May 16, 1933. M. G. BENJAMIN 1,908,947

RECORDING MECHANISM FOR POWER INSTRUMENTS AND METERS

Filed March 6, 1928 3 Sheets-Sheet 1

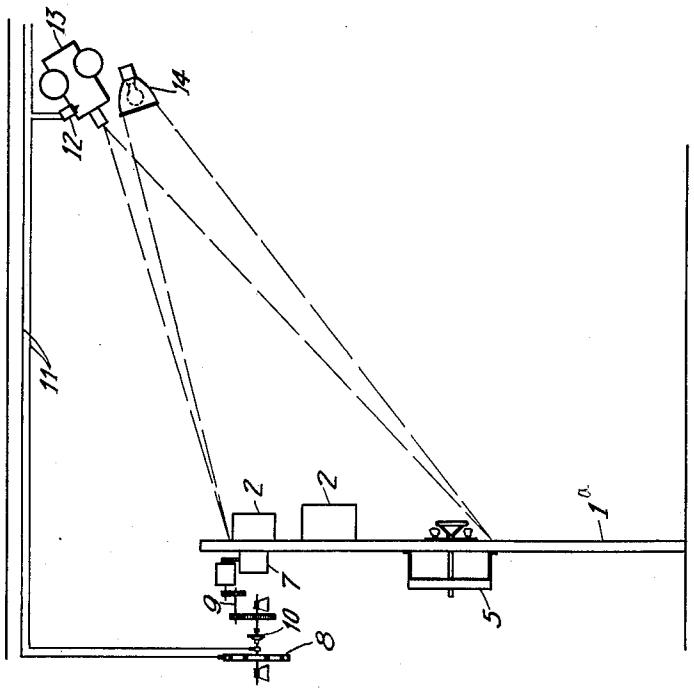


Fig. 1.

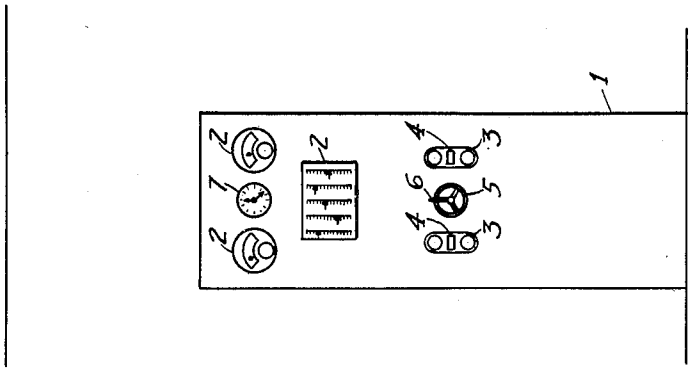


Fig. 1a.

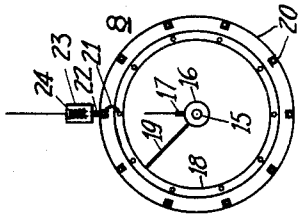


Fig. 2.

M. G. Benjamin
INVENTOR.

May 16, 1933. M. G. BENJAMIN 1,908,947

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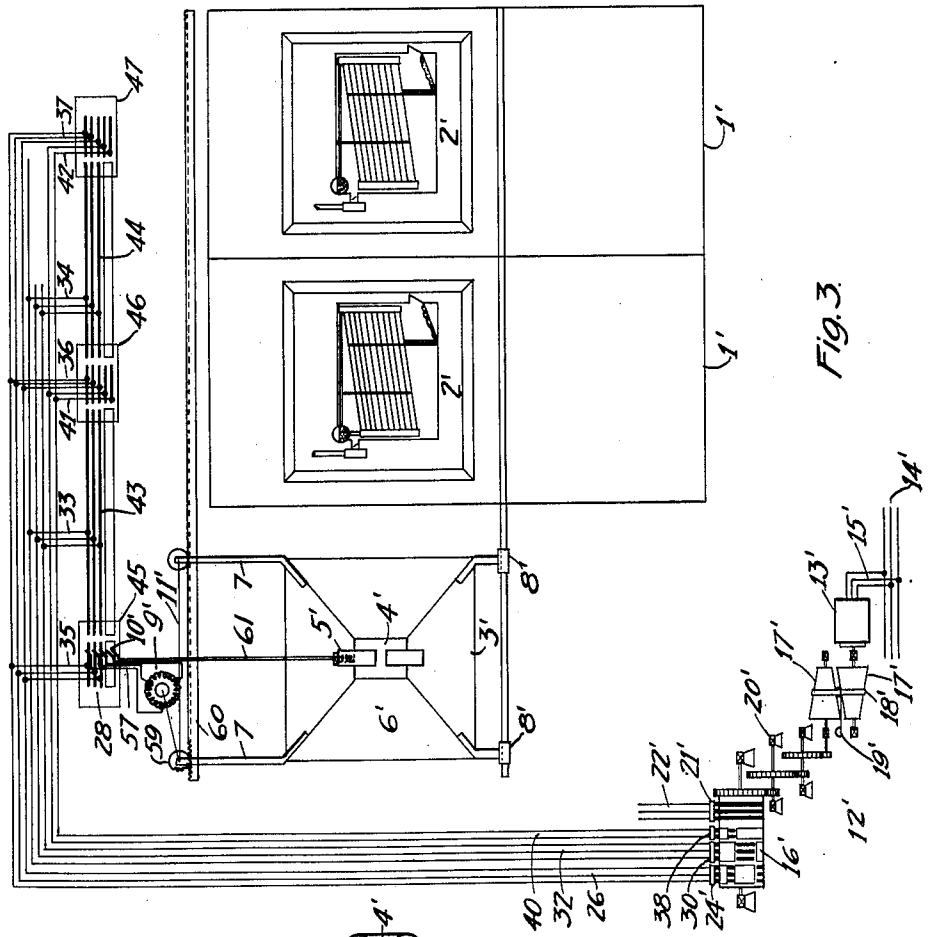


Fig. 3.

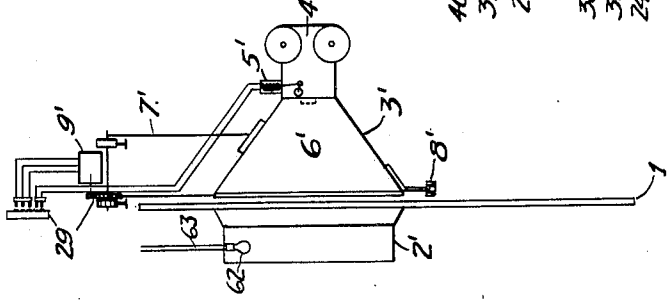


Fig. 3a.

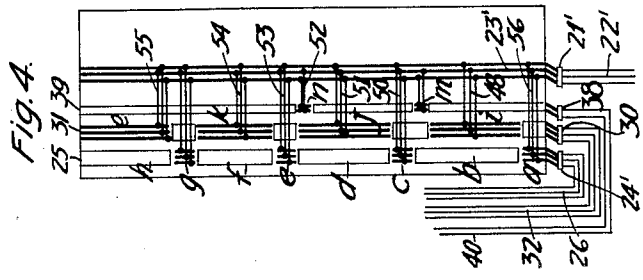


Fig. 4.

M. G. Benjamin
INVENTOR.

May 16, 1933. M. G. BENJAMIN 1,908,947

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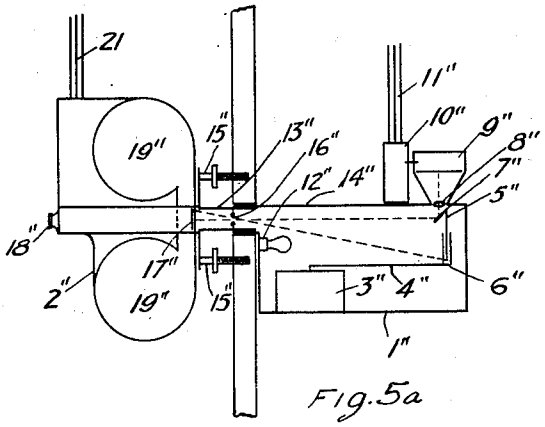


Fig. 5a

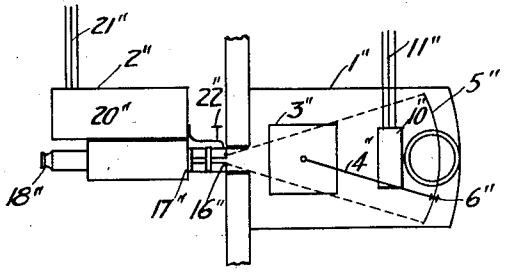


Fig. 5.

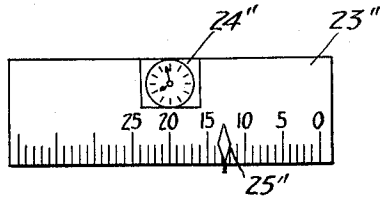


Fig. 6.

M. G. Benjamin
INVENTOR

Patented May 16, 1933 1,908,947

UNITED STATES PATENT OFFICE

MERRILL G. BENJAMIN, OF LAKEWOOD, OHIO

RECORDING MECHANISM FOR POWER INSTRUMENTS AND METERS

Application filed March 6, 1928. Serial No. 259,447.

The present invention relates to improvements in the method of recording the readings and indications of power instruments, meters, and other presentable indications of the operating functions of power apparatus and machinery, for example, the indicating apparatus of a steam boiler as described in my copending application No. 254,915, dated February 19, 1928. The condition of other instrument and control boards may be recorded, as, for example, the control panels of a turbo-generator or the distribution panels of an electric power system—in fact any set, group or system of meters and indicators as well as any group or system of operative apparatus such, for example, as a group of oil switches or high tension switch apparatus.

The invention is illustrated as embodied in connection with instruments and instrument boards of steam boilers, one of the instrument boards being similar to that described in my copending application No. 254,915, and consisting of a diagrammatic or small scale representation of the main boiler unit having its elements operatively connected with the main unit in such a manner as to afford a presentable indication on the diagrammatic unit of the various functions of the main unit together with the condition or position, or both, of operative elements of the main unit. For the purpose of this description, the instrument unit is illustrated as being recessed in a steel panel and arranged so that the unit can be illuminated artificially from the rear, facilitating ready observation by the operator and providing a clear space for passing the hood of an automatic camera for photographing the unit at intervals.

The novel feature of this invention consists in the means for recording the indications as presented by indicating instruments and apparatus referred to. This means is illustrated in this case as an arrangement for passing a camera over the panel board to a point from which a photograph of the indicators can readily be made. The movements of the camera are controlled by means of an electric clock or other mechanism for accurately timing such operations. Means are provided within the camera for illuminating the instrument board or indicators. The camera illustrated is of the motion picture type using a film roll which is readily removable daily or at other convenient intervals. The shutter of the camera is automatically controlled so that one or more exposures of the object may be made at one setting. This is a desirable feature as conditions exist frequently, during rapidly changing loads, such that accurate records of the magnitude and characteristics of these changes would be highly important while, for ordinary conditions, a record consisting of single exposures at intervals of several minutes might be sufficient.

For a complete understanding of the invention, reference is made to the accompanying drawings in which

Figure 1 is a diagrammatic illustration, with parts in side elevation, of a preferred embodiment;

Figure 1*a* is a front elevation of the instrument panel shown in Figure 1;

Figure 2 is an enlarged view of a detail;

Figure 3 is a diagrammatic illustration, with parts in front elevation of a modified form;

Figure 3*a* is a side elevation of the panel and camera shown in Fig. 3;

Figure 4 is a development of the contact drum shown in Figure 3;

Figure 5 is a top plan view of a further modified form;

Figure 5*a* is a side elevation thereof; and

Figure 6 is an illustration of the record produced by the apparatus shown in Figures 5 and 5*a*.

In the attached drawings Figs. 1 and 1*a* show a metering panel board generally indicated by reference numeral 1. Various styles of electrical or mechanical meters are indicated by numerals 2. Indicating control switches are shown at 3, the indicators being shown at 4. 5 indicates an ordinary field rheostat as might be used on a generator field with an indicator 6. 7 indicates a clock, the face being visible from the front of the board and the mechanism contained in a case mounted on the rear of the panel. To the mechanism of the clock is geared a contact disc 8 through an ordinary train of

gears 9 insulated by insulating coupling 10. Contact disc 8 is connected in series by lines 11 with a source of electric current and solenoid 12 for operating the shutter of a motion picture camera 13. Electric lamp 14 is indicated as being part of the camera installation for illuminating the panel board.

Fig. 2 is a detail of the contact disc 8 of Fig. 1. This disc is of insulating material and has mounted on its shaft 15, contact ring 16 on which bears brush 17. Connected to this contact ring 16 is annular ring 18 by means of connection 19. Arranged around the circumference of the contact disc are a series of contact inserts generally indicated by reference numeral 20. Each contact insert is drilled for receiving a jumper plug 21, the other end of which is received by a similar hole drilled in the annular ring at a point opposite. Arranged to make contact with these contact segments is brush 22 with its brush holder 23 and spring 24. By means of the gearing the contact disc is driven at a speed, for example, of 1 revolution in 10 minutes. If one contact insert is connected to annular ring then the circuit in which solenoid 12 of the camera is connected will be closed once every 10 miuutes, making only one exposure every 10 minutes. The purpose of the additional contact inserts is to provide a means of varying the number of exposures taken in a given interval of time. This may be accomplished by adding jumpers at proper points.

Figs. 3 and 3*a* illustrate in diagrammatic form a recording device for a plurality of units wherein a single camera is used to record the indications of one or more groups of indicators as might be the case where, for example, a number of boiler units were equipped with indicating meters as described in my copending application No. 254,915, of February 16, 1928. These meters mounted on their panels are indicated generally by reference numeral 1′. The indicator itself is shown at 2′ as being recessed into its panel. 3′ indicates generally the camera assembly including the camera 4′ with its solenoid operated shutter 5′, hood 6′, trolley suspension 7′, guide rollers 8′, operating motor 9′, collector brushes 10′ and driving gear 11′. Reference numeral 12′ generally indicates the timing and controlling mechanism which consists of a motor 13′ which is connected to the power system wiring 14′ by a three-phase connection 15′. Connected to motor by suitable shafts and couplings is a drive mechanism for varying the speed of the control drum 16′. This speed control consists of two cone pulleys 17′ placed with their tapers opposite and connected by a belt 18′ which may be shifted and held to any desired position by shifter 19′. An ordinary train of gears 20′ then connects the drive to contact drum 16′ which would be driven at approximately 1 revolution in 10 minutes for the purpose of this arrangement.

The control of the operation of the camera begins with the contact drum 16′ which takes power in this illustration from a three phase circuit by means of contact brush 21′ and its connections 22′. In order to better disclose connections on this drum a development of the drum surface with its circuits is shown in Fig. 4. Here contact brush 21′ with its connection to three phase source of power is indicated by 22′. Continuous contact strips around the drum are indicated by 23′. Contact brush 24′ bears on contact strips 25 which are live at "*a*", dead at "*b*", live at "*c*", dead at "*d*", live at "*e*", dead at "*f*", live at "*g*" and dead at "*h*". The external three phase leads 26 connect to trolley bars 28 at points 35, 36 and 37, supported by bracket 29 of Fig. 3. Contact brush 30 connects to contact strips 31 of drum 16′. These strips are live only at sections "*i*", "*j*", "*k*" and "*l*". The external three phase connections 32 of brush 30 connect to trolley bars at points 33 and 34 shown in Fig. 3. Contact brush 38 is a single phase brush and connects to contact strips 39 of drum 16′. These contact strips are live only at points "*m*" and "*n*". The external connections 40 of brush 38 lead to contact bars at points 41 and 42 of Fig. 3. Trolley bars 28 of Fig. 3 it will be noticed are divided into sections consisting of the running sections 43 and 44 and short operating sections 45, 46 and 47 which are completely insulated from running sections. It will be noticed also that contact strips 23′ of Fig. 4 which are energized through brush 21′ are the feeders for the other sections on contact drum being connected to these sections by cross connections 48, 50, 51, 52, 53, 54, 55 and 56, and other connections not numbered.

The operation of the system is as follows: As the drum 16′ is rotated brush 24′ comes in contact with live section "*a*" of contact strip 25. This energizes trolley bars of section 45 through connections 35, which, in turn, energizes motor 9′ through its connections 57 on collector brush 10. Motor 9′ is indicated as being a three phase squirrel cage type. Motor 9′ then rotates and drives through suitable gearing to geared drive wheel 59 which engages rack 60. This causes the camera unit 3′, through its hangings 7′, 7′, to move toward indicator panels 1′, brush 10′ moving onto trolley section 43. Meanwhile drum 16′ has turned causing brush 24′ to move off contact section "*a*" onto section "*b*", also causing brush 30 to come in contact with live section "*i*" of contact strips 31. Through connections 32 and 33 trolley section 43 becomes energized and consequently motor 9′ is energized through its connections and brushes as before. Since the connections are in the same rotation as in the first posi-

tion motor will rotate in the same direction causing camera unit to move on until brush 10′ is over trolley section 46. At this time section 46 is not energized as brush 24′ which feeds this section through connections 26 and 36 is on the dead section "*b*" of contact bar system 25. This causes camera unit to stop. Live section "*m*" of contact bar system 39, however, has come in contact with brush 38 which energizes single phase leads 61 through connections 40 and 41, single phase brushes of brush system 10′, causing solenoid 5′ to operate shutter of camera 4′. At this time live section "*c*" of contact strip section 25 has come under brush 24′ energizing three phase circuit of trolley section 46 which causes motor 9′ to drive camera unit to position 44. Trolley section 44 is now energized through live section "*j*" of contact strip system 31, brush 30, connections 32 and 34. This causes camera unit to move to position opposite indicators on next panel. At this time as before single phase trolley bars are energized through live section "*n*" of contact strip system 39, brush 38, connections 40, 42 and 61 to operate solenoid 5′ on camera shutter.

At this time live section "*e*" of contact strip system 25 comes under brush 24′ energizing motor 9′ through connections 26 and 37, brushes 10′ and connections 57. It will be noted, however, that the cross connection 52 from distributor bars 23′ to section "*e*" are reversed from those of sections "*a*" and "*c*". This reversal of one phase causes motor 9′ to rotate in the opposite direction moving camera unit back toward its starting position its brushes 10′ coming in contact with trolley section 44 which is now energized by having brush 30 come in contact with live section "*k*" of contact strip system 31. Section "*k*" it will be noticed is connected in the same phase relation as section "*e*" which causes motor 9′ to continue rotation in the same direction moving its brush 10′ onto trolley section 46 which is energized as was section 47 but by contact section "*g*" of contact system 25. Here the same phase relation exists causing motor 9′ to continue driving camera unit on to trolley section 43 which is energized as was section 44 but by contact section "*l*" of system 31. The phase relation being the same in this case motor 9′ continues until its brush 10′ comes into contact with trolley bar section 45 which is now dead as the system feeding this section through brush 24′ is in contact with dead contact strip section "*h*" of contactor strip system 25. The operation is repeated when drum rotates to bring brush 24′ into contact with section "*a*" again.

Figs. 5, 5*a* and 6 illustrate still another form or embodiment of my invention in the combination of an indicating meter or instrument with a photo recording device built as part of the instrument. Figs. 5 and 5*a* show a plan and elevation of the device consisting generally of indicating instrument 1″ and automatic camera 2″. The indicating instrument shown is the usual form of a horizontal edgewise type of electrical meter. The usual form of mechanism familiar to those skilled in the art is indicated at 3″. The hand or pointer of the instrument is indicated by 4″. The indicating scale is shown at 5″. This scale is shown attached to the upper part of enclosing case and for the purpose of this instrument has a scale visible both front and rear. It will be noticed that the pointer 4″ has a double target 6″ so that one target is visible to the front of the scale and the other is visible to the back. Arranged at the center and upper part of scale 5″ is a mirror or prism 7″, a lens 8″ and a clock 9″ driven by a motor 10″ having leads 11″ for connection to a source of electric power. An electric lamp or source of light within the instrument case is indicated at 12″. The camera unit 2″ is so mounted that its tube 13″ fits within an extension of the case 14 of the instrument 1″ and is adjustable by means of attachment screws 15″. Camera tube 13″ carries a shutter and a lens or orifice 16 and a slot 17″ for inserting ground glass for focusing camera by means of a view finder having an eyepiece 18″. The film reels are contained in camera housing indicated at 19″. A motor with timing and operating gear similar to that illustrated in Figs. 1 and 2 is contained in a case 20″. Connections to a source of electric power are indicated at 21″.

In Fig. 6 is indicated the view of instrument scale and clock which is presented to the camera and which is photographed automatically or at will by pressing a manual shutter trigger 22″ shown in Fig. 5. Reference numeral 23″ indicates scale of meter, 24″ the view presented in mirror of clock and 25″ the target of instrument pointer.

"Chart" as used herein means any surface such as a screen, ground glass, board, or sheet of paper or film upon which the image of the record may become visible.

"Function of a power unit" as used herein would mean in the case of a turbo-generator, the voltage, current, frequency, or any two or more of these functions.

"Time schedule" as used herein is to be considered to mean any predetermined timing, as for example one exposure every minute between 7 A. M. and 10 A. M., one exposure every 3 minutes until 11:30 A. M., etc.

No attempt has been made in these specifications to illustrate features or devices which are well understood in the art, as for instance the motor and clock, motion picture camera, shutter mechanism, etc. The motor and clock is simply used as a convenient device for keeping accurate time and timing the operation of novel mechanisms herein

described. The motion picture camera and its operating mechanism is not a part of this invention and is well understood, hence, no detail is given, it being merely used as a convenient means of illustrating my novel arrangement for recording various indications.

For the sake of simplicity, the drawings have been made largely diagrammatic. It is to be understood that the invention is not to be limited to its preferred embodiment but that the various instrumentalities diagrammatically illustrated may be variously constructed, and that the invention may be embodied in other structures within the scope of the invention as defined in the following claims.

I claim:

1. In a recording system, means for indicating the condition of power apparatus, a movable camera, and means for controlling the movements of the camera to bring it successively into proper focus with certain of said means, in accordance with a predetermined time schedule, and means for automatically operating the camera.

2. A recording system having groups of indicators for a plurality of power units, a camera, automatic means for moving the camera into focus with successive indicators and means for automatically operating the camera, when brought into position to photograph one of said indicators.

In testimony whereof, I have hereunto set my hand.

MERRILL G. BENJAMIN.