Aug. 11, 1942. J. F. TIMMONS 2,292,911

TIME OPERATED CIRCUIT CONTROLLER

Original Filed Nov. 30, 1938 4 Sheets-Sheet 1

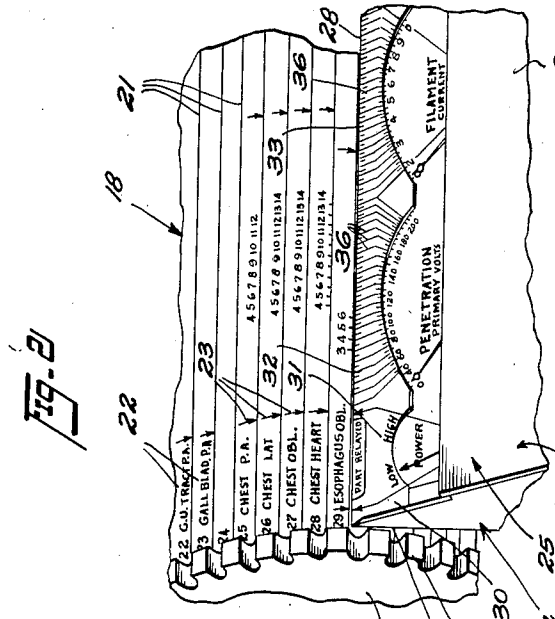


Fig. 2

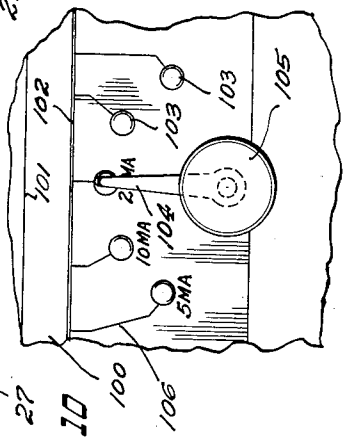


Fig. 10

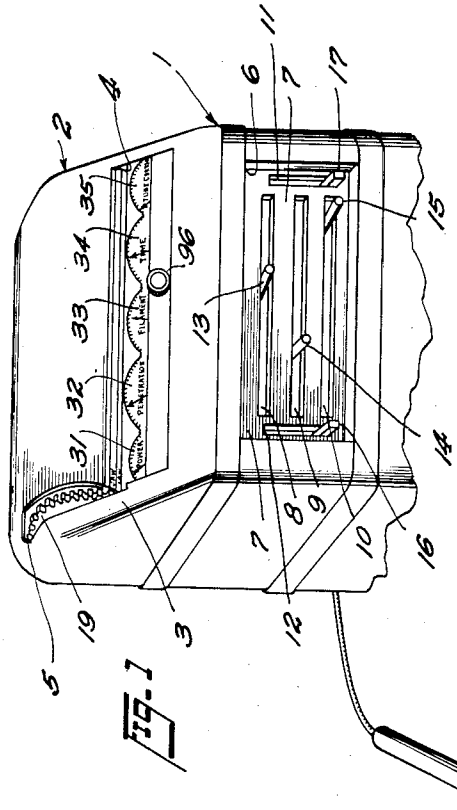


Fig. 1

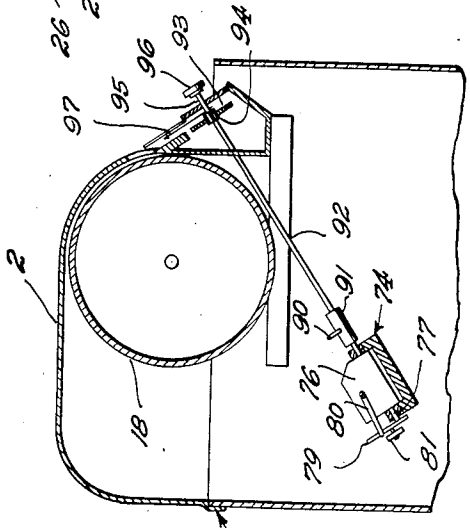


Fig. 3

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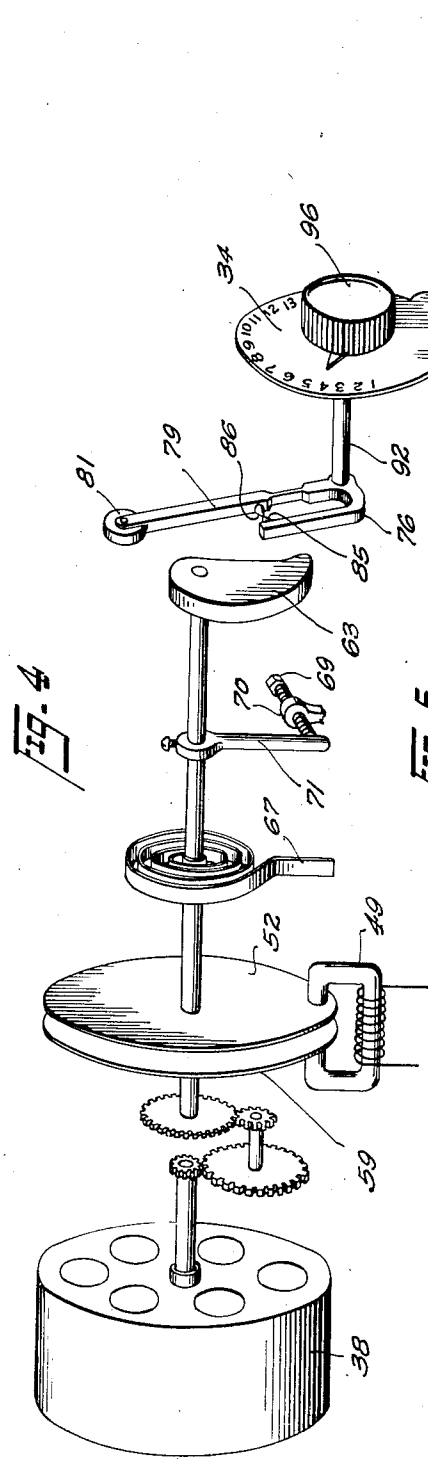


Fig. 4

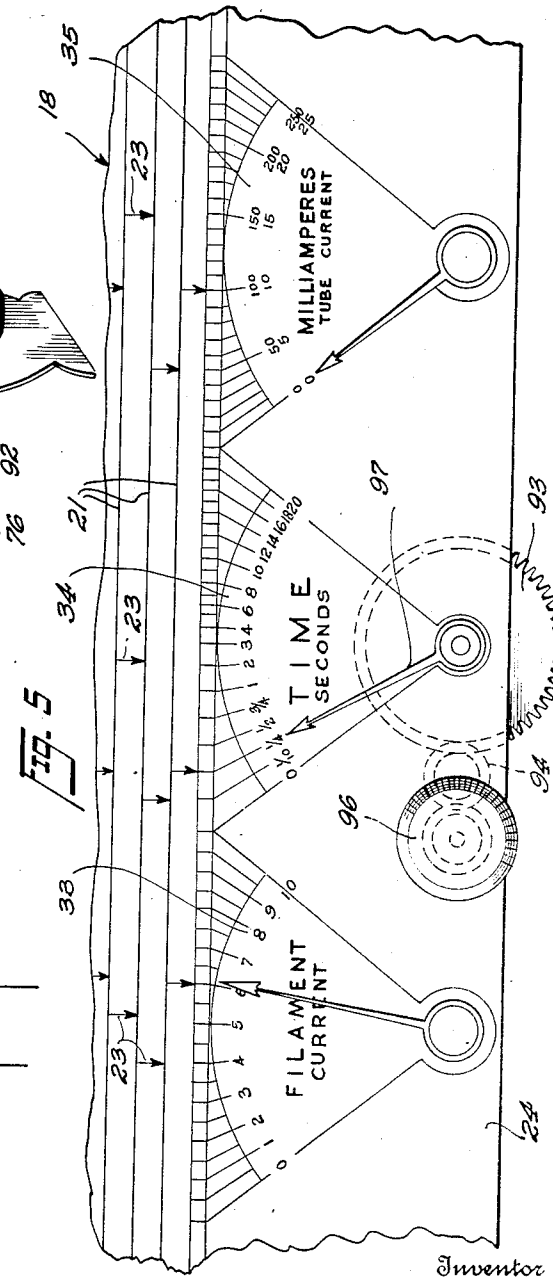


Fig. 5

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FIG. 6

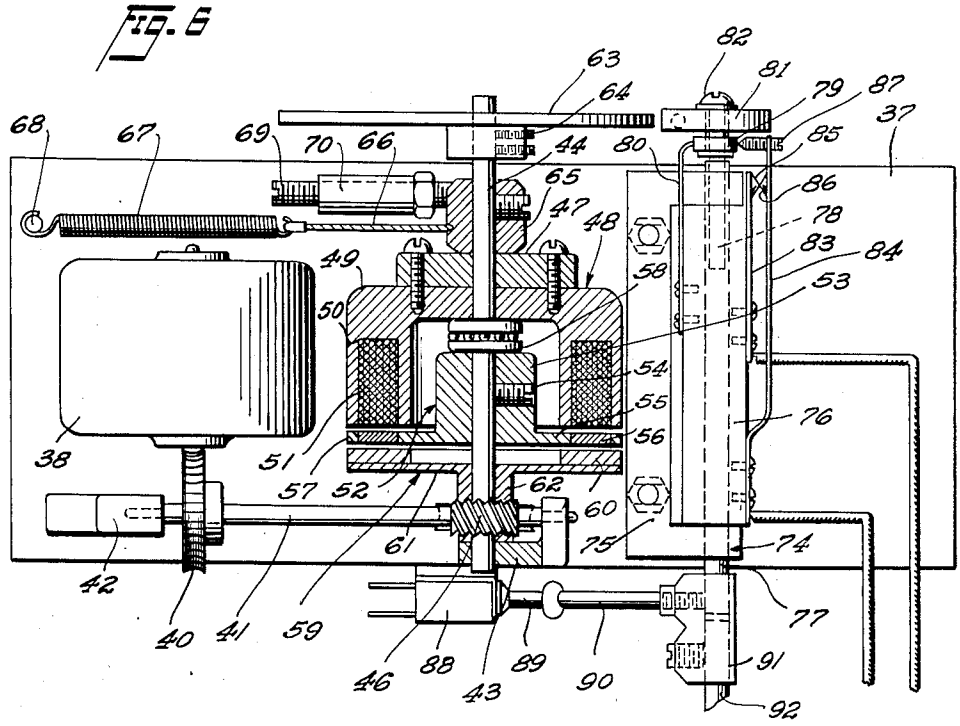
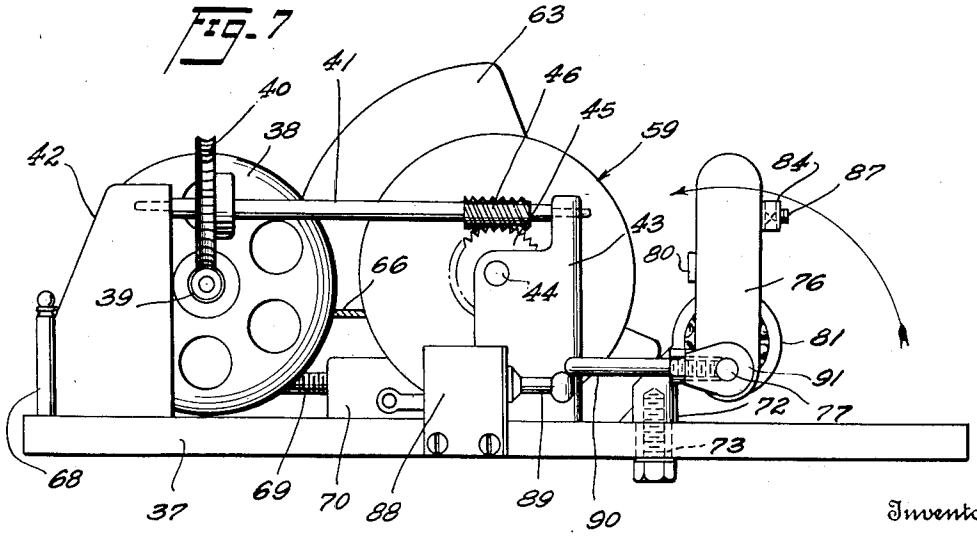


FIG. 7



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TIME OPERATED CIRCUIT CONTROLLER

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FIG. 8

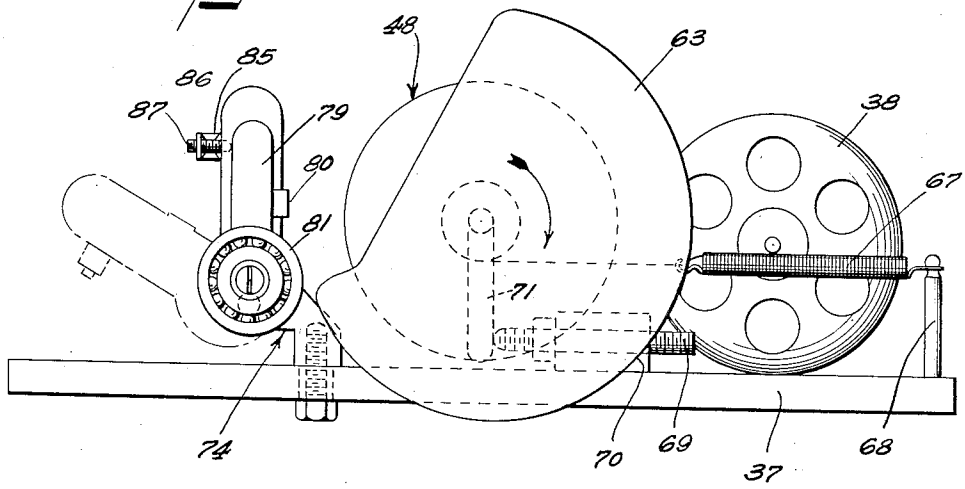
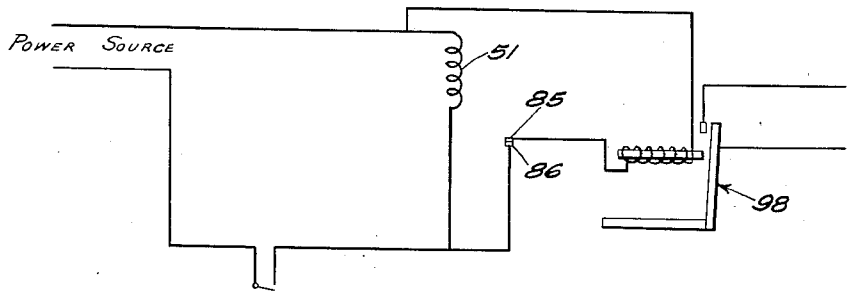


FIG. 9



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UNITED STATES PATENT OFFICE

2,292,911

TIME OPERATED CIRCUIT CONTROLLER

John Frederick Timmons, Cleveland, Ohio

Continuation of application Serial No. 94,993, November 30, 1938. This application July 10, 1939, Serial No. 283,667

4 Claims. (Cl. 200—38)

This invention relates to an improved time operated circuit controller and is a continuation of my application filed August 8, 1936, Serial No. 94,993, allowed November 30, 1938.

One object of the invention is to provide a time operated circuit controller which will be operable for opening and closing an electric circuit after the passage of a predetermined time interval.

A further object of the invention is to provide apparatus of this character wherein the predetermined time interval prior to opening or closing of the electric circuit may be varied within a relatively wide range.

Another object of the invention is to provide a time operated circuit controller having an improved electromagnetic clutch which will be operable for insuring quick response to the time operated mechanism employed for opening and closing the circuit.

A further object of the invention is to provide a time operated circuit controller employing means for indicating a predetermined time interval for opening or closing a circuit, and also means for making a permanent record of given predetermined time settings so that the first means may be set to aline with the second means at any one of the given predetermined time settings so that the circuit may be opened or closed.

A further object of the invention is to provide a time operated circuit controller which lends itself particularly well for use with X-ray machines and which will employ means enabling an X-ray technician or operator to preset the time interval for energization of an X-ray tube in accordance with the requirements of a given X-ray operation so that the X-ray tube will be energized during the preset time interval and will be deenergized at the exact end of said time interval.

A further object of the invention is to provide a time operated circuit controller having a continuously operable synchronized motor, an electromagnetic clutch and a cam operable by energization of the electromagnetic clutch, said cam being engageable with an adjustable switch member for opening or closing contacts controlling an electric circuit, the switch member being adjustable for engaging the cam after the passage of a given predetermined time interval.

A still further object of the invention is to provide a time operated circuit controller having a drum provided with indicia relating to operations to be carried out in a given time interval, and mechanism including a scale having indications for cooperating with the indicia for indicating time required for completing a given operation, said mechanism including a pointer for indicating on the scale a given preset time interval, and means for opening or closing a circuit after passage of the time interval indicated by the pointer on the scale.

Other and incidental objects of the invention not specifically mentioned hereinbefore will become apparent during the course of the following description.

In the drawings forming a part of my application:

Figure 1 is a fragmentary perpective view of my improved time operated circuit controller.

Figure 2 is an enlarged detail perspective view better showing a portion of the drum, together with the meters cooperating therewith.

Figure 3 is a vertical sectional view showing the relationship between the drum and the mechanism for effecting control of the length of the time interval taking place preliminary to shifting certain of the contacts for controlling the electric circuit.

Figure 4 is a schematic diagram showing the entire mechanism.

Figure 5 is an enlarged front elevation showing the meters and the time interval controlling mechanism as they would appear in relation to the drum.

Figure 6 is a top plan view of the operating mechanism.

Figure 7 is a rear view of said mechanism.

Figure 8 is a front view of said mechanism.

Figure 9 is a wiring diagram.

Figure 10 is a detail plan view showing a slightly modified control mechanism.

Referring now more particularly to the drawings, wherein like numerals of reference will be seen to designate like parts throughout the various views, the numeral 1 indicates in general a casing which is of pressed metal or any other desired material. The casing may, of course, be of any shape desired but will be seen to include a cover 2 which is provided with a slanting or inclined front wall 3. The top 2 is formed with a laterally extending opening 4 and said opening communicates at one end with a vertically extending slot 5.

Beneath the cover 2, the casing 1 is provided with a rectangular opening 6 which extends laterally substantially the entire width of said casing. Mounted in the opening 6 is a panel 7 preferably of insulating material. The panel is formed with a plurality of laterally extending slots 8, 9 and 10. Vertically extending slots 11

and 12 are also provided in the opposite ends of the panel. Mounted in the slot 8 is a lever 13, the purpose of which is to control the filament current to an X-ray tube, in a conventional manner. Levers 14 and 15 are mounted, respectively, in the slots 9 and 10 and serve to control the output of an autotransformer which is contained within the casing. It should be understood that the autotransformer and the controls therefor, as well as the filament control, are all of conventional construction. The structure shown may, of course, be varied to suit conditions prevailing at certain installations. A lever 16, in the slot 12, is effective for controlling the power level. The lever 16 may be electrically or mechanically connected to the power level indicator 31 so that the power level indicator will show which position the lever 16 is in high or low power. Connected to the power lever 16 is a switch to effect a range change electrically of millimeter 35. That is meter will be connected on "high" range for high power lever setting and low range for low power lever setting. A lever 17 in the slot 11 serves as an off and on switch.

As best seen in Figures 1, 2, 3 and 5 of the drawings, there is mounted, within the cover 2, a drum 18. The drum 18 is provided at one end with a rotating disc 19 which is formed with a serrated edge 20, which edge projects through the vertically extending slot 5 in the cover for manual engagement. As best seen in Figure 2, the drum 18 is provided with a plurality of spaced lines 21 at one end of each of which is indicia 22 relating to a particular X-ray operation. A plurality of arrows 23 are located adjacent certain indicia and the purpose of these arrows will be set forth in more detail hereinafter.

Mounted in the laterally extending opening 4 in the cover 2, is a meter assembly indicated generally by the numeral 24. The meter assembly, as best seen in Figure 2, comprises a casing 25, which casing is provided with walls 26 and 27 tapered toward their upper ends and meeting at said upper ends to define a relatively thin edge 28 which is located in close spaced relation to the lines 21 on the drum 18. The front wall 27 comprises a lower portion 29 which is of opaque material and an upper portion 30 which may be of glass or other transparent material. The lower portion of 27 which is marked 29 may be provided with adjustment screws mounted in it to permit setting the meter needles on either normal or suppressed zero points. The portion 30 overlies a plurality of meter scales 31, 32, 33, 34 and 35. It should be understood that the meter scales may be associated with meters of any desired type. The meters shown are those used in conjunction with X-ray equipment. More specifically, the meter 31 indicates the power level while the meter 32 is a primary volt meter. The meter 33 is a filament current meter and the meter 35 is employed for measuring the current to the anode of the X-ray tube in the X-ray system. The meter 34 is used for indicating the time duration of energization of the X-ray tube. This meter and the apparatus associated therewith will be fully described hereinafter. The scales 31 through 35 are each provided with graduations in an arcuate path and said graduations are extended by lines 36 to the edge 28 so that certain of them will be alined with indicia located on the drum.

Reference is now had to Figures 3, 6, 7 and 8 of the drawings, wherein is shown in detail the time control mechanism which will regulate the interval of time during which an X-ray tube is energized. It should be understood that although the mechanism has been shown in conjunction with an X-ray tube, it may be employed for controlling energization or the like of any apparatus for any predetermined period of time. The time control mechanism is to be mounted in the casing or cabinet 1 beneath the cover 2 thereof. The time control mechanism includes a base 37 which is rectangular in contour and is mounted, as best seen in Figure 3, in the cabinet on a plane inclined to the vertical. The purpose for mounting the base, with the time control mechanism thereon, in this manner will be hereinafter set forth. Mounted on the base near one end thereof is an electric motor 38 of the synchronous type. The motor is provided with a drive gear 39 which meshes with a gear 40 mounted on a drive shaft 41. Brackets 42 and 43, mounted on the base near the front thereof, support the drive shaft 41, said bracket 43 also defining journaling means for one end of a cam shaft 44, which cam shaft has a pinion 45 rotatable thereabout. The pinion 45 meshes with a driving worm 46 which is carried at the opposite end of the drive shaft 41.

The cam shaft 44 is supported near its other end by a bracket 47 which is mounted on the base and which bracket also serves to mount the elements of an electric magnetic clutch 48. The clutch 48 includes a cup-shaped magnet 49 which has an annular opening 50 in which is mounted a magnet coil 51. The element 49 is located axially of the cam shaft 44 and said cam shaft is rotatable freely through said element. The clutch 48 also includes a driven disc 52 which disc includes a core 53 which is secured to the cam shaft 44 by means of a set screw 54 and a disc portion 55. The driven disc 52 also includes an intermediate non-magnetic ring 56 which is located outwardly, radially, of the disc portion 55, and said driven disc 52 also includes an outer ring 57 of the same material as the disc 55. The driven disc 52 is rotatable with the cam shaft 44 and said disc is limited against inward movement toward the inner face of the magnet element 49 by a roller thrust bearing 58. The electromagnetic clutch assembly 48 also includes a driving disc or ring 59 which includes a ring member of soft iron 60 and a slightly resilient disc 61 which connects the ring member 59 with a hub 62 which surrounds the cam shaft 44. The hub 62 has mounted thereon the pinion 45.

Mounted on the cam shaft 44 at its opposite end is a cam 63 held in position on the shaft by a set screw 64. It will be understood that rotation of the shaft of the synchronous motor 38 will impart rotative movement to the gears 39 and 40, to the drive shaft 41. Rotation of the drive shaft 41 will impart rotation to the pinion 45, whereupon the driving disc 59 will be rotated about the cam shaft. Upon energization of the magnet coil 51 of the magnet element 49, the ring member 60 will be drawn into engagement with the driven ring 52 and the cam shaft will be rotated for rotating the cam. The thrust bearing 58 will limit movement of the hub 53 inwardly so that the driven ring or disc 52 will be prevented from engaging the end face of the magnet. Therefore, during energization of the magnet coil 51, the driving and driven discs will be engaged and the cam will be rotated.

Fitted about the cam shaft 44 adjacent the

rear face of the bracket 47 is a relatively small drum 65. The drum 65 has normally trained thereabout a cable 66 to the opposite end of which is connected a retractile spring 67. The opposite end of the spring is connected to a post 68 on the base 37. The cable 66 cooperates with the drum 65 and the spring 67 for rotating the cam shaft 44 to initial starting position upon deenergization of the magnet coil 51 of the electromagnetic clutch and consequent separation of the driving and driven discs.

An adjusting screw 69, mounted in a bracket 70 on the base near the rear side thereof, engages a tongue 71, shown in dotted lines in Figure 8, which depends from the drum 65. The screw 69 can be shifted for regulating, to a small degree, the position of the cam when in inoperative position.

Mounted above the base 37 on mounting posts 72, which mounting posts are adjustable in elongated openings 73, is a mounting yoke 74. The yoke 74 has its bight portion 75 disposed in parallel spaced relation to the cam shaft 44 and to the electric magnetic clutch assembly. A switch mounting block 76, of insulating material, is swingingly connected between the arms of the yoke 74 by a control shaft 77. The shaft 77 extends through the mounting block 74 and through the arms of the yoke and is counterbored at its outer end to receive, as best seen in dotted lines in Figure 6, a stem 78. The stem 78 carries a lever 79 thereon, which lever extends in substantially vertical alinement with the switch mounting block 76. A spring 80, mounted on the switch mounting block 76 at one side thereof, has its free end engaging the lever and yieldably holds said lever in substantial alinement with said block 76. It should be understood, however, that the lever 79 is movable with respect to the block 76. Carried on the lever 79 at its outer face and rotatable thereon, is an operating bearing 81 of the roller type. The operating bearing 81 is rotatably held on the lever 79 by a screw 82. As will be clearly seen in Figure 6, the operating bearing is disposed in alinement with the edge of the cam 63 so that when said cam is rotated a predetermined distance, the operating bearing will be engaged. A pair of switch members 83 and 84, of spring metal, are mounted on the switch mounting block 76 and are disposed in substantially superposed position one with respect to the other. The switch members carry contacts 85 and 86 respectively, and the switch member 84 carries, at its upper end, an engaging screw 87 of insulating material which is engageable by a side edge of the lever 79. It will be understood that engagement of the operating bearing 81 by the cam will shift the lever 79 and separate the contacts 85 and 86 for opening an electric circuit to a circuit breaker or the like which controls a transformer that furnishes high voltage supply to an X-ray tube anode. It should be further understood that, instead of opening the contacts 85 and 86, they may be so arranged that they will become closed upon engagement of the operating bearing by the cam.

A toggle switch 88 is mounted at the forward side of the base 37 and is provided with a lever 89. The lever 89 is engageable by a control arm 90 carried on a coupling 91, which coupling has one end thereof connected with the shaft 77 and the other end connected with a shaft 92 which, as best seen in Figure 3, extends upwardly beneath the drum and into the meter assembly behind the scale 34. The shaft 92 is provided with a relatively large gear 93 at its upper end. The gear 93 meshes with a pinion 94 carried on a stem 95 which stem extends through the front wall of the meter assembly. A knob 96 is mounted on the end of the stem and is adapted for manual engagement. A pointer 97 is connected with the gear 93 and shaft 92 and, as best seen in Figure 5, is adapted to travel over the scale 34, which is graduated in units of time. It will thus be seen that by rotating the knob 96, the shaft 92 will be rotated for swinging the shaft 77, with the block 76 thereon, in the yoke 74. Swinging of the block 76 will effect swinging of the lever 79 with the operating bearing 81 thereon, toward or away from the edge of the cam 63. The operating bearing and lever are so positioned with relation to the pointer 97 that when said pointer indicates a quarter of a second on the scale 34, the cam will rotate, after energization of the motor 38, and will engage or disengage the contacts 85 and 86 after the passage of the predetermined time interval, i. e., one quarter of a second. The knob 96 may be rotated for positioning the pointer at sixteen seconds, for example. When this is done, the motor is automatically started. Upon energization of the magnetic clutch, the cam will rotate and engage or disengage the contacts after the passage of the sixteen second interval. As soon as the clutch is again deenergized, the spring 67 will return the cam to its original position, when it will be ready for a further operation.

The operation of the invention should be obvious from the foregoing description. However, it is believed that a brief summary will not be out of place. As heretofore stated, the drum 18 is provided with longitudinally extending marked off places throughout its circumference and said marked off places each have thereon indicia relating to an X-ray operation. By again referring to Figure 2 of the drawings, it will be seen that the word "Esophagus" has been written on line 29 on the drum. This means, of course, that data on the line opposite the word "Esophagus" relates to the necessary setting of the X-ray machine preliminary to X-raying the esophagus. One of the arrows 23 will be noted to the left of the word and in line with an arrow on the low side of the power level meter. This, of course, indicates that the esophagus is to be X-rayed at low power. Another of the arrows is seen above certain of the filament current scale markings. For example, above the extended scale marking indicating 3½. This, of course, means that the filament current indicator will be set at this point for X-raying the esophagus. The time indicating meter 34 is set in accordance with an arrow 23 which indicates the proper length of time for energization of the X-ray tube for this operation. On the tube current scale will be placed an arrow indicating the proper current in milliamperes for the X-raying of the esophagus. All that is necessary will be to close the circuit through the auto transformer from a suitable power source, when the motor 38 will be caused to rotate and, of course, as heretofore described, the driving disc 59 will be caused to rotate in the electromagnetic clutch assembly. When the circuit is closed through the magnet coil 51, by means of a suitable push button or other circuit closer, the cam is caused to rotate for the predetermined time interval set on the scale 34, after the passage of which interval the contacts will be opened. It should be understood

that while the contacts are closed the high tension current is being supplied to the anode of the X-ray tube for effecting the desired X-raying operation. When the contacts are opened, after the passage of the predetermined time interval, the circuit breaker in the primary circuit of the high tension transformer will open and the X-ray tube will be deenergized.

The circuit breaker or contactor is shown diagrammatically at 98 in Figure 9, which figure is, of course, a wiring diagram, representing one of several methods in conventional use. As heretofore stated, as soon as the press button is released, the coil 51 is deenergized and the cam shaft will be returned by the spring 67 to the normal starting position so that the machine will be ready for the next X-raying operation. Any number of X-raying operations may be indicated on the drum. The indicators on the meters will, of course, cooperate with the arrows on the drum so that the proper settings for the meters may be assured preliminary to energization of the X-ray tube. The switch 86 is so arranged that energization of the X-ray tube may not take place until the operator has turned the time control to a predetermined setting. In this manner, danger of injury to the X-ray tube is prevented.

In order to obtain a rapid understanding of the operation of the time control mechanism, Figure 4 has been inserted. This figure, as heretofore stated, is a schematic diagram. It discloses the entire path of the operation from the synchronous motor through the reduction gearing and magnetic clutch to the cam, which is engageable with the operating bearing for swinging the lever and energizing the X-ray tube for a predetermined time interval, which time interval will be varied by movement of the lever with respect to the cam.

Referring to the modification of the invention, as shown in Figure 10 of the drawings, the numeral 100 indicates a portion of a drum which is of identical construction to the drum 18. The drum 100 has lines 101 thereon which are adapted to confront an edge 102 of a casing. Instead of employing meters, as shown in the preferred embodiment of the invention, I employ, in this embodiment, a plurality of contacts 103 which are selectively engageable by a switch arm 104 which is operated by a knob 105. The contacts 103 have lines 106 extending therefrom to the edge 102 so that said lines may be alined with arrows on the drum for indicating proper settings for an X-ray tube for operations, indicia relating to which is carried on the drum. Summarizing, the modification of the invention merely discloses an alternate form of control for filament current or the like, which alternate form will cooperate with the drum in the same manner that the scales of the meters in the preferred form will cooperate with said drum.

Having thus described the invention, what I claim is:

1. In a time operated circuit controller, a motor, a cam shaft, a driving ring rotatable about the cam shaft, means for transmitting continuous constant speed rotative movement from the motor to the driving ring, a driven ring fixed on the cam shaft, electromagnetic means operable for locking the driving ring to the driven ring for imparting rotative movement to the cam shaft, a cam fixed on the cam shaft, switch mounting means, switch members on the means and having contacts, a lever associated with the switch mounting means and movable therewith and engageable with one of the switch members, and means connected with the lever and engageable with the cam upon rotation of said cam a predetermined distance for shifting the lever and the contacts for controlling an electric circuit.

2. In a device of the class described, a switch mounting block, switch members mounted on the block, a yoke for adjustably mounting the switch mounting block on a supporting surface, a lever associated with the mounting block and movable with respect thereto, said lever being engageable with one of the switch members, a bearing carried by the lever, an electromagnetic clutch including a magnet, a driving ring and a driven ring, a cam shaft extending through the clutch, means anchoring the driven ring to the cam shaft, a thrust bearing between the driven ring and the magnet for limiting movement of the driven ring and driving ring toward the magnet, a motor, means for imparting rotative movement from the motor to the driving ring, a cam on the cam shaft, said magnet being energizable for shifting the driving ring into engagement with the driven ring for imparting rotative movement to the cam shaft and cam whereby the cam will be caused to rotate for engaging a portion thereof with the bearing for shifting the lever and shifting one of the switch members for controlling a circuit, and means on the cam shaft operable for returning the cam and cam shaft to original inoperative position upon deenergization of the magnet, said switch mounting block being movable for shifting the bearing toward or away from the cam for enabling a predetermined time interval to elapse before engagement of said switch member.

3. In a device of the class described, a motor, a cam shaft, an electromagnetic clutch associated with the cam shaft and including a magnet having a winding, a driven ring connected with the cam shaft and disposed adjacent the magnet, a driving ring rotatable about the cam shaft, means for imparting rotative movement from the motor to the driving ring, means for limiting inward movement of the driving and driven rings toward the magnet, energization of the winding of the magnet effecting electromagnetic connection between the driving and driven rings for imparting rotative movement to the cam shaft, a cam on the cam shaft and engageable with the cam after the passing of a predetermined period of time for controlling an electric circuit.

4. In a device of the class described, a motor, a pair of cooperating contacts, an electromagnetic clutch including a magnet, a driven ring and a driving ring, said magnet having a winding, a cam shaft extending through the magnet and through the driven ring and driving ring, means connecting the driven ring with the cam shaft, a cam carried by the cam shaft, means for imparting rotative movement from the motor to the driving ring whereby upon energization of the winding rotative movement will be transmitted to the cam shaft through the driven ring, a cam on the cam shaft, and means engageable with the cam and movable for shifting certain of the contacts and changing their normal contact relationship, said last mentioned means being shiftable toward or away from the cam for predetermining the time interval for changing the normal contact relationship.

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