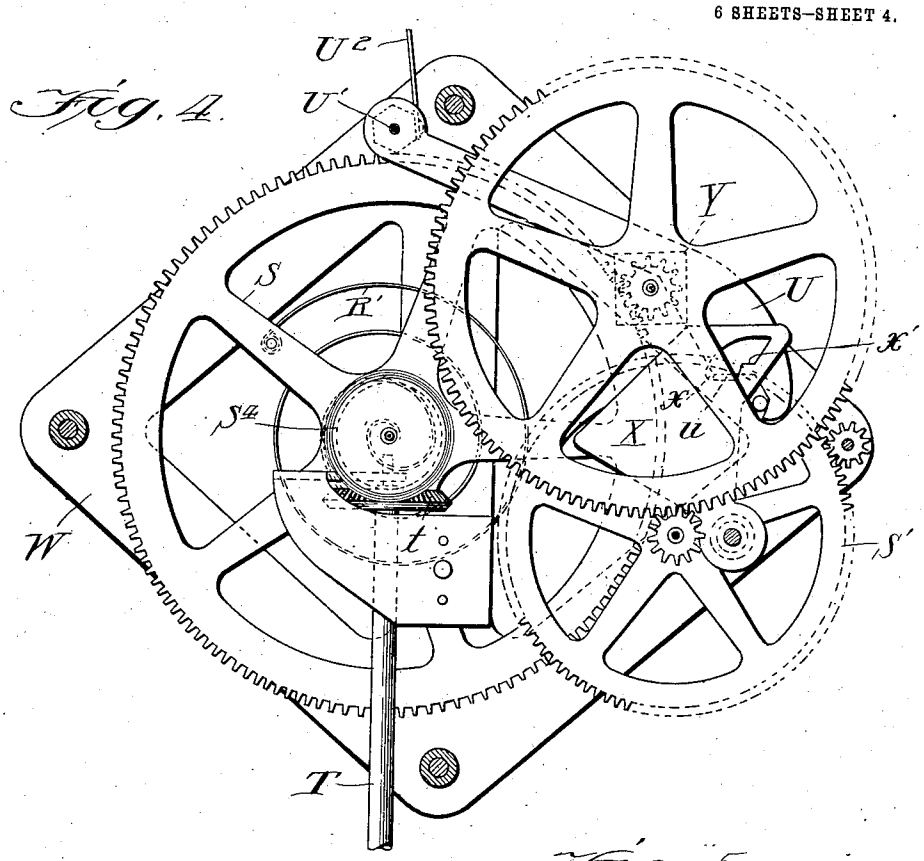
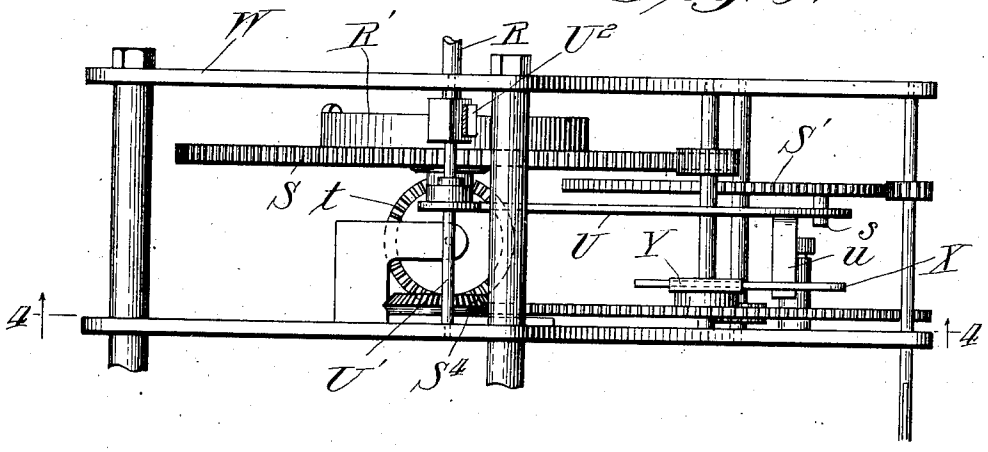


Fig. 5.



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6 SHEETS—SHEET 5.

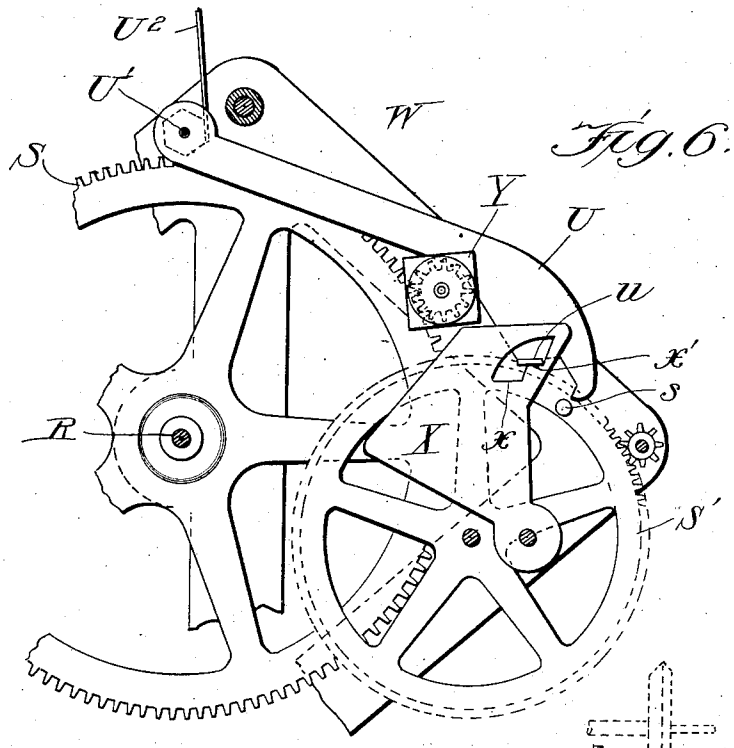

Fig. 6.

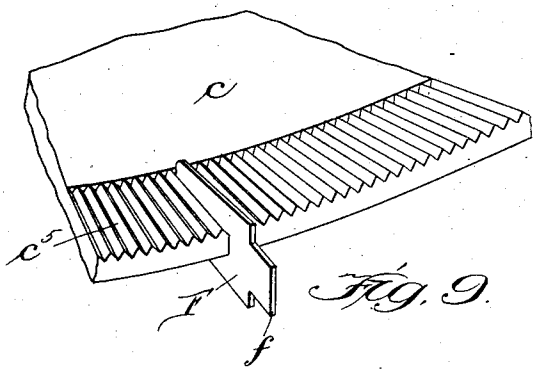

Fig. 9.

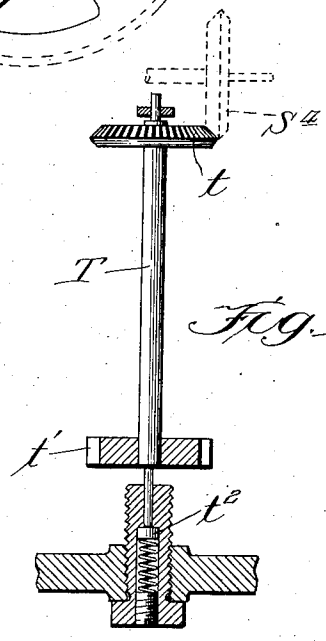

Fig. 10.

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APPLICATION FILED SEPT. 15, 1909.

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6 SHEETS—SHEET 6.

Fig. 8.

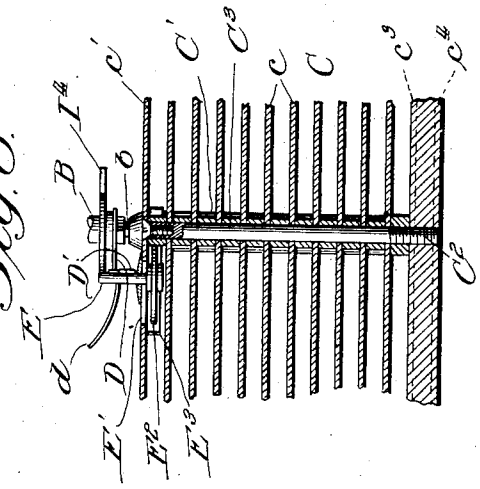


Fig. 12.

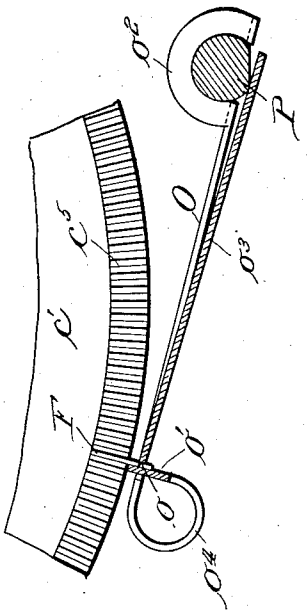
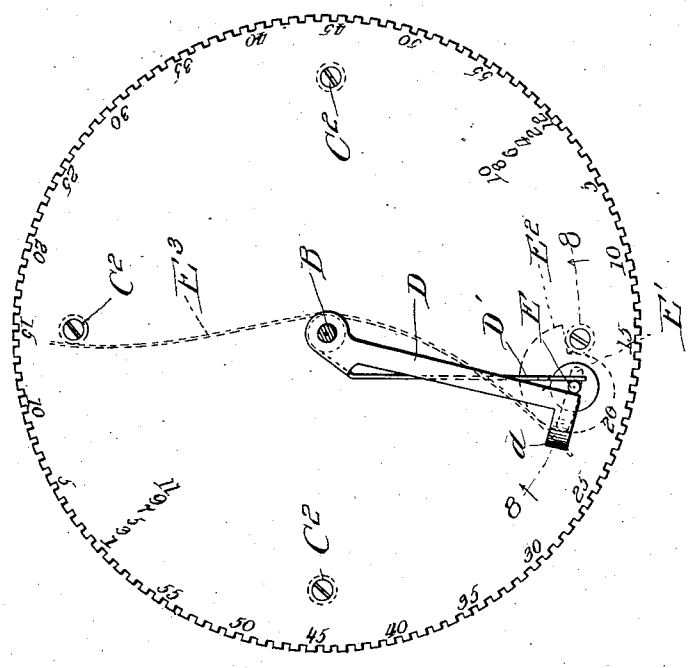


Fig. 1.



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PROGRAM-CLOCK.

1,027,202. Specification of Letters Patent. Patented May 21, 1912.

Application filed September 15, 1909. Serial No. 517,765.

To all whom it may concern:

Be it known that I, CHARLES BALLARD HALE, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful Improvement in Program-Clocks, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to devices for controlling one or more signals or indicators so as to bring them into operation automatically at any desired time or times during any desired interval of time and has for its object to provide a device of this character which shall be simple and durable in construction, which shall be efficient and reliable in operation, and which shall be elastic so as to afford a wide range of control.

My invention has for a further object the provision of a simple and novel form of controlling drum whereby adjustments and changes in the time periods may be made quickly and with accuracy.

My invention has for a further object to provide various simple and novel elements which go to make up a device of the character specified.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects among which are those heretofore enumerated, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a side elevation of a device embodying a preferred form of my invention, illustrating one way of associating it with a clock so as to be controlled thereby; Fig. 2 is a front elevation of said device as illustrated in Fig. 1; Fig. 3 is a section taken on line 3—3 of Fig. 2; Fig. 4 is a view on an enlarged scale showing the motor mechanism in front elevation, with the front plate removed; in other words, it is a section taken on line 4—4 of Fig. 5; Fig. 5 is a plan view of the motor mechanism; Fig. 6 is a view similar to Fig. 4, showing a different position of the parts, and portions being broken away and omitted in order more clearly to illustrate the remainder; Fig. 7 is a plan view of the timing drum, together with the clutch for connecting it to its driving shaft; Fig. 8 is a section taken on the curved line 8—8 of Fig. 7; Fig. 9 is a perspective view showing on a greatly enlarged scale a fragment of one of the disks comprising the drum and one of the contact pieces in position; Fig. 10 is a detail of one of the driving elements between the motor spring and the drum; Fig. 11 is a detail showing one of the contact fingers and cam post; Fig. 12 is a sectional view showing the device for positioning the contact clips upon the drum during the operation of applying the clip.

Referring to the drawings, A represents a skeleton frame in the upper portion of which is mounted a revoluble stub shaft B.

C is a drum journaled at its lower end in a bearing *a* in the frame and at its upper end in the end of the stub shaft B, as at *b*. I prefer to provide a clutch between the stub shaft and the drum so that the drum may either be driven from the stub shaft or be released therefrom and spun about freely. The clutch is most clearly shown in Figs. 7 and 8 and conveniently consists of an arm D fixed to the stub shaft and projecting radially thereto so as to engage with a stud E projecting from the adjacent end of the drum.

D^1 is a spring finger carried by the arm D in position to engage with the side of the stud opposite that on which the arm lies so as to hold the stud yieldingly against the arm. The arm D is preferably made of flat spring metal so as to be substantially rigid in the plane at right angles to the axis of rotation but yielding in the transverse direction and, on the free end of the arm, I prefer to arrange a rearwardly-extending, upwardly-inclined lip, *d*. The members D and D^1 may conveniently be made from a single sheet of metal which is first cut into the proper shape and then bent so as to make the finger lie in a plane at right angles to the arm as shown. When the parts are in the position shown in Fig. 7, a counter-

clock-wise movement of the stub shaft and arm will cause the drum to be driven positively. If a turning effort in the same direction is applied to the drum while the arm remains stationary the spring finger will yield until the stud passes beyond the free end thereof, and the drum will then be free and can be moved independently of the stub shaft or the clutch. In order to bring the stud into operative relation with the clutch again, the drum is turned until the stud strikes against the underside of the lip or ear d, a further movement of the drum then springing the arm upwardly until the stud passes beyond the front edge thereof and thereby permits the arm to drop in place again behind it.

The drum is preferably made up of a series of disks c superposed upon each other but separated from each other and tied together by means of a central post C^1 and a series of posts C^2 distributed about the disks near the edges thereof. The disks may be spaced apart by means of washers or sleeves C^3 surrounding the posts between adjacent disks. The top of the drum is preferably formed of a graduated disk c^1 having a series of notches or teeth c^2 upon the edge, each of these notches or teeth representing a unit period of time as, for example, one minute. In order to give rigidity to the drum the two bottom disks c^3 and c^4 are preferably formed integral with each other as shown. Each of the disks except the top one is knurled on one side adjacent to the periphery thereof so as to form a series of fine, radial teeth c^5 as shown most clearly in Fig. 9, although, of course, these teeth may be otherwise formed. The purpose of these teeth is to provide seats for contact clips, one of which is shown at F in Fig. 9. These clips are small fork-shaped pieces of metal, the forks of which are just large enough to receive the edge of one of the disks. When the clips are in position on the disks each of them lies between two of the small teeth or ribs and has one end projecting. It will, therefore, be seen that the teeth or ribs serve not only to give a finer adjustment for the clips about the periphery of the drum than is afforded by the graduations upon the top disk, but they also prevent the clips from being displaced and maintain them securely in radial positions.

Arranged at one side of the drum are a series of yielding contact fingers G, there being one of these fingers for each of the disks on the drum except the graduated disk at the top. These fingers are so positioned that when free to do so, the contact tips g (most clearly shown in Figs. 3 and 11) lie adjacent to the peripheries of the several disks so as to be engaged by contact clips which may be carried upon the respective disks during rotation of the drum. These fingers may be supported in any suitable way as, for example, on a post A^2 from which they are insulated by a block of insulating material G^1. In the particular arrangement shown the fingers are electrically connected together in pairs by means of conducting plates G^2 each of which overlies the ends of two of the fingers and is secured to the post A^2 by means of a bolt G^3; the bolts G^3 being insulated from the post and serving as electric terminals or binding posts. It will, of course, be understood that the fingers may be electrically independent of each other or that any desired number may be permanently connected together either by means of clamping plates or by means of conductors extending from one binding post to the other. Each of the contact fingers has a projection g^1 which forms with the member g a fork within which lies a controlling member in the form of a cam cylinder H. The cam cylinder is made of insulating material and has a series of depressions h distributed about its periphery from one end toward the other, the arrangement being such, that when one of the projections g^1 lies within one of the recesses, the corresponding contact tip g is held in proper position with respect to its coöperating disk through the resiliency of the main portion of the contact finger: that is, the contact tip lies in the path of any clip which may be carried by the corresponding disk on the drum so that as the drum is rotated the clips engage with the contact tip in succession. The cam cylinder is connected with the driving mechanism, preferably the stub shaft B so as to be actuated in definite time relation with respect to the drum. Since it is desired to have each of the contact fingers remain in operative relation to its respective disk during one complete rotation of the disk, the actuating means for the cam cylinder is so arranged that the cylinder is turned one step for each revolution of the drum, thereby making it possible to shift one or more of the contact fingers after each revolution of the drum. The shifting of the contact fingers, of course, depends upon the grouping which is desired and, therefore, one finger after another may be brought in position at regular intervals throughout the entire period of time represented by the drum or two or more fingers may be shifted at one time, the adjustment being made as will hereinafter be described by adjusting the cam cylinder. In order to move the cam cylinder in the manner described I arrange upon the upper end thereof a ratchet wheel H^1, the teeth h^1 of which are equal in number to the number of hours in a day divided by the time represented by one of the disks.

I is a double-ended pawl carried upon the

end of one arm of the bell crank lever I^1, the lever being pivoted at its elbow to the frame as at I^2. The long arm I^3 of the bell crank lever extends adjacent to the stub shaft B upon which is mounted a cam I^4, arranged in the form of one turn of the spiral.

It will be seen that as the stub shaft revolves in the counter-clockwise direction as viewed in Fig. 3, the cam will gradually force the free end of the long arm of the bell crank lever toward the right until, after a complete revolution has been made of the arm, it is free to drop to the lowest point upon the cam. During the rotation of the cam in the manner described, a spring I^5 which is secured at one end to the bell crank lever is placed under tension so that as soon as the arm of the lever leaves the highest point on the cam the spring turns the lever back again to its original position. The movement which the cam produces in the lever carries the pawl back so that the driving end *i* engages with the tooth on the ratchet wheel in rear of the one with which the pawl has been in engagement. Upon the release of the lever from the cam and the return of the bell crank lever to its original position, the pawl forces the ratchet wheel forward one step; the rear end of the pawl i^1 engaging with the ratchet wheel at the completion of the stroke and preventing the ratchet wheel from jumping around too far. The spring I^5 may take any desired form but, for convenience, it may be formed integrally with the bell crank lever, the whole being stamped from resilient sheet metal and the lever being bent so as to lie in a plane at right angles to the plane of the lever itself so as to make the arms of the lever rigid under stresses in the same direction as those which cause the spring arm to yield. The free end of the spring may be carried to and engaged with the side of the stub shaft. Instead of mounting the pawl directly upon the bell crank lever, I prefer to arrange it upon an auxiliary arm I^6 which has a spring lip i^2 engaging with the back of the pawl to hold it securely against the ratchet wheel. I^7 is a set screw carried by the short arm of the bell crank lever and engaging with the rear side of the auxiliary arm I^6. By turning this set screw adjustment of the pawl may be made as well as compensation for weakening of the actuating spring. The free end of the auxiliary arm is preferably extended as at I^8 in order to form a finger piece which may be grasped so as to oscillate the bell crank lever manually in order to vary the position of the cam cylinder independently of the drum.

The drum is intended to take care of all intervals within a predetermined period of time as, for example, the hours and minutes of a day. It may be that the program is not the same for every day in a week, it being, perhaps, desirable, as in schools, to have no program on certain days or to omit the regular program during certain periods on some days. I have, therefore, provided a second timing device which is to take care of multiples of the periods represented by the drum as, for example, the days of a week. This device is indicated as taking the form of a disk K which has gear teeth *k* about its periphery meshing with a pinion H^4 on the cam cylinder. The teeth on the pinion are equal in number to the number of teeth in the ratchet wheel so that whenever the cam cylinder is moved forward one step the disk is moved in synchronism. The disk is divided radially into seven sections each of which represents one day and the number of teeth on the disk is such that during each revolution of the cam cylinder, representing a period of time equal to one day, the weekly disk is rotated through an angular distance corresponding to a day. Each section of the weekly disk is divided into the hourly periods represented by the disks on the main drum. Rigidly connected with the disk K is a second disk K^1, the two being concentric and the disk K^1 being preferably arranged beneath the other so as not to obscure the graduations upon the top of the latter. The disk K^1 is preferably made of the same thickness as the disks of the main drum so that the same clips which are used upon the drum may also be placed upon the disk K^1.

L is a spring finger which lies in position to engage successively with the clips which have been placed in position upon the disk K^1. The member L is preferably insulated from the frame work so that current passing in at the terminal or binding post *l* can flow only when the finger L engages with a clip on the disk K^1, the circuit being interrupted while this disk occupies a position such that there is no clip to engage with the finger.

M is a gage secured to the frame and provided with an opening *m* adjacent to the upper portion of the cam cylinder. The upper end of the cam cylinder is provided with indexes which are visible through the opening *m*. In the arrangement shown the indexes 12^M and 2^A are visible through the opening and consequently the upper finger G is so situated as to be in the path of any clips which may be arranged upon the uppermost disk *c*, this disk representing the hours from twelve midnight to two a. m. Since there are twelve disks, each one will represent a period of two hours so that provision is made for a program extending throughout the entire twenty four hours of a day. Of course, the manner in which the

apparatus is used may be varied to suit desired conditions. For instance if no program is desired during the night time each disk could be used to represent a single hour, or a fraction of an hour if desired. However, as I have shown a calibration for two hour periods in connection with each disk I shall, for the sake of simplicity, confine the explanation to this arrangement, since the modifications with respect to varying the connections and calibrations are self evident.

Assuming that there is a clip uppermost of the disk c and that the apparatus is driven in any suitable manner, then it will be seen that at one point in the rotation of the drum this clip will engage momentarily with the uppermost of the fingers G. If now there is a clip on the disk K^1 at the point corresponding to the hours from twelve to two of the particular day under consideration, then by connecting a leading-in wire to the terminal l a continuous electrical circuit will be completed from the terminal l, through the finger L, through the clip on the disk K^1, thence through the frame work and parts of the drum to the uppermost of the disk c, through the clip on that disk, through a finger G, and thence to the terminal G^2 associated with that finger. Consequently if the circuit for an electric bell or other device is completed except for a break which may occur in the program apparatus an alarm will be given or an indication made at this time. If the apparatus is being used in a school building where there are no exercises on Saturday and Sunday all of the clips representing the several Saturdays and Sundays on the weekly timing device are removed and, therefore, even though the apparatus continue to run on these days, no circuit can be closed because of the break at the disk K^1. In the same way, by removing any of the clips representing different hours throughout the week, the electric continuity of the circuit will be interrupted at the weekly timing device during these hours and no signal or indication will be given. After the drum has made a complete revolution the uppermost of the fingers G is moved out of its operative position by the cam cylinder and the next finger comes into play. The weekly timing device is also moved forward one step. In the same way one finger after another may be brought into play and the proper signals or indications will be given as determined by the position and number of clips on the various disks of the drum and of those upon the disk K^1.

In order to position the clips properly upon the several disks of the drum I have provided a pawl or catch N arranged in position to be pressed into the notches or teeth c^2 of the drum so as to hold it stationary.

In addition I have provided a clip-inserting device which may conveniently consist of a holder O slidably mounted upon a shaft P which is arranged beside the drum and extends parallel to the axis thereof. The holder is provided with a notch o of a width equal to the width of the stem f of the clips. The holder is also provided with a spring-held finger o^1 which registers with the recess o. In using the device, the stem of a clip is inserted in the notch o and the finger o^1 is allowed to bear against it so as to hold it in place. After the disk has been locked against rotation by means of the member N the holder is slid along its shaft until the clip is opposite the disk upon which it is to be placed. The holder is revoluble upon the shaft as well as slidable thereon so that after the clip has been brought into the plane of the proper disk, the holder may be rotated so as to force the forked portion of the clip over the edge of the disk. The holder is then swung back, the clip remaining upon the drum. A new clip is then inserted in the holder and the drum is turned around until the member N engages with the notch indicating the time at which the next signal or indication is to be given. The holder is then pushed against the drum so as to place the clip in position as before. In this way the drum is turned until all of the clips which it is desired to place upon the first disk are in position. The same operation is gone through with the following disks until the entire drum is filled, assuming, of course, that it is desired to use the entire drum; for if only a part of the disks are to be used, it is unnecessary to place any clips on the remaining ones.

The utility of the clutch between the driving shaft and the drum is now apparent for it permits the drum to be left perfectly free during the operation of placing the clips in position, changing their relations or removing them; the drum being unclutched when it is desired to perform any of these operations and, after their completion, the clutching engagement being again made.

The member M is provided with an index m^1 which extends into proximity with the notched disk c^1 so that when a clip which has been positioned in the manner heretofore described is being engaged by one of the contact fingers, the index m^1 points to the time. It will also be seen that if the cam cylinder is to be shifted upon the hour the index m should point to the hour just as the cam cylinder is moved. Consequently if there is any variance between the time at which a clip should be engaged by a finger or the cam cylinder moved and the time designated by the index, the apparatus is out of adjustment.

In assembling the parts they are perma-

nently connected in such a manner as to effect a substantial adjustment, that is one within a few minutes. The stub shaft is then rotated in a manner to be hereinafter described, until the cam cylinder snaps forward a step and, if the index m^1 now points exactly to the hour, the adjustment is correct. If, however, the index points to one or two minutes before or after the hour then the adjustment may be corrected by shifting the drum angularly with respect to the remaining parts. This may conveniently be accomplished by making the stud E adjustable angularly of the drum. This may be done in the manner shown most clearly in Figs. 7 and 8. The stud is shown as extending through an elongated, curved slot E^1 in the disk c^1. On the end of the stud beneath the disk is a cam E^2, this cam being, for the sake of convenience, an interchangeable one, similar to the cam I^1.

E^3 is a leaf spring which engages with one side of the cam E^2 and engages with the connecting member C^3 at the center of the drum and one of the connecting members C^2 at the side. The stud and its cam are arranged adjacent to a stop of some kind, this being conveniently one of the connecting members C^2. Consequently the spring tends to force the cam against the stop. It will be seen that by turning the cam in one direction it causes the distance between the stud and the stop to be increased, consequently producing a relative movement between the stud and the drum in one direction. If the cam is turned in the other direction so as to bring a lower portion thereof adjacent to the stop, the spring forces it toward the stop until it engages therewith and, therefore, the drum and the stud are moved revolubly in the opposite direction from that which took place before. By this means I have made provision for adjusting the drum angularly in either direction so as to bring it into proper relation to the cam cylinder.

It will be understood that the holder for the clips which I have described may take various other forms, the arrangement shown being, however, a simple and suitable one. As shown, the holder is made of a piece of resilient metal having one end bent so as to surround the shaft P more than half way as at o^2. At the center is formed a finger or tongue o^3, the free end of which is adapted to bear against the side of the shaft which is visible through the open mouth of the portion o^2. The shaft may be flattened on one side so that through engagement of the spring finger or tongue with the flattened portion, the holder is held yieldingly in a position wherein it is prevented from swinging around into the path of the contacts carried by the drum, something which might accidentally occur if the holder were left entirely free. The spring finger o^1 may be formed by bending the free end of the holder so as to produce one or more loops as shown at o^4. When the finger o^1 is moved away from the notch, the diameter of the loops is decreased and when the finger is released the tension under which these loops have been placed carries it back in operative position.

In order to simplify the construction of the cam cylinder and permit ready adjustment to be made of the cams thereon, I prefer to build it up of disks of insulating material strung upon a rod which also forms the shaft of the cylinder. The shaft or rod upon which the disks are arranged is preferably polygonal in cross section. It will be seen that if each disk is provided with a depression in its edge, all of the disks being alike, these depressions may be distributed about the cylinder in as many angular positions as there are sides to the polygonal shaft. The number of positions which may be obtained for the recesses circumferentially of the shaft may be increased by so locating the recesses in the edges of the disks that when the disks are turned upsidedown a series of cam surfaces may be obtained which is distributed about the cylinder in such a manner that the cams of the first series (with the disks right side up) alternate with those of the second series. In the arrangement shown there are twelve fingers and consequently provision should be made for securing twelve cam surfaces distributed circumferentially of the cylinder.

In accordance with my invention I make the shaft or rod H^2 upon which the disks H^3 are mounted hexagonal in cross section and arrange the recesses or cam surfaces h in the edges of the disks at an angle of approximately 15 degrees from a radius passing through one of the corners of the hexagonal opening. It will, therefore, be seen that twelve different cam positions may be obtained with disks which are exactly alike; six positions being obtained by superposing a series of disks displaced angularly 60 degrees from each other, and a second series being obtained by additional disks which are placed in position up side down at angles of 60 degrees from each other for the recesses or cams of the second series will be spaced half way between those of the first series.

The mechanism which I have heretofore described may be driven in any suitable way. I prefer, however, to provide a motor, such as a spring which when free to do so turns the drum through a predetermined angle, namely, an angle corresponding to one minute of time. I also prefer to provide a clock or other time measuring device

which will release the spring at intervals of one minute thereby causing the drum to be moved step by step at intervals of one minute. I prefer to make use of a motor which will turn the drum quickly when the motor is released so that the clips will not remain in engagement with the contact fingers for any considerable length of time. This is very desirable since, in the case of a bell which will run as long as the circuit remains closed, it would be objectionable to keep the circuit closed as long as would be necessary if the drum were driven continuously from the clock mechanism. By the present arrangement it is possible to make the circuit and again break it within a very short interval of time and, if it be desired to keep the circuit closed longer, two or even three clips may be placed side by side, thereby increasing the time during which a circuit remains completed. Therefore it is possible to make signals which are entirely different from each other since some may be short and sharp where only a single clip is used and others may be of longer duration because a plurality of clips have been arranged one beside the other.

In the arrangement shown there is a clock Q suitably attached to the frame work of the apparatus so as to drive a main shaft R, this being conveniently done by means of a gear q driven by the clock and meshing with a pinion r on the main shaft. The main shaft is suitably connected in any desired way with a motor spring R^1. The free end of the spring is connected to the first element S of a train of gearing which drives a counter shaft from which the stub shaft B is driven. One of the members S^1 of the gear train is provided with a laterally-projecting pin s. Normally this pin is engaged by a detent U which locks the gear train against movement. This detent is pivotally mounted by means of a suitable shaft U^1 journaled in the frame work W of the motor mechanism. U^2 is an arm projecting from the detent into proximity to a movable pin or finger q^1 carried by and driven from the clock. The member q^1 is intended to make a revolution every minute, thereby tripping the detent at intervals of one minute apart. In Fig. 2 the parts are in a position wherein the detent is just about to be tripped since the pin has just engaged with the end of the arm U^2. The condition of the parts at this time is shown on an enlarged scale in Fig. 4; the detent being supported by means of a lip u which rests upon a shoulder x in a pivoted gravity dog X. The tripping of the detent lifts the free end thereof far enough to raise the lip u into the plane of a second shoulder x^1 in the dog. The dog is so proportioned that it normally tends to assume the position wherein the shoulder x^1 lies directly beneath the lip u and, therefore, as soon as the detent is tripped the gravity dog drops and after the pin q^1 has passed beyond the arm U^2 the detent is prevented from again dropping into engagement with the pin s by reason of the engagement between the lip u and shoulder x^1. The motor spring is now free to drive the train of gearing and rotate the counter shaft T. This action continues until a cam device Y, which is carried upon one of the members of the gear train directly over the dog X, engages with the dog and moves it back to its former position. There is now nothing to support the detent and it again drops into the position shown in Figs. 2 and 4 so as to lie in the path of the pin s; and when this pin comes around to the proper position, it is engaged by the detent and the gear train is locked. The parts are so adjusted that the detent at no time bears upon any of the members of the gear train except when it is engaging with the pin s, it being held out of engagement with all parts of the gear train by the gravity dog, thereby avoiding all friction on the moving parts.

In order that the drum and the cam cylinder may be turned independently of the motor mechanism I prefer to provide a clutch, preferably between the stub shaft B and the gear train. This may conveniently be accomplished by supporting the counter shaft T upon a yielding bearing t^2 so that when pressure is applied in the axial direction the counter shaft may be depressed so as to carry the gear wheel t upon the end thereof out of engagement with the last gear S^4 in the motor train. The pinion t^1 upon the other end of the counter shaft and the gear B^1 upon the stub shaft are so proportioned that the depression of the counter shaft does not bring these two members out of mesh and, therefore, by depressing the counter shaft and turning it the drum and the cam cylinder may be turned at will. In order to prevent the stub shaft from turning backward I have provided a fine toothed ratchet wheel B^2 which is engaged by a pawl B^3.

While I have illustrated only one form of my invention and have described this form at great length, I do not desire to be limited to the details of construction so illustrated and described but intend to cover all variations in construction and arrangement of parts which come within the terms employed in the definitions of my invention which constitute the appended claims.

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

1. In a program clock, a revoluble timing device, a driving shaft, a stud carried by

said device, a lever arm extending from said shaft and engaging with said stud, and means for adjusting said stud angularly of the said device.

2. In a program clock, a revoluble timing device, a driving shaft, said device having an elongated slot therein, a stud projecting through said slot, a shoulder on said device adjacent to said slot, a cam on said stud engaging with said shoulder, and a driving connection between said shaft and said stud.

3. In a program clock, a revoluble timing device, a driving shaft, said device having an elongated slot therein, a stud projecting through said slot, a shoulder on said device adjacent to said slot, a cam on said stud engaging with said shoulder, and a spring for holding said cam against said shoulder.

4. In a program clock, a revoluble timing device, a stud on said device, a driving shaft, an arm extending from said shaft and engaging with one side of said stud, and a spring finger on the arm engaging with the opposite side of the stud, said finger being so proportioned as to lock the stud and the arm together while permitting them to be released from each other when a slight pressure is applied tending to produce a relative movement of one away from the other.

5. In a program clock, a revoluble timing device, a stud on said device, a driving shaft, an arm extending from said shaft and engaging with one side of said stud, and a spring finger on the arm engaging with the opposite side of the stud, said finger being so proportioned as to lock the stud and the arm together while permitting them to be released from each other when a slight pressure is applied tending to produce a relative movement of one away from the other, said arm being yieldable in the direction axially of the stud and having an inclined under surface to permit the stud to be brought automatically in operative relation to said arm by pushing it against the arm from the rear.

6. In combination, a revoluble member, a stud projecting from the said member at one side of the axis thereof, a flat spring arm projecting from said shaft and engaging at one edge thereof with the side of said stud, the under side of said arm being inclined in rear of said edge so as to permit the stud to ride under the arm from the rear and lift it, and a spring finger associated with said arm and engaging with said stud so as to lock it to the arm, said arm being constructed so as to be unyielding in a plane at right angles with the axis of the drum, and said finger being so constructed and arranged that the stud may be freed by pressing it against said finger.

7. In combination, a revoluble member, a stud projecting from said member, a driving shaft, and a driving member carried by said shaft and engaging with said stud, said driving member comprising a flat sheet metal arm rigid in the plane at right angles to the axis and yieldable in the direction at right angles to said plane, together with a flat finger formed integral with said arm and lying in a plane at right angles to the plane of said arm.

8. In a program clock, a support, a drum mounted on said support and carrying a contact, a contact finger secured to said support in position to coöperate with said contact, a driving shaft, and a driving connection between said shaft and said drum, said connection including means for shifting said drum angularly independently of said shaft so as to adjust the relation between said contact and said finger.

9. In a program clock, a drum composed of a series of disks, spacing members between the disks, tie rods passing therethrough to fasten the disks together, and contact pieces detachably secured about the edges of said disks.

10. In a program clock, a drum composed of a series of disks, spacing members between the disks, and tie rods passing therethrough to fasten the disks together, one face of each disk being knurled on one face adjacent to the edge thereof so as to provide minute radial grooves.

11. In a program clock, a drum composed of a series of disks, spacing members between the disks, and tie rods passing therethrough to fasten the disks together, one face of each disk being knurled on one face adjacent to the edge thereof so as to provide minute radial grooves, and clips having forks fitting over the edges of the disks.

12. In a program clock, a revoluble drum composed of a series of separated parallel disks, detachable contact clips secured about the edges of said disks, a plurality of contact fingers mounted adjacent to said drum, and time-controlled mechanism for driving said drum.

13. In a program clock, a drum composed of a series of superposed parallel disks separated from each other, a guide arranged beside said drum and extending lengthwise thereof, and a clip holder slidably mounted on said guide so as to be capable of being moved opposite any one of the disks.

14. In a program clock, a drum composed of a series of superposed parallel disks separated from each other, a series of detachable clips adapted to be positioned upon the edges of said disks, a guide arranged beside said drum and arranged lengthwise thereof and a clip-holder slidably mounted on said guide so as to be capable of being moved into positions which will bring a clip held therein opposite any one of the disks.

15. In a program clock, a timing drum, a plurality of fingers mounted adjacent to said drum for coöperating therewith, a controlling device for said fingers, a driving shaft, a clutch between said shaft and said drum, a driving connection between said shaft and said controlling device, a motor, and a driving connection between said motor and said shaft including two coöperating members one of which is yieldingly supported so that it may be moved out of operative relation to the other.

16. In combination, a motor, a train of gearing connected to said motor so as to be driven thereby, a finger for engaging with one of the gear members to lock it, a pivoted gravity-actuated dog having therein two separated shoulders for supporting said finger respectively in operative and in inoperative positions, said dog being arranged to assume the position wherein it supports the finger in its inoperative position when free so to do, and a cam on a second member of the gear train to move said dog into its other position.

17. In a program clock, a revoluble member having therein a contact, a contact finger arranged to coöperate with said contact, a controlling device for said finger, a second revoluble member having a contact, a contact piece for coöperating with the latter contact, and actuating means for said revoluble members and said controlling device constructed and arranged to cause the said finger to lie in the path of its coöperating contact at predetermined intervals and to cause the contact which coöperates with said contact piece to engage therewith at intervals which are multiples of the aforesaid intervals.

18. In a program clock, a revoluble drum constructed and arranged to support a plurality of contacts distributed lengthwise thereof, a plurality of separated stationary contact fingers adapted to coöperate with said contacts, a revoluble member adapted to support a series of groups of contacts each containing as many contacts as there are fingers, a contact piece adapted to coöperate with the latter contacts, a controlling device for causing said fingers to move into and out of the path of their coöperating contacts, and means for actuating said drum, said member and said device so as to bring said fingers successively into the paths of their coöperating contacts and bring the contacts on said revoluble member successively into engagement with said contact piece.

19. In a program clock, a revoluble timing device for unit periods, a revoluble timing device for multiple periods, detachable contacts on each of said devices, those on the latter device being arranged in series each containing as many as there are units represented by the other device, contact fingers coöperating with the contacts on the device representing unit periods, a contact piece coöperating with the other contacts, a controlling device for said fingers for causing them to be brought successively into operative relation to their coöperating contacts, and actuating means for said devices for causing each of said series of contacts to be carried past said contact piece during each cycle of movement of said fingers.

20. In a program clock, a revoluble drum composed of a series of separated disks each of which is constructed and arranged to carry contacts about its periphery, a series of contact fingers arranged adjacent to said drum, there being a finger for each disk, a cam device for controlling said fingers and causing them to be brought into coöperative relation with said disks in succession, motor mechanism for moving said drum step by step, connections between said mechanism and said cam device for actuating it upon each revolution of the drum, a revoluble member constructed and arranged to carry a series of groups of contacts each of which may contain as many contacts as there are disks, a contact piece in position to engage with said latter contacts successively as the said member is revolved, and means for revolving said member upon the completion of each revolution of said drum through an angular distance equal to the distance between two consecutive contacts on the said member.

21. In a program clock, a timing drum graduated to represent the hours and minutes of a day, a disk graduated to represent the days and hours of a week, said drum being arranged to support contacts at hour and minute points, said disk being arranged to support contacts at hour points in each day of the week, a contact piece lying in the path of the contacts on the disk, a series of fingers each representing different hours of a day located adjacent to the drum so as to coöperate with the proper contacts on the drum, a cam device for bringing said fingers successively into operative relation to the contacts on the drum; and actuating means constructed and arranged to move the drum step by step, cause the relation between said fingers and the drum to change after each revolution of the drum, and cause said disk to be rotated an angular distance equal to the distance between two of the hour marks after each revolution of the drum.

22. In a program clock, a drum composed of a series of parallel disks, means for securing said disks rigidly together so as to leave spaces between consecutive disks, and contact pieces detachably secured about the edges of said disks.

23. In a program clock, a drum composed

of a series of parallel disks, means for securing said disks rigidly together so as to leave spaces between consecutive disks, and clips having forks fitting over the edges of the individual disks.

24. In a program clock, a revoluble timing device, a stud mounted on said device, means for adjusting said stud angularly relative to the axis of said devices, a driving shaft having its axis parallel with the axis of said device and a lever arm extending from said shaft into engagement with said stud.

25. In combination, a program apparatus, driving mechanism for said apparatus, a catch for restraining said driving mechanism, a spring for actuating said driving mechanism, a clock, means on said clock for winding said spring, and means on said clock for periodically tripping said catch.

In testimony whereof, I sign this specification in the presence of two witnesses.

CHARLES BALLARD HALE.

Witnesses:
WM. F. FREUDENREICH,
H. S. GAITHER.