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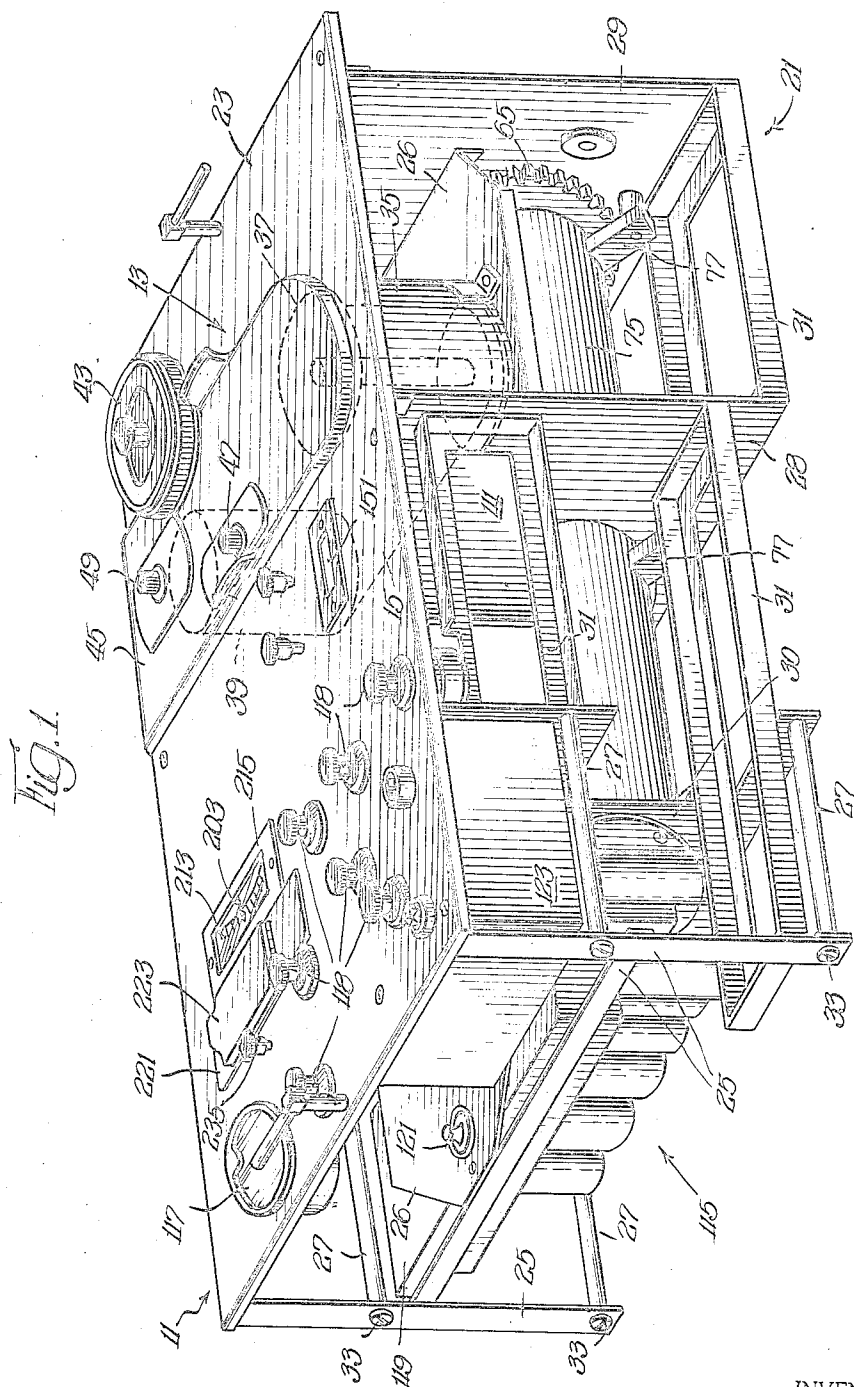
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2,438,341

ELECTRO-CARDIOGRAPH

Filed Aug. 27, 1942

4 Sheets-Sheet 1



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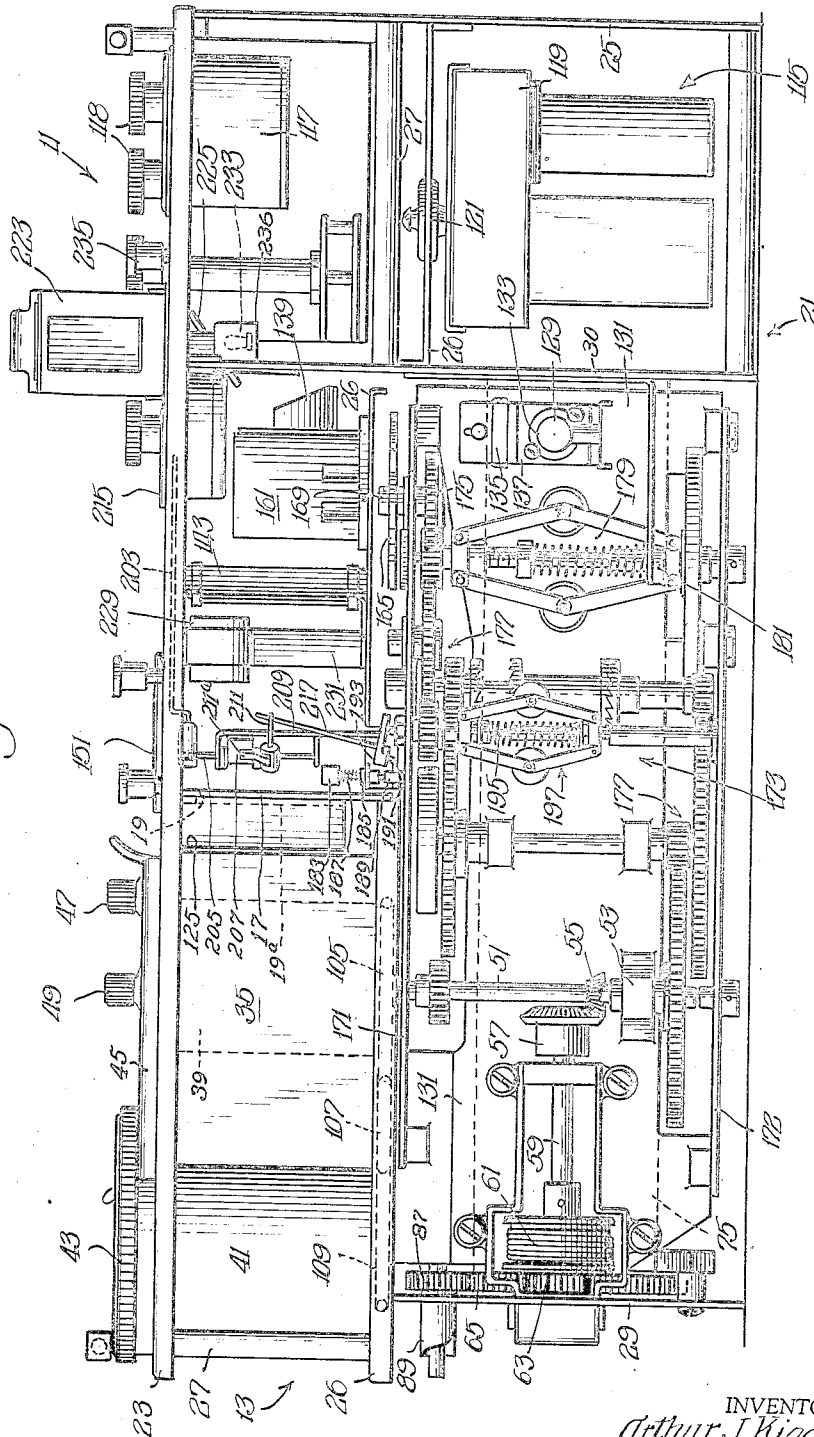
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4 Sheets-Sheet 2

Fig. 2



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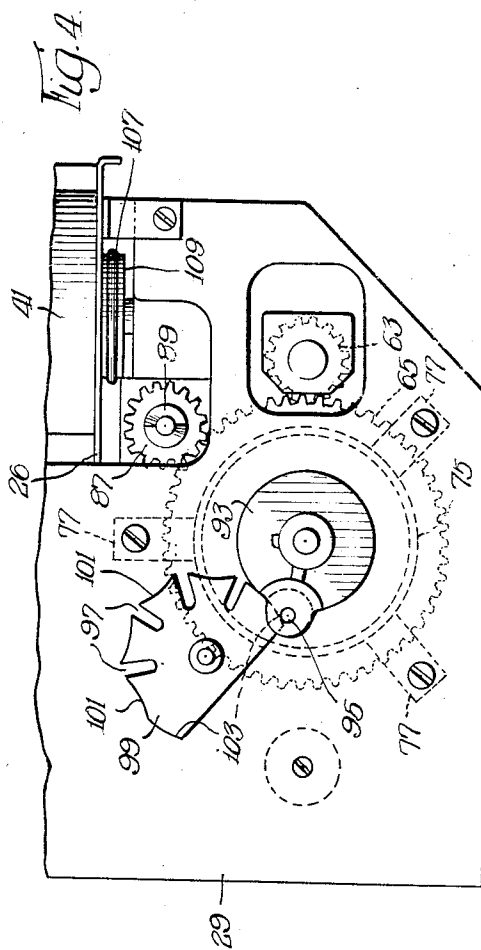
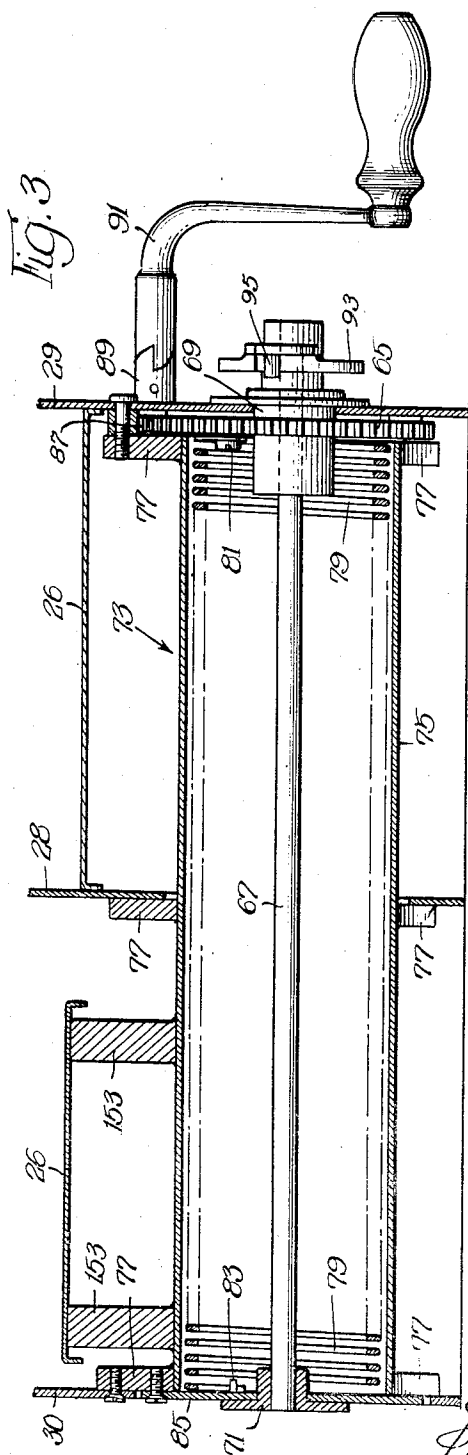
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Filed Aug. 27, 1942

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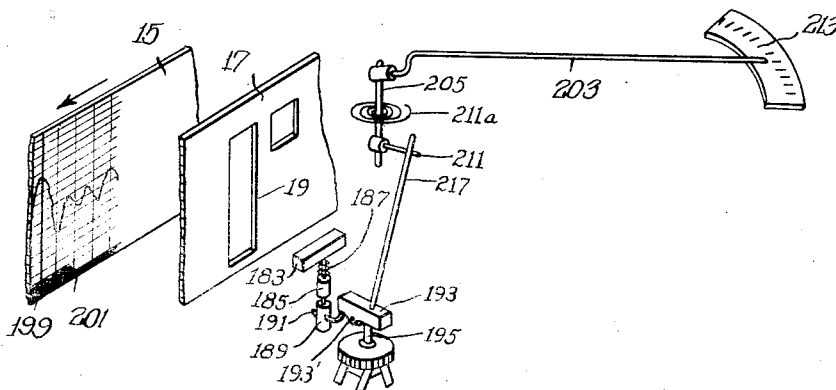
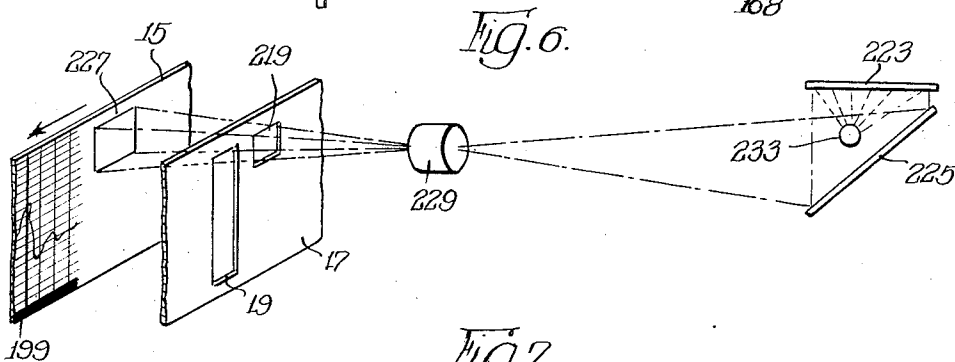
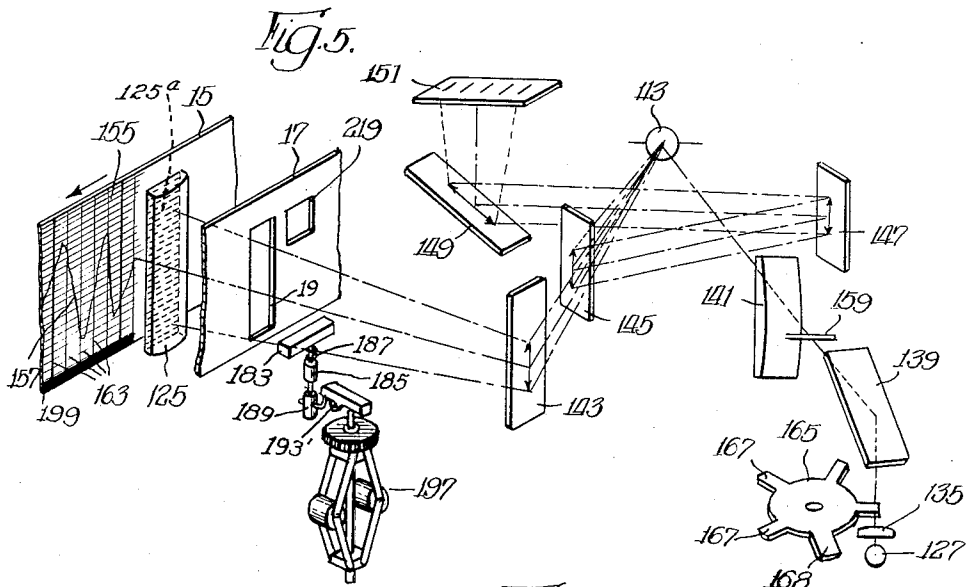
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4 Sheets-Sheet 4



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2,438,341

ELECTROCARDIOGRAPH

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Application August 27, 1942, Serial No. 456,373

5 Claims. (Cl. 234—60)

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The present invention relates in general to indicating and recording apparatus and has more particular reference to oscillographs, the invention pertaining specifically to electro-cardiographic apparatus.

Recording apparatus of the character mentioned ordinarily comprises motor mechanism for reeling a strip of sensitive material at uniform speed past an exposure window and electrical equipment for converting the fluctuating impulse to be pictured to an oscillating beam of light and applying such beam to the strip of sensitive material in order to apply a graph on the strip and thereby picturize the fluctuating impulses to make a record of the same.

The apparatus for creating the fluctuating light beam, particularly where minute fluctuations are involved, is of exceedingly sensitive character and jars or other vibrations applied to the apparatus may be impressed as extraneous vibration of the light beam, thereby producing errors in the record on the sensitive film unless care is taken to prevent such unwanted vibration in the apparatus; and it is an important object of the present invention to minimize vibration in apparatus of the character mentioned.

Another important object is to provide spring driven motor means for reeling a record strip in apparatus of the character mentioned, and to provide a frame or mounting for the motor means, which mounting forms an integral part of the framework on which other elements of the recording apparatus are supported; a still further object being to form the motor mount as a tubular member extending longitudinally and preferably centrally of the framework of the apparatus to thereby rigidify and strengthen the same and thereby avoid unwanted vibration in the recording apparatus when the same is in operation.

Another important object is to provide an improved spring motor comprising a helical spring anchored at one end on the frame of the apparatus and supported and enclosed within a tubular motor housing, the other end of the spring being drivingly connected with a winding and driving gear which overlies and closes the other end of the tubular housing.

A still further important object resides in utilizing a segmental Geneva wheel escapement for limiting the turning movement of the winding and driving gear in either direction to prevent over-tensioning of the spring by excessive winding and also for preventing the motor from operating after the spring has become unwound to the extent that the driving effect thereof is insufficient to maintain the driven winding apparatus in operation at a desired rate of speed.

Still another important object is to provide means for establishing the fluctuating influence to be recorded as a fluctuating or oscillating black-

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cut zone within a field of light, said field of light containing the blackout zone shifting therein being applied to the sensitive strip at the exposure window whereby all of said strip in said window is exposed to light except in the area thereof that is blacked out.

Another important object is to provide for entirely blacking out the beam applied to the record strip through the exposure window in order to form thereon a vertical line of width corresponding to the blackout period, such line comprising the portion of the moving strip that is unexposed to light through the exposure window during the blackout period; and such lines forming a time gauge on the record strip indicating a unit of elapsed time between adjacent lines.

Another important object is to provide means for impressing a speed indicating record on the recording strip as the same is drawn past the exposure window to show the place or places at which the rate of travel of the record strip changed, no matter how slightly; a further object being to utilize a blocking member movable in the exposure window preferably at an end thereof, said blocking member being movable in the window in response to the operation of a speed governor, the member being movable into the window from the edge thereof in proportion to the speed of movement of the record strip as determined by the governor, thereby screening the edge portions of the record strip from light rays and producing an unexposed marginal portion in said strip, the thickness of which unexposed marginal portion varies with the speed of travel of the strip past the exposure window.

Another important object is to produce a fluctuating blackout zone in a light beam by establishing the beam at a stationary light source and directing the beam past a stationary blocking rod so that the beam including the shadow of the blocking rod falls upon an oscillating mirror, thereby reflecting the shadow of the rod as an oscillating blacked out portion on the light beam.

Another important object is to periodically interrupt the light beam by rotating an interrupter wheel, preferably at uniform speed across the path of the beam, said interrupter wheel having outstanding blades or fingers adapted each to interrupt the light beam while lying in its path.

Another important object is to provide means for photographing identifying indicia upon the record strip; a further object, in this connection, being to utilize a card holder adapted to receive a typewritten or otherwise marked card in position to be illuminated and a light image thereof cast, as through a suitable lens, upon the sensitive record sheet to thus photograph the image of the written card on the record strip.

These and numerous other important objects and advantages, and inherent functions of the

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invention will be fully understood from the following description, which taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a perspective view of apparatus embodying the present invention;

Fig. 2 is a rear side view of the apparatus shown in Fig. 1;

Fig. 3 is a sectional view illustrating a portion of the apparatus shown in Figs. 1 and 2;

Fig. 4 is a view of the structure shown in Fig. 3 seen from the right hand end thereof;

Fig. 5 is a perspective view of a lens and mirror system employed in the device shown in Figs. 1 and 2;

Fig. 6 is a perspective view of means for recording identifying indicia on the record strip; and

Fig. 7 is a perspective view of speed indicating and recording apparatus.

To illustrate the invention, the drawings show indicating and recording apparatus 11 (Figs. 1 and 2) comprising an electrocardiograph embodying winding mechanism 13 for moving a record strip 15, at uniform speed, in the direction illustrated by arrows in Figs. 5, 6 and 7, behind a side wall 17 of a light-proof housing 35. The side wall 17 is formed with a window 19 through which the strip is progressively revealed for exposure.

The side wall 17 also forms a part of a framework 21 of exceedingly rigid construction and is preferably made of metal. Upon the side wall there is mounted operating and control mechanism for applying a beam of light, progressively modulated in accordance with the characteristics of an impulse to be recorded on the film. This mechanism is arranged to apply the light beam through the window 19 and upon the film to thereby make a record of such impulse.

The framework 21, in the illustrated embodiment, includes a top panel 23 upon which some of the parts of the apparatus are mounted. In addition, the framework comprises bars 25, rods 27, plates 26, end panel 29, intermediate panels 28 and 30, and sheet metal bracing members 31. All of these parts are interconnected as by welding or other suitable fastening means including screws 33, to form a rigid frame work for the support of the elements of the indicating and recording apparatus.

The frame work 21 embodies a housing 35 of light proof construction within which the record strip is enclosed for exposure. Prior to exposure the unexposed record strip is supported on a storage reel 37 at one end of the housing 35, the record strip being progressively drawn from the reel 37 past the window 19 where it is exposed and thence around a film roller 39 at the opposite end of the housing 35. From the roller 39 the exposed film is delivered through a light proof slot in the housing 35 into a casing 41 containing a receiving reel for the exposed film. The top of the casing 41 is normally closed by a removable cover 43 to permit removal of the exposed record strip for processing. The housing 35 opens at its top through the panel 23 and is normally closed by a light proof cover 45. A control knob 47 extends through the cover 45 and through manipulation of a rack and pinion, serves to operate a slide 19a on the wall 17 for the purpose of varying the width of the exposure window 19.

An indicator knob 49 may be drivingly connected with the roller 39 through a friction clutch.

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This knob 49 may project upwardly of the cover 45, and said knob and cover may carry cooperating indicator means such as an index mark on the periphery of a flange portion of the knob in position to sweep over or adjacent an indicating scale formed on the cover 45. The knob 49, because of its friction drive connection with the roller 39, may be adjusted for zeroizing purposes, in order to show the length of the record strip that may have passed the window during an exposure operation.

In order to draw the record strip at uniform speed past the window 19, the roller 39 is drivingly connected with a shaft 51 which extends downwardly thereof through the bottom of the housing 35. This shaft is suitably journaled, as at 53, on the frame work 21 and is provided with a pinion 55 making driving connection with a gear 57 on a shaft 59 which is also suitably journaled in the frame work 21. The shaft 59, through a spring actuated clutch mechanism 61, is drivingly connected with a pinion 63 which meshes with a gear 65. This gear, as shown in Figs. 3 and 4 of the drawings, is fastened on a shaft 67 journaled, as at 69, at its gear carrying end, in the panel 29 of the frame work, said panel being illustrated at the right hand end of Fig. 1 of the drawings. The other end of the shaft 67 is journaled, as at 71, in a cover plate 85 mounted in the panel 30. The gear 65 is driven by a spring motor 73 comprising a tubular housing 75 which is connected at its ends to the panels 29 and 30 and to the intermediate panel 28 through which said tubular housing extends. The housing is rigidly fastened to each of the panels by means of outstanding lugs 77 formed thereon. Thus the housing of the motor constitutes an integral part of the frame work 21, thereby utilizing the tubular housing as a longitudinally extending bracing member rigidifying the frame and making for an exceedingly sturdy structure.

Within the tubular housing 75, and loosely supported thereby, is a helical spring 79, one end of which is fastened, as at 81, to the inner face of the gear 65 which is positioned across the open end of the tubular housing 75 and between said end and the panel 29. The other end of the spring 79 is fastened, as at 83, to the frame work but to a plate 85 which closes said end of the tubular housing, the plate 85 being rigidly secured in the intermediate panel 30 of the frame work 21.

In order to tension the spring 79 the panel 29 supports a pinion 87 fitted with a stem 89 forming a dog clutch for the removable reception of and connection with a handle or crank 91. The pinion 87 is in driving engagement with the gear 65, so that by turning the crank 91 the gear 65 may be caused to turn in a direction tensioning the spring 79. The gear 63 also is turned during the cranking operation, but slippage in the spring clutch 61 prevents operation of the film driving mechanism.

In order to prevent undue tensioning of the spring 79, the shaft 67, outwardly of the panel 29, as shown in Figs. 3 and 4, is provided with a hub 93 carrying an eccentric pin 95 in position to engage successive slots 97 of a segmental Geneva wheel 99, the peripheral edges of which intermediate the slots 97 are curved, as at 101, to ride upon the circular surface of the hub 93. The wheel 99 is segmented or cut away on one side, along a line spaced from the axis of the wheel, whereby said wheel comprises a curved pe-

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ripheral edge portion in which the slots 97 and curved portions 101 are formed, the said line of segmentation defining the opposite ends of said curved peripheral edge portion of the wheel. The said opposite ends of the curved peripheral edge portion of the segmental wheel 99 are unslotted to provide shoulders 103 to engage the pin 95 and prevent further turning movement of the shaft 67 whenever the spring 79 reaches a desired tension, either in being wound up or in being unwound, when driving the recording apparatus.

The shaft 51 is directly connected with the strip driving roller 39 and carries a pulley 105 which extends beneath the bottom of the housing 35. The pulley 105 is connected by means of a belt 107 with a pulley 109 which extends beneath the bottom of the casing 41 and which is drivingly connected with the strip receiving reel in said casing. The intermediate portion of the frame work 21 carries galvanometer means 111 (Fig. 1) supported rigidly on one of the frame elements 31 at one side of the frame work. This galvanometer comprises a reflecting mirror 113 (Fig. 5) mounted for oscillating movement about a horizontal axis. The galvanometer also comprises means for oscillating the mirror accurately in accordance with impulses applied on the galvanometer. The end of the frame work 21, remote from the winding mechanism 13 supports electrical equipment 115, indicated in Figs. 1 and 2, including an indicating meter 117, mounted on the panel 23, and suitable operating knobs 112, for controlling the equipment 115, which knobs are conveniently exposed upwardly of the panel 23. The electrical equipment is yieldably supported on a sub-frame 119 as on rubber supports 121 secured in one of the plates 26 forming the frame work. The apparatus also includes electrical apparatus enclosed in a box 123 which is supported in the frame work under the panel 23.

The electrical equipment is of a character adapted to transform and translate fluctuating impulses, such as impulses developed by heart action, and apply corresponding electrical impulses upon the galvanometer 111, in order to vibrate or oscillate the mirror 113 in accordance with the impulses to be recorded.

The vibratory impulses thus imparted to the mirror 113 are applied through the window 19 (Fig. 5) upon the record strip 15 as the same is drawn past the window. Immediately behind the window is disposed a suitable lens 125 for converging light passing through the window upon the record strip 15.

Light for application upon the record strip 15 originates at a source comprising a small incandescent lamp 127 enclosed in a housing 129 (Fig. 2) fixed in the frame work, preferably upon a longitudinal panel 131 which extends along one side of the spring motor housing 75 and which is rigidly bolted thereto, said panel 131 carrying the driving mechanism 51-63. Light from the lamp 127 is projected through an opening 133 in the casing 129, and, as shown more clearly in Fig. 5 of the drawings, passes thence through a lens 135 carried in a bracket 137, which also carries the lamp housing 129. After passing the lens 135, the light beam strikes upon a mirror 139 which is supported at a predetermined angle on one of the frame plates 26. From the mirror 139 the beam of light is reflected through a condensing lens 141 and directed upon the mirror 113 of the galvanometer whence the light beam is reflected as a vertically vibrating or oscillating beam of light. Part of this oscillating beam

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strikes upon a reflecting mirror 143 and is reflected thereby upon the wall 17, at the window opening 19 thereof, so that a portion of the oscillating beam may pass through the opening 19 and through the lens 125 to impinge upon the record strip 15. Another portion of the oscillating beam, reflected by the galvanometer mirror 113, strikes another reflecting mirror 145 which is positioned to direct that portion of the oscillating beam, impinging thereon, successively upon two reflecting mirrors 147 and 149 positioned to direct the so reflected beam portion upon the back of the ground glass screen 151. This screen is mounted in an opening formed in the panel 23 so that a visual observation of the beam may be made from in front of the panel.

The mirrors 139, 143, 145, 147 and 149 are mounted on suitable supports carried by the frame plate 26, shown at the left hand end of Fig. 3, which plate 26 is rigidly supported by the housing of the motor 73 as by pedestals 153, so that the mirror system is supported entirely upon the rigid frame work of the motor.

The light beam which is applied through the window 19 is sufficiently wide to extend beyond the confines of the opening 19, the central portions of the beam only passing through the opening and impinging upon the record strip. Consequently the record strip, which preferably comprises a light sensitive film, will be entirely exposed to light except in such portions thereof as are screened. Between the window opening and the film is placed a screen which may comprise a series of graduated marks 125a (Fig. 5) on the back of the lens 125, which marks extend parallel with the direction of movement of the film. These marks are equally spaced apart and serve to throw equidistant longitudinal shadows 155 on the moving film to thereby prevent exposure of the film along such shadow lines and thus form a striated or lined appearance in the exposed film after development thereof, such lines forming gauge marks on the film for use in interpreting the record made thereon.

The record or graph is made on the film as a wavering line 157 comprising an unexposed portion of the film created by a shadow member, preferably comprising a wire 159, extending in the horizontal plane which includes the horizontal axis of the galvanometer mirror, said shadow wire 159 being disposed between the lamp 127 and the mirror 113, preferably between the reflecting mirror 139 and the condensing lens 141. This wire is supported preferably on a bracket 161 (Fig. 2) which also carries the reflecting mirror 139 and the condensing lens 141. The wire 159 serves to black out the central portions of the light beam which is thus reflected from the mirror 113 with a central blacked out portion in the oscillating beam which ultimately reaches the recording film 15 and the ground glass 151. Accordingly, the film 15 will be exposed to light rays, except in those portions of the film which from time to time extend in line with the blacked out portion of the light beam. The record graph line 157 consequently will comprise unexposed portions of the film superimposed upon the shadow lines 155.

In making graphical records, particularly records of heart action, it is of extreme importance to maintain constant speed of travel of the record strip 15, in order that the diagnostician using the record strip for diagnostic purposes may place reliance in the uniformity of the record so far as the time element is concerned, and means is provided for establishing time gauging lines

163 directly on the record strip. This is accomplished by means of a timing wheel 165 (Figs. 2 and 5) comprising a disc formed with peripheral fingers 167 extending radially outwardly of the edge of the disc. The disc is supported for rotation on a stem 169 which is journaled for rotation on a plate 171 which forms a part of the frame work 21, being mounted on the panel 131. The wheel is positioned for rotation so that the outstanding fingers successively pass across the light beam emanating from the source 127, the wheel to this end being conveniently disposed between the lens 135 and the reflecting mirror 139. The wheel 165 is turned at uniform speed corresponding with the speed of movement of the film 15 by means of driving mechanism 173 powered by the motor 73 through the shaft 51 so that the light beam is blocked at equal intervals successively by the fingers 167 which preferably are equally spaced on the wheel. One of the blocking fingers of the wheel is preferably wider than the others in order to interrupt the light beam for a slightly longer interval. When the light beam is interrupted, of course no light whatever may fall upon the film 15 which therefore remains unexposed during such interval to create the transverse time gauge lines 163 thereon. Since in the illustrated embodiment there are four fingers 167 of uniform width and a wider finger 168, it will be noted that, every fifth time, the gauge line formed on the record strip 15 will be wider than the intervening four lines.

In order to drive the timing wheel 165, the shaft 169 thereof is provided with a gear 175 which in turn meshes with a gear train 177 supported on shafts carried by the plates 171 and 172 and the plate 131, said gear train being driven by the shaft 51. The gear train includes a governor 179, which operating in conjunction with a friction pad member 181 supported on the frame plate 30, serves to limit the speed at which the driving mechanism, and hence of the timing wheel 165, may be driven by the motor.

In spite of all precautions, it is exceedingly difficult to insure uniformity of speed of travel of the record strip 15 and of the timing wheel 165, and the present invention includes means for indicating on the record 15 any even slight variations in speed. To this end a movable light blocking member 183 (Figs. 2, 5 and 7) is provided comprising a bar supported on a stem in front of the lowermost end of the window opening 19. This stem is vertically movable in a supporting bearing 185 and is normally urged in an upward direction by means of a spring 187 encircling the stem and disposed between the bearing 185 and the block 183. Beneath the bearing the stem is provided with a yoke 189 which receives an actuating finger 191 whereby the stem and the member 183 may be depressed downwardly in the bearing 185. The finger 191 is carried on a tilting frame 193 which is actuated by the stem 195 of a speed responsive device 197 (Figs. 2 and 5) of the ball governor type. The device 197 is drivingly connected with the gear train 177 and consequently rotates at a speed corresponding to the speed at which the said gear train is driven by the motor. As the device 197 is thus turned, the ball governor mechanism thereof serves to elevate the stem 195 in proportion to its speed, the stem rising and tilting the frame 193 about its pivot 193' with increasing speed, thereby lowering the blocking member 183. When the mechanism is stationary the member 183 is at its highest elevation in the window opening 19 and blocks

the light ray at the bottom of the window to produce an unexposed film portion 199 (Figs. 5 and 7) at the edge of the film, such portion being narrower when the device is operating at normal speed. Should any variation from normal speed occur during the operation of the device, the unexposed strip 199 will become wider if speed is decreased, and become narrower if speed increases. Any sudden change in speed will be shown as a shoulder 201 in the speed indicating area. Consequently the record itself will have at all times along an edge of the strip a clear indication of any variation in speed of the apparatus during the record making period.

It should be noted that the apparatus for making a record of speed variations, namely, the member 183, the bearing support 185, and the device 197, are all supported on the rigid plate 171. Means is also provided for giving a visual indication of the speed at which the apparatus is operating at any instant during the making of a record, the same comprising a pointer 203 mounted on a stem 205 which in turn is pivotally supported in a bearing 207 (Fig. 2) carried by a bracket 209 on the plate 171. The stem 205 has an actuating arm 211 and spring means 211a is provided for normally urging the stem in a direction to press the arm 211 against a stop provided by the bracket 209, the stem, when said arm 211 engages the stop, being in position such that the pointer 203 is at a zero speed indicating position on a dial 213 (Fig. 7), which dial is exposed through a window opening 215 (Figs. 1 and 2) defined by a suitable frame on the panel 23. The tilting frame 193 of the light blocking member 183 is provided with an arm 217 which extends thence in position to engage the actuating arm 211 of the pointer device to press on said arm, as the speed of the device increases, to thereby turn the pointer device against the influence of its biasing spring 211a so that the pointer 203 will move across the graduated scale 213 as speed increases. The scale 213, preferably at its mid portion, may be provided with a normal speed indicating graduation to thereby show when the apparatus is operating at a predetermined normal operating speed.

The apparatus includes means operable, when the record strip 15 is stationary, as at the conclusion of a record making period, to apply identifying characters by photographing the same on the sensitive material which comprises the record strip 15. To this end the panel 17 is provided with a window opening 219 (Fig. 6) adjacent the recording window 19 and the panel 23 is provided with an opening defined by a frame 221 (Fig. 1), which frame carries a hinged cover plate 223 normally pressed as by means of a spring toward closed position on the frame 221. This cover 223 is formed to removably receive a data card on its upper side, upon which card may be formed the identifying indicia to be photographed upon the record strip 15. These characters may be conveniently applied to the card as by typewriting or other preferred marking process.

After the typed or otherwise marked card is positioned on the under side of the cover 223, the same may be closed on the frame 221 to expose the marked face of the card downwardly through the opening in the panel 23. Immediately beneath said opening an inclined mirror 225 is disposed in position to reflect an image of the card to and through the window opening 219 and upon an area of the strip 15, as indicated at 227. The projection of the image of the card from the mirror

225 through the window opening 219 may be accomplished either directly or by interposing a suitable lens 229 between the mirror and the opening 219, said lens 229 being supported in a bracket 231, which in turn may be mounted on the plate 26 which carries the mirrors 139, 143, 145, 147 and 149 and the lens 141.

At the moment when it is desired to photograph the image of the card upon the record strip 15, the card may be illuminated by energizing a lamp 233 which is disposed in a suitable housing 236 disposed beneath the panel 23 adjacent the mirror 225 and formed with an opening to direct light rays upon the supported indicia card on the under side of the cover member 223. The marked face of the card being thus illuminated, a light image thereof is formed on the record strip 15 in the area 227. Illumination of the lamp 233 may be controlled by means of a press button 235 disposed on the upper side of the panel 23 adjacent the frame 221.

The apparatus and equipment herein disclosed affords an exceedingly lightweight recording device, due in part to the utilization of the housing of the motor 75 as a tubular, frame rigidifying backbone. By means of the manner in which the tubular housing of the motor 75 is disposed and anchored in the frame structure, an extremely lightweight frame with adequate rigidity is provided for the support of the driving mechanism. Furthermore, the arrangement of the driving mechanism snugly and along one side of the rigid motor housing makes for an exceedingly compact yet lightweight arrangement of the elements of the recording apparatus.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the form herein disclosed being a preferred embodiment for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. In an electrocardiograph adapted to reproduce an oscillating beam of light upon a moving film, a framework including a rigid tubular member and frame means on and outwardly of said tubular member, film carrying and moving means, and oscillating light beam producing means supported on said framework outwardly of said tubular member, motor means supported on said tubular member and drivingly connected with said film moving means, said rigid tubular member forming a backbone for the framework and serving as the main support for the moving film and the oscillating beam of light, whereby motor induced vibrations in the electrocardiograph are reduced to a minimum to thereby increase the accuracy of reproduction.

2. In an electrocardiograph mounted upon a framework and adapted to reproduce an oscillating beam of light upon a moving film driven from a spring motor, a tubular housing which forms a part of the framework of the electrocardiograph and which serves as a housing for the spring motor, a main winding and driving gear which overlies and closes one end of the tubular housing, and a helical spring supported and enclosed within the tubular housing, one end of the

helical spring being anchored upon the framework of the electrocardiograph and the other end being drivingly connected with the main winding and driving gear, said arrangement and construction of elements serving to reduce vibrations in the electrocardiograph to a minimum to thereby increase the accuracy of reproduction.

3. In an electrocardiograph adapted to reproduce an oscillating beam of light upon a moving film, light blocking means movable in one edge of said beam of light for variably blocking the same to prevent exposure of said moving film, and means for moving said light blocking means into said beam of light in accordance with the speed of movement of the moving film, whereby variations in the speed of the moving film are indicated by a shadow of varying width upon the moving film.

4. In an electrocardiograph adapted to reproduce an oscillating beam of light upon a moving film, a light blocking member movable in an edge of said beam of light adapted to variably block a portion of the beam of light to prevent exposure of the moving film by said blocked portion of the beam, and speed responsive means driven in timed relation with the speed of said moving film and drivingly connected to move said blocking member progressively into said beam of light to increase the light blocking effect thereof in direct proportion to the speed at which said film is moved, whereby increases in the speed of the film are indicated by a shadow of increased width upon the moving film.

5. In an electrocardiograph adapted to reproduce an oscillating beam of light upon a moving film, mechanism for impressing a speed indicating record upon said moving film, said mechanism comprising speed responsive means driven in timed relation with the speed of the moving film, a movable light blocking member being adapted continuously to block out a portion of the beam of light whereby said blocked out portion is prevented from exposing the moving film, said light blocking member being subjected to motion in response to the variations in the speed of said speed responsive means, whereby changes in the speed of said moving film are indicated by changes in the width of an unexposed portion of said moving film.

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