

[54] **DEPRESSOR BAR TYPE RECORDING APPARATUS**

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[51] Int. Cl. G01d 15/16

[58] Field of Search..... 346/46, 61, 141,
346/17, 34

[56] **References Cited**

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[57] **ABSTRACT**

A depressor bar type chart recording apparatus of the type having a dotting apparatus axially slidable on a rotating drive shaft and being activated by the rotating drive shaft to sequentially impress different colored ink dots upon the chart at selected axial locations. The dotting apparatus has a slide tube rotating with the drive shaft and carrying a dotting cam and a sequencing cam. The frame for the dotting apparatus includes a sliding portion coupled to the slide tube for axial motion therewith, and a swinging portion pivoted to the sliding portion and having a cam follower engaging the dotting cam for causing the swinging portion to be pivoted. A dotting shaft is carried by the swinging portion of the frame, and has at one end a dotting wheel with circumferentially spaced dotting needles brought into contact with the chart as the frame swings, and at the other end sequencing means engaging the sequencing cam and intermittently rotating the dotting needles into position for contacting the chart. A plate is pivotally mounted on the swinging frame portion, and carries an inkpad which is rotated along with the dotting shaft and is brought into contact with the dotting wheels as the plate moves inertially upon movement of the swinging frame portion.

7 Claims, 8 Drawing Figures

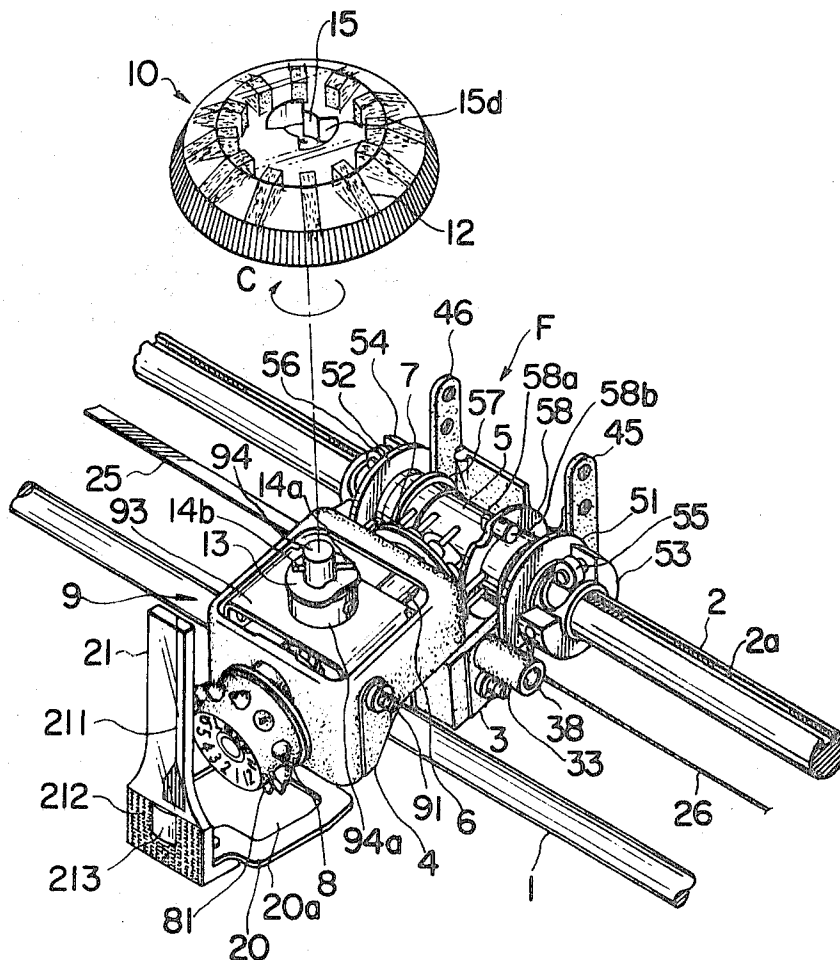


FIG. 1

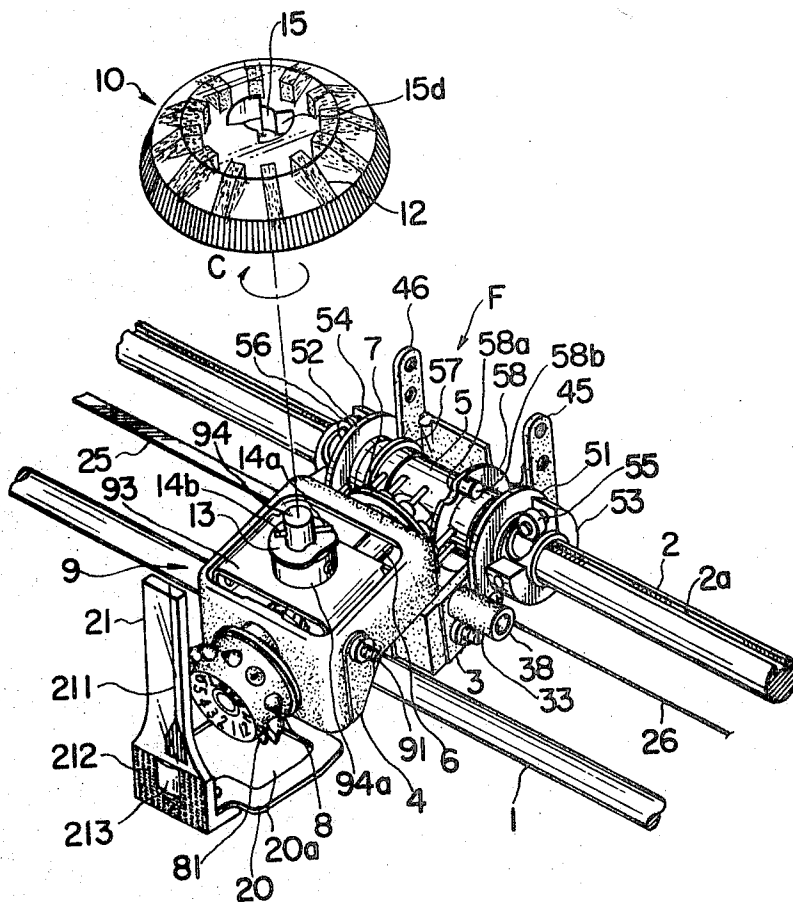


FIG. 5A(1)

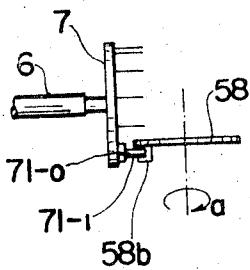


FIG. 5B(1)

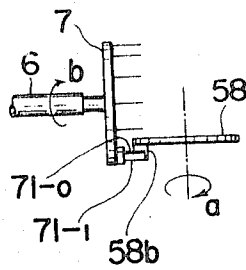


FIG. 5C(1)



FIG. 5A(2)

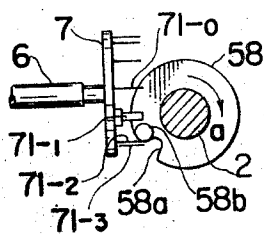


FIG. 5B(2)

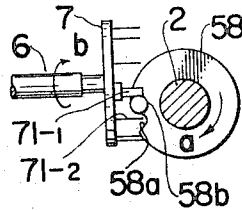


FIG. 5C(2)

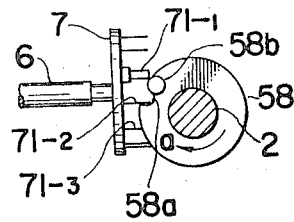
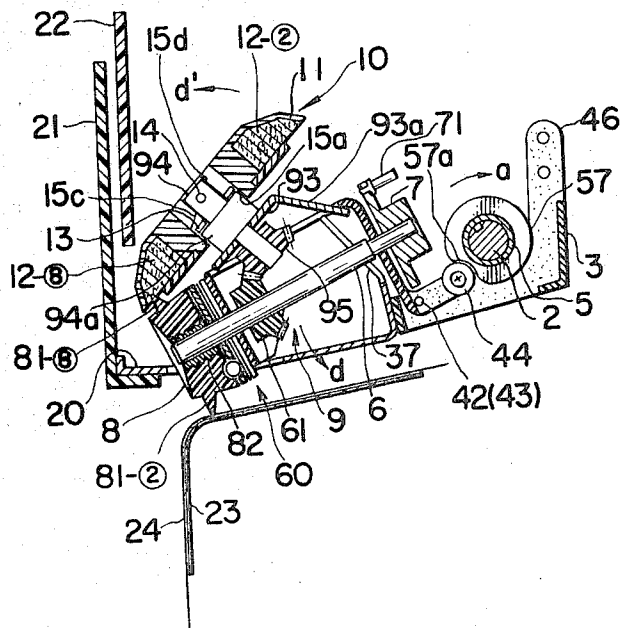


FIG. 6



DEPRESSOR BAR TYPE RECORDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to depressor bar type chart recording devices. Such devices are useful, for example, in control processes aimed toward achieving a uniform temperature inside a large furnace, where it is often the practice that one recording meter is used for recording on a single chart the time-varying temperature measured by a plurality of temperature detectors suitably located inside the furnace.

One such type of recording meter is the depressor type, generally used in connection with automatic null-balancing. The depressor bar type recording device comprises a dotting wheel with dotting needles corresponding in number to the number of measuring points. The dotting wheel is intermittently rotated to bring the inked dotting needles successively into contact with the recording chart to record the measured values. The present invention relates to this type of recording apparatus.

2. Description of the Prior Art

One generally known depressor bar type chart recording mechanism has a swinging frame moved by a lever which is supported at one end by the swinging frame and pivoted by a cam. The dotting wheel is made of a metal, with a plurality of dotting needles implanted at regular intervals around the wheel body. Under each needle positioned for dotting is a fork-shaped guide member for holding the needle in position before it dots the chart. Needles are inked with an inkpad shell mounted by the use of screws.

This conventional mechanism is complicated in construction and heavy. Furthermore, because the inkpad shell is fastened to the frame with screws, a screwdriver must be available for its mounting or dismounting. Positioning of the inkpad is supposed to be accurate relative to the dotting needles; however, this is difficult in the prior art, because of awkward construction. Still further, the guide member for the dotting needle necessitates an intricate structure for the dotting mechanism as a whole. As a result, recording instruments incorporating this mechanism are structurally complicated, they are inconvenient to use, their production cost is high, the size of the instrument is large, and portability decreases.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a depressor bar type chart recording device which is structurally simple, small in size, light in weight, and easy to operate, free of the drawbacks in the prior art.

Briefly, the depressor bar chart recording device of this invention is characterized by a frame with a sliding portion and a swinging portion, both of which, for example, are die-cast of a light metal. The swinging frame portion is pivotally carried by the sliding frame portion, engages at one end with a cam, and is allowed to swing directly in response to the cam rotation. In other aspects, dotting wheel and a plurality of dotting needles are molded into one unit with a hard synthetic resin implanted with a metal insert. The front of the dotting wheel has symbols, such as digital numbers, indicating the individual measuring points. A lens window, through which any digital number on the dotting wheel can be clearly observed, is provided. A compact, built-

in detent mechanism having a ball and a spring is disposed where the dotting wheel is in contact with the swinging frame portion, and serves to stop the dotting wheel in position during its intermittent rotation, thus truing each dotting needle before it touches the chart. The inkpad shell is mounted on a shaft coupled for rotation with the dotting wheel having a pin implanted in the diametral direction. The legs of the pin exposed on both sides of the shaft are different in length, and a compression spring is fitted round the shaft. This arrangement allows the inkpad shell to be accurately set in position relative to the mounting shaft and dotting needles, without using a special tool.

Other objects, aspects and advantages of the present invention will be pointed out in, or apparent from, the detailed description hereinbelow, considered together with the following drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of recording apparatus according to the invention;

FIG. 2 is a side view of the apparatus of FIG. 1 with the dotting elements in their raised position;

FIG. 3 is a plan view;

FIG. 4 is a perspective view illustrating the frame used for the apparatus of FIG. 1,

FIGS. 5(A) (1) through 5(C) (2) are partial plan and elevational diagrams showing steps in the sequencing cam movement; and

FIG. 6 is a sectional side view showing the apparatus of FIG. 1 with the dotting elements in their depressed position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 through 3, the dotting apparatus according to the invention is arranged for movement along a supporting rod 1 and a driving shaft 2 disposed in parallel with the rod 1. The rod 1 and shaft 2 are supported at both ends by a conventional instrument housing frame (not shown), and the driving shaft 2 has a keyway 2a formed in the axial direction.

The frame F for the dotting apparatus, illustrated separately in FIG. 4, comprises a slide frame 3 and a swing frame 4 which are substantially square in shape and die-cast of a light metal such as an aluminum alloy. The swing frame 4 has a rear panel 41 from which supporting members 42 and 43 extend on both sides. The supporting member 43 has a bearing roller 44 which is positioned in contact with a dotting cam 57 to cause swing frame 4 to swing, as will be specifically described below. The supporting members 42 and 43 fit into the slide frame 3, and screw-pins 33 and 34, which are fastened on side panels 31 and 32 of the slide frame 3, hold the supporting members 42 and 43 and enable the slide frame 3 and swing frame 4 to swing with respect to one another.

As shown in FIGS. 2 and 3, a roller 35, mounted on a front panel 36 of the slide frame 3, is in forward contact with the supporting rod 1, and provides support for the slide frame 3. A slide tube 5, fitting over drive shaft 2, is rotatably attached to the slide frame 3 by means of plates 51 and 52 attached to slide frame 3 with screws. Both ends of slide tube 5 are fitted with rings 53 and 54 which hold roller bearings 55 and 56 in keyway 2a drive shaft 2, and thus the slide tube 5 is coupled to the driving shaft 2 in such a manner that the

slide tube 5 receives the rotating force from the driving shaft 2 and can slide with the slide frame 3 in the axial direction.

A depressor cam 57 having a recessed part 57a, and a changeover cam 58 having a notch 58a and a feed roller 58b are attached to the slide tube 5. The swing frame 4 has its center of gravity forward of the screw pins 33 and 34, and thus the roller 44 on swing frame 4 keeps contact with the lower circumference of the depressor cam 57 by gravitational forces.

The sliding motion of the dotting apparatus is limited by cylindrical stops 38 and 39 on the sides of slide frame 3 (FIGS. 1 and 3), each of which carries a rubber cylinder arranged to hit the instrument housing frame on either side as the dotting frame F swings from side to side, and thus serves as a buffer in stopping the dotting frame.

A dotting shaft 6, rotatably supported by the swing frame 4, is perpendicular to the driving shaft 2 and equipped at one end with an indexing or sequencing plate 7 having twelve circumferentially spaced, axially extending pins 71. The sequencing plate 7 is disposed at a right angle to sequencing cam 58 and engages the sequencing cam in a peripheral position where two of the 12 pins 71 always lie outside the plane of the cam 58 (i.e., below the cam as shown in FIG. 3). At its other end, dotting shaft 6 mounts a dotting wheel 8 having a trapezoidal section and having twelve individual dotting needles 81 disposed radially therearound. As shown in FIG. 6, the dotting wheel 8 is molded of hard synthetic resin with a central metal insert 82 to receive dotting shaft 6. The dotting wheel 8 is accurately aligned by means of a detent mechanism 60 having a ball and a biasing leafspring disposed where the dotting wheel 8 is in proximity to the swing frame 4 (FIG. 6). The detent mechanism 60 serves to true each of the dotting needles 81 in position when dotting. As will be described in greater detail below, the front of the dotting wheel 8 is supplied with digital numbers correlating the individual dotting needles 81 to the measuring circuits which supply data the needles are to record.

The dotting needles are inked prior to being impressed on a chart by swinging plate 93 supported by the swing frame 4 with pins 91 and 92, a mounting shaft 94 rotatably coupled to the plate 93, a bevel gear 95 on shaft 94 which meshes on a line connecting pins 91 and 92 with a bevel gear 61 secured to dotting shaft 6, and an inkpad shell 10 which is dismountably fitted on the shaft 94. As shown in FIGS. 3 and 6, the swinging plate 93 has a sloped portion 93a which rests against the end of an L-shaped plate 37 provided on swing frame 4. Twelve cells 11, each having an opening facing toward the swing frame 4, are formed radially in the inkpad shell 10 and accommodate inkpads 12, soaked respectively with ink of different colors to be supplied to dotting needles 81. The inkpad shell 10 is removably attached to mounting shaft 94 upon a collar 94a, on which a flat compression spring 13 of corrugated disk shape is fitted. A pin 14 is implanted in the mounting shaft 94 in the diametral direction, and as shown in FIG. 3, the exposed portions 14a and 14b of the pin 14 are different in length on opposite sides of the shaft 94. The inkpad shell 10 receives shaft 94 and pin 14 in a mounting hole 15 which comprises a collar receiving hole 15 into which the collar 94a of the mounting shaft 94 is fitted, a pin receiving hole 15b having a ϕ -shaped outline duplicating the outer irregular configuration of

mounting shaft 94 and pin 14, and an internal pin securing hole 15d shaped like an "8" and having its bottom surface 15c partly sloped to form a ramp.

Secured to slide frame 3 is a bracket 20 having a square hole 20a beneath dotting wheel 8, and a pointer 21 fastened in front of dotting wheel 8 and in front of a stationary scale 22 indicating axial position. The pointer 21 is made of a transparent acryl resin and has a vertical sight line 211 colored, for example, in red. A rough surface area 212 irregularly reflects light, and surrounds a square window 213 opposite the number in the lowest position on the dotting wheel 8, corresponding to the dotting needle in position for marking. As shown in FIG. 1, window 213 has a convexed portion forming a lens to enlarge the image of the number being viewed.

The dotting apparatus is positioned above a chart 24 transported on a chart guide plate 23. Axial position of the dotting apparatus is determined by positioning elements including a steel band 25 and a stranded metal wire 26, connected at one end to the slide frame 3, and at the other end to a pulley coupled to the rotating shaft of a balancing motor associated with a conventional automatic null-balancing mechanism (not shown in Drawings). Lugs 45 and 46 in the rear of the slide frame 3 are equipped with a suitably shaped actuating plate or the like which moves with the dotting frame F and turns on or off a microswitch to allow an alarm mechanism to operate if the measured values exceed predetermined limits.

The chart recording apparatus having the dotting apparatus described above is operated in the following manner.

Indexing of the Dotting Needles and Dotting of Chart
The operation of the apparatus will be described beginning with a starting position in which the roller 44 is in contact with the circumference of the dotting cam 57, and the sequencing cam 58 is positioned relative to the sequencing plate 7 as shown in FIGS. 5(A) (1) and (2), with one 81-1 of the dotting needles 81 being located in the lowermost position of the dotting wheel 8, opposite recording chart 24. When the driving shaft 2 rotates in the direction of arrow a, the sequencing cam 58 is rotated accordingly, the feed roller 58b is brought into contact with pin 71-1 of the sequencing plate 7 and feeds the pin 71-1 upwardly, thereby rotating the sequencing plate 7 in the direction of arrow b, as shown in FIGS. 5(B)(1) and (2). As pin 71-1 is thus fed, the following pin 71-2 moves outwardly across the plane of sequencing cam 58 through the notch 58a therein. At the same time, the preceding pin 71-0 moves inwardly over the plane of sequencing cam 58. Although sequencing cam 58 continues to rotate, the sequencing plate 7 stops rotation as shown in FIG. 5(C) (1) and (2).

This intermittent rotation of the sequencing plate 7 causes the dotting wheel 8 to rotate by one-twelfth of a revolution and to feed the next dotting needle 81-2 to the lowermost position of the dotting wheel 8, whereupon the dotting needle 81-2 faces the chart 24. The stop position of the dotting wheel 8 is determined by detent mechanism 60, which serves to true the dotting needle 81-2 relative to the chart 24.

The measuring circuit related to the dotting needle 81-2 is then automatically null-balanced, and the dotting frame F is positioned axially on the driving shaft 2, with the measured value being indicated on the scale

22 by the pointer 21. At this moment the roller 44 enters the recessed portion 57a of the dotting cam 57, thereby swinging the swing frame 4 on the screw pins 33 and 34 in the direction of arrow d. As a result, the dotting needle 81-2 touches the recording chart 24, to 5 instantaneously record the measured value. FIG. 6 shows the recording apparatus as it appears at this stage in the dotting operation.

When the driving shaft 2 further rotates and again assumes the circumferential position of FIGS. 5(A) (1) 10 and (2), the feed roller 58b feeds the next pin 71-3 upward, to rotate the dotting wheel 8 by another one-twelfth revolution. As a result, the next dotting needle 81-3 faces the recording chart 24. The corresponding measuring circuit is null-balanced, and the next dot is 15 marked on the chart as described previously. These operations are repeated twelve times (or the number of times necessary to utilize each dotting needle) to form one cycle of the recording operation which the recording 20 apparatus of this invention performs.

The digital number on the dotting wheel 8 indicating each measuring point can be easily observed through the lens window 213 of the pointer 21, except while the rotary wheel is in motion.

Inkpad Indexing and Dotting Needle Inking

When the dotting shaft 6 rotates intermittently to 25 index the dotting wheel 8 as described above, the rotating force is conveyed to the mounting shaft 94 through the bevel gears 61 and 95, and the inkpad shell secured to the mounting shaft 94 is also intermittently rotated. 30 The inkpads 12 are thus indexed synchronously with the indexing of the dotting needles.

As described above, the movable plate 93 is capable of swinging about the axis of pins 91, 92, and upon 35 movement of the swing frame 4 in the direction of arrow d, the movable plate 93 swings in the direction of arrow d' because the sloped portion 93a is in contact with the stationary plate 37, and the sloped portion 93a is thus prevented from lowering. Accordingly, the inkpad 12-8 in the frontmost position of the inkpad shell 40 is pressed against the dotting needle 81-8 located at the top of the dotting wheel (which occurs when the dotting needle 81-2 is in the lowermost position). When dotting shaft 6 rotates by one-twelfth revolution to feed 45 dotting needle 81-9 to the frontmost position of the dotting frame F, the inkpad shell 10 also rotates by one-twelfth revolution, and the next inkpad 12-9 faces the dotting needle 81-9. This dotting needle is inked as the inkpad shell next swings during motion of the swing 50 frame 4. In this fashion the same dotting needle is always inked in the same color, and error in inking is eliminated.

Mounting/Dismounting of the Inkpad Shell

The inkpad shell is mounted in the following manner. 55 The inkpad shell 10 is first placed on the mounting shaft 94, centering the mounting hole 15 about the mounting shaft 94 and inserting pin 14 through the ϕ shaped pin receiving hole 15b with the different length pin portions 14a and 14b matching the different length 60 pin openings in hole 15b. When the pin 14 reaches the 8-shaped turning hole 15d, the inkpad shell is rotated by an angle of about 90° in the direction opposite to arrow c, causing the pin 14 to ride up on ramp surface 15c and causing inkpad shell 10 to oppose the expansion 65 force of the spring 13. The spring 13 is gradually compressed, and the inkpad shell 10 is fully secured to the mounting shaft 94 at the point when the pin por-

tions 14a and 14b come into contact with the side walls of the 8-shaped revolving hole 15d.

Because the legs 14a and 14b of the pin 14 have different lengths, and because the pin receiving hole 15b conforms to the shape of the pin, possibilities for misaligning the inkpad shell 10 on the mounting shaft 94 are completely eliminated. Since the side wall of the 8-shaped hole 15d has a constant position relative to the inkpads 12, the inkpads automatically are positioned in proper correspondence to the individual dotting needles 81 simply by mounting the inkpad shell 10 on the shaft 94. When the mounting shaft 94 rotates, the rotational force causes pin portions 14a and 14b to push against the side walls of hole 15d, and this insures the inkpad shell 10 will not become loose due to indexing movement of the inkpad shell. The inkpad shell 10 can be dismounted by rotating the inkpad shell 10 in the direction of arrow c, to return the pin portions 14a and 14b into alignment with the pin openings in pin receiving hole 15b.

The recording apparatus of this invention has a number of advantageous features, summarized below.

1. The dotting apparatus consists essentially of only a slide frame having a slide tube, a dotting wheel equipped with dotting needles, and a swing frame associating a dotting shaft, a sequencing plate and an inkpad mechanism. Hence the number of necessary components is minimized, overall construction is simplified, size is reduced, and production cost is lowered.

2. The dotting frame itself consists essentially of only a slide frame and a swing frame which is rotatably coupled to the slide frame and swung directly by a roller means. This construction further enhances the advantages of simplicity and economy noted above.

3. The dotting wheel carrying the dotting needles, as well as bevel gears of the inkpad mechanism, may be formed into one unit by the use of synthetic resin. This serves to simplify construction and to reduce weight.

4. The stop positions of the intermittently rotating dotting wheel are accurately determined by a detent mechanism of simple construction, using the combination of a ball and a spring. This arrangement dispenses with the need for another frame or means for determining the position of each dotting needle, helps reduce the size of the device, and assures an accurate dotting action.

5. Attachment of the inkpad shell is effected by means of a pin on the mounting shaft exposing two legs of different length, and a compression spring is fitted round the pin. This pin-and-spring arrangement serves to simplify the inkpad shell mounting mechanism and facilitates mounting/dismounting the inkpad shell.

6. The foregoing pin arrangement allows the inkpad shell to rest securely in position whenever it is mounted. Hence the inkpad positioning is always kept accurate relative to the position of each dotting needle.

7. A lens window is provided on the pointer, thus permitting easy readout of the number indicating the corresponding measuring point even though the overall size of the depressor mechanism is minimized.

By following the principles of the invention, a very lightweight apparatus may be obtained. For example, the weight of an entire unit manufactured according to this invention was only 140 grams.

Although specific embodiments of the invention have been disclosed herein in detail, it is to be understood that this is for the purpose of illustrating the invention,

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and should not be construed as necessarily limiting the scope of the invention, since it is apparent that many changes can be made to the disclosed structure by those skilled in the art to suit particular applications.

We claim:

1. A chart recording apparatus of the type having a dotting apparatus axially slidable on a rotating drive shaft and being actuated by the rotating drive shaft to sequentially impress different ink dots upon the chart at selected axial locations wherein the dotting apparatus comprises:

a slide tube rotating with the drive shaft and slidable therealong;

a dotting cam and a sequencing cam mounted on the slide tube;

frame means including a sliding portion rotatably secured to the slide tube for axial movement therewith and a swinging portion pivotally supported by the sliding portion and having cam follower means engaging the dotting cam for causing the swinging portion to be pivoted thereby;

a dotting shaft carried by the swinging portion of the frame means;

a dotting wheel mounted at one end of the dotting shaft and having a plurality of circumferentially spaced dotting needles thereon;

sequencing means at the other end of the dotting shaft and engaging the sequencing cam for intermittently rotating the dotting shaft and for causing the dotting needles to be successively brought into position for contacting the chart;

a plate pivotally coupled to the swinging portion of the frame means on an axis parallel to the pivoting axis of the swinging frame portion and pivoting inertially as the swinging frame portion is pivoted; and

an inkpad shell removably attached to the pivoting plate and being brought into contact with the respective dotting needles as the plate is pivoted inertially with the swinging frame portion;

whereby as the driving shaft is rotated at constant speed, the dotting shaft and wheel are intermittently rotated by the sequencing cam and means to bring successive dotting needles to face the chart,

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the swinging frame is swung by the dotting cam and follower to impress a dot upon the chart, and the inkpad shell is pivoted to ink another dotting needle.

2. A chart recording apparatus as claimed in claim 1 wherein the dotting wheel comprises a central metal insert and wherein the dotting needles and metal insert are embedded in and joined by molded synthetic resin.

3. A chart recording apparatus as claimed in claim 1 further comprising a detent mechanism engaging said dotting wheel and having a plurality of stop positions corresponding to the aligned positions of the dotting needles facing the chart.

4. A chart recording apparatus as claimed in claim 3, wherein said detent mechanism is attached to the swinging frame portion and comprises a spring-loaded ball.

5. A chart recording apparatus as claimed in claim 1 wherein a scale is disposed along the path of the dotting apparatus and wherein the dotting apparatus comprises a pointer disposed opposite the scale, the dotting wheel is marked with symbols indicating the individual dotting needles, and the pointer is arranged with a lens-shaped window aligned with the symbol corresponding to the dotting needle facing the chart.

6. A chart recording apparatus as claimed in claim 1 wherein the inkpad shell is mounted on a shaft coupled for rotation with the dotting shaft to bring corresponding portions of the inkpad in contact with particular dotting needles, and wherein the inkpad shell is removably mounted to the shaft by means of a pin extending through said shaft with different exposed lengths on each side of the shaft, the inkpad shell having a mounting hole with different length openings on each side of the shaft to receive the pin in only one alignment.

7. A chart recording apparatus as claimed in claim 6 wherein the inkpad shell mounting hole includes an 8-shaped portion with a ramp surface at the bottom for engaging said pin, the mounting shaft having a compression spring mounted thereon and compressing as the inkpad shell is rotated relative to the mounting shaft and the pin slides along the ramp surface.

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