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CHART-DRIVE MECHANISM FOR A STRIP-CHART RECORDER

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2 Sheets-Sheet 1

Fig. 1

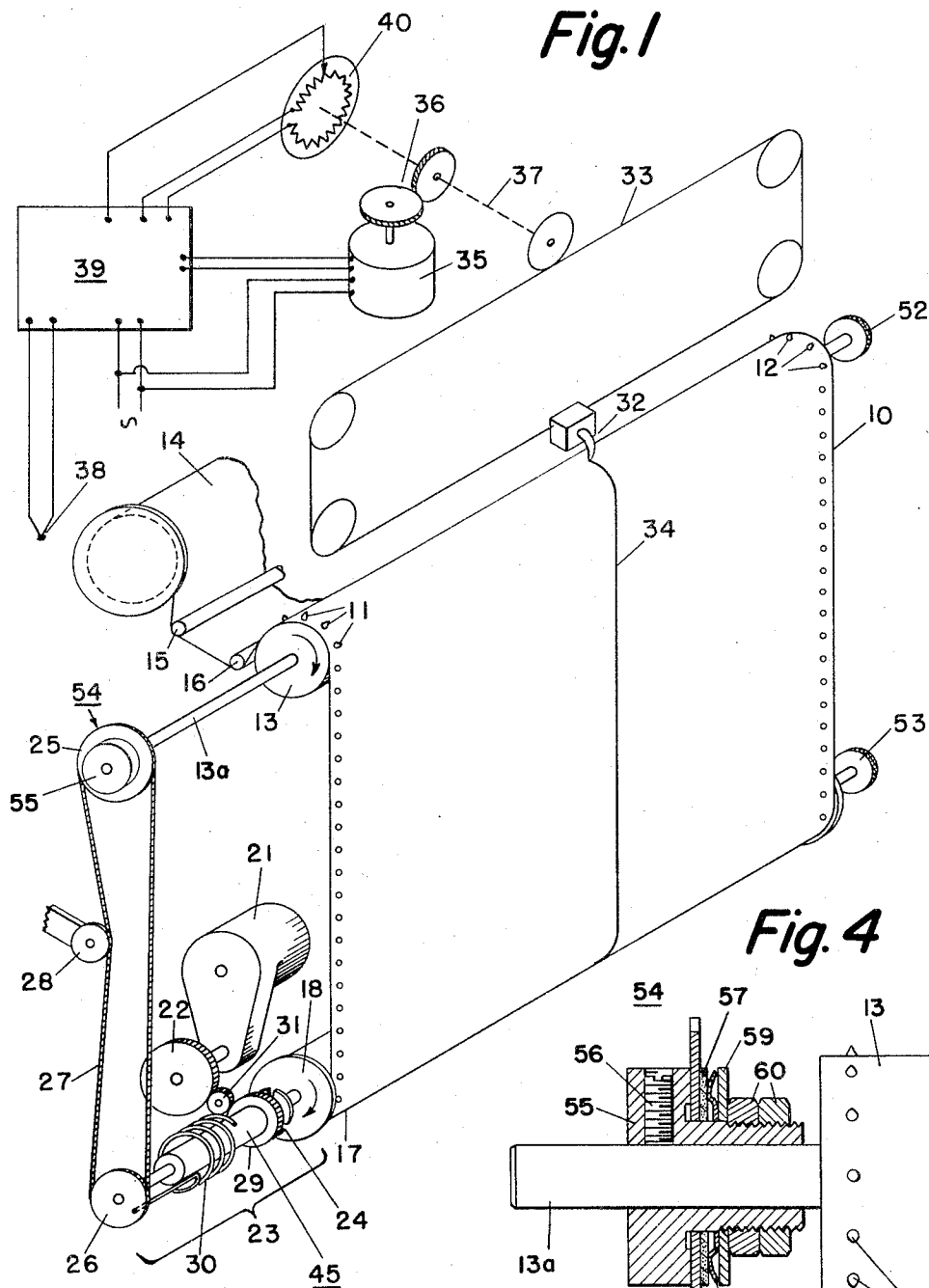
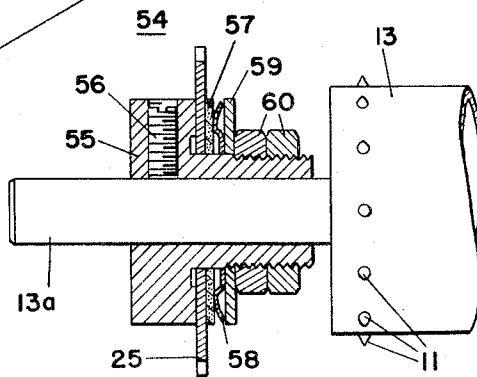


Fig. 4



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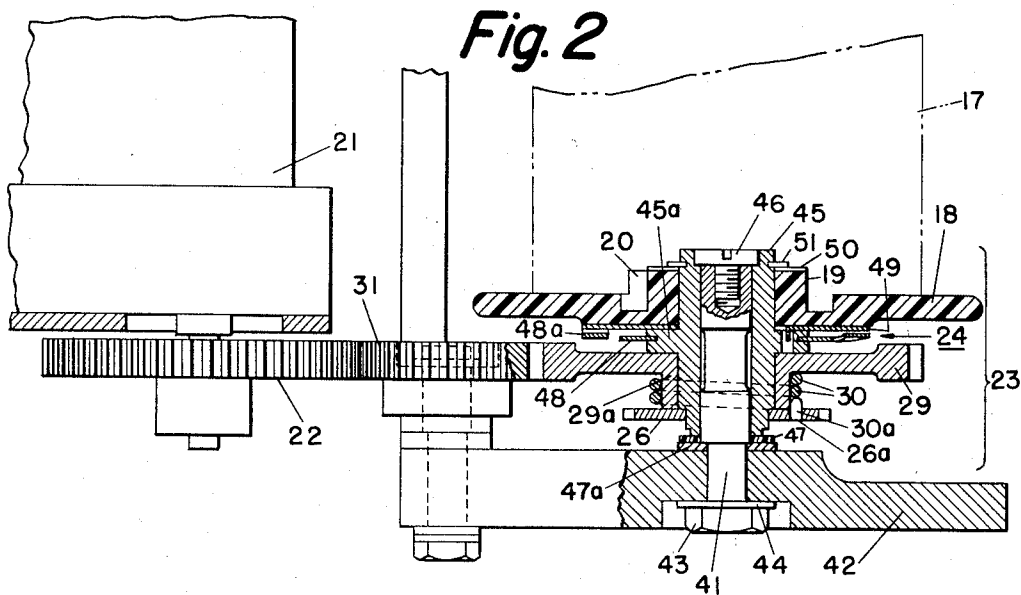
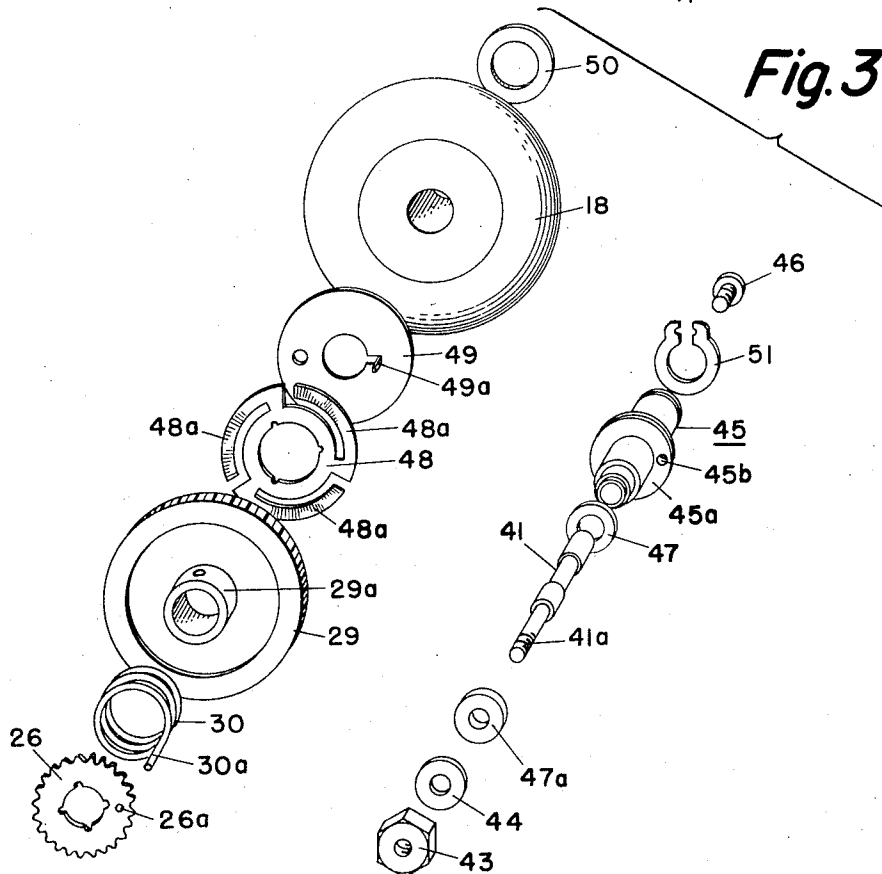
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2 Sheets-Sheet 2



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CHART-DRIVE MECHANISM FOR A STRIP-CHART RECORDER

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The present invention relates to a chart-drive mechanism for a strip-chart recorder of the type having a chart-drive roll and a chart takeup roll, and more particularly to a drive mechanism for driving a chart-takeup roll at a rate of speed higher than that of the chart-drive roll to apply tension to chart paper as it moves between the rolls and has for an object the provision of a simple compact motion-transmitting device mounted on a chart-takeup roll supporting structure for coupling the chart-drive roll and the chart-takeup roll to a driving motor, while permitting manual drive of the chart-drive roll independently from the driving motor.

In strip-chart recorders of the type employing a drive roll and a chart takeup roll or reroll, it is desirable to maintain the chart under tension as it is advanced during the course of recording thereon. The maintenance of tension is complicated by the fact that the chart-takeup roll continually changes its diameter as the chart paper is wound thereon, thus necessitating a constant change in speed of the chart-takeup roll in order to maintain the aforesaid tension. It is customary to provide means for rotating the reroll or takeup roll faster than the chart-drive roll and likewise to provide slip between the takeup roll and a drive mechanism so that the rotational speed of the chart-takeup roll will be governed by the diameter of the takeup roll and a predetermined tension will be constantly applied to the chart paper.

It is also desirable in strip-chart recorders to provide means for manually adjusting the position of the chart paper either to advance the position or to examine past records printed on those portions of the chart stored on the chart-takeup roll. In order to facilitate such examination and movement of the chart paper, it is advantageous to provide means for decoupling the chart-drive roll and the chart-takeup roll from the driving motor.

In accordance with the present invention, there is provided a simple, compact drive mechanism for a strip-chart recorder of the type including a chart-drive roll, a chart-takeup roll and a driving connection between the chart-drive roll and a chart-support roll. A driven element is rotatably mounted on a chart-takeup roll support means for connection to a driving motor to transmit motion to the chart-drive roll and the chart-takeup roll. Motion is transmitted to the chart-takeup roll by way of a slip clutch. The chart-takeup roll is driven at a speed maintaining tension on the chart. A second clutch is mechanically connected between the driven element and the driving connection and functions to provide a transmission of motion to the driving connection from the driven element when the element is driven in a chart-advancing direction and provides slip between the element and the driving connection when the driving connection is rotated in the same direction at a speed greater than that of the element.

More particularly, and in accordance with the present invention, there is provided an assembly comprising a takeup roll support means having a rotatable element. A sprocket is affixed to the rotatable element for connection

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to the chart-drive roll. The driven element comprises a gear having an extended hub portion and rotatable about the rotatable element. Motion is transmitted between the gear and the sprocket by way of a helical spring-type clutch, one end of which is secured to the sprocket and the helix of which is wound on the hub portion of the gear. A spring washer-type clutch is secured to the rotatable element and frictionally engages a portion of a takeup roll supporting flange mounted for rotation about the rotatable element.

For further objects and advantages of the present invention, reference may be had to the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagrammatic perspective view of a strip-chart recording and measuring system embodying the present invention;

Fig. 2 is a top view of a portion of the chart-drive mechanism partly in section;

Fig. 3 is an exploded view of a transmission assembly embodying a preferred form of the present invention; and

Fig. 4 is a cross sectional view of a clutch for the driving roll.

Referring now to the drawings, and more particularly to Fig. 1, the invention in one form has been shown broadly in a typical application where it functions to advance a chart while maintaining tension on the chart during the advancement. In Fig. 1, a chart 10 is threaded over driving pins 11 and 12 carried by a chart-driving roll or cylinder 13. The chart 10 is fed from a feed roll 14 and passes under rods 15 and 16 to be subsequently rewound on a takeup roll 17. Such supply rolls and takeup rolls may comprise drums, though in typical commercial applications the charts are wound upon tubular mandrels which when applied to the recorder are engaged by suitable chart-supporting flanges of a type illustrated in Fig. 4 of Moore Patent 2,690,951 which are pressed into co-operative relation with the respective ends of the mandrels. A typical reroll supporting flange is exemplified by the flange 18, Fig. 2, which is provided with a hub 19 for receiving the tubular mandrel of the takeup roll 17. The flange 18 includes an extending portion 20 which engages a corresponding slot in the mandrel of the takeup roll for driving engagement between the mandrel and the flange.

In Fig. 1, the driving roll or cylinder 13 is driven in a clockwise direction as is the takeup roll 17 by way of a driving means 21 which is illustrated as an electric motor. Both the driving roll 13 and the takeup roll 17 are coupled to a driving gear 22 of the motor 21 by way of a motion-transmitting assembly 23. The assembly 23, embodying the present invention, includes the features assuring that the chart will be held under tension as it is advanced between the chart-driving roll 13 and the takeup roll 17 and providing an automatic decoupling of the chart-driving roll and the takeup roll from the driving motor 21 upon manual advancement of the chart without interfering with the re-rolling of the chart onto the takeup roll.

Since the diameter of the roll 17 will be changing, growing larger as the chart 10 is advanced, there is provided in the motion-transmitting assembly a frictional drive or slip clutch 24 for the takeup roll so that the chart will be maintained in slight tension throughout the operation, thus to assure that the chart will be snugly wound upon the takeup roll. The speed of rotation of the driving means for the takeup roll 17 is so selected as to maintain the chart taut with minimum paper on the takeup roll, and hence as the diameter of the roll increases, the speed will be adequate to apply through the friction-driving means 24 a force which maintains the chart in tension throughout the subsequent operation.

The supply roll 14 need not be mechanically driven, the weight and friction involved being sufficient to maintain taut that part of the chart between the driving roll 13 and the supply roll 14.

The chart-driving roll 13 is mechanically connected to the driving gear 22 of the motor 21 by way of an overdriving arrangement including sprockets 25 and 26 and chain 27. The chain 27 is maintained taut about the sprockets 25 and 26 by way of a slack adjuster 28. The sprocket 25 is made larger than the sprocket 26 to effect an overdrive relation between the takeup roll 17 and the driving roll 13, i. e., the takeup roll 17, as aforesaid, will run faster than the drive roll. The sprocket 26 is connected by way of a clutch 30 to a driven element 29 mechanically coupled to an idler element 31 and the driving gear 22. The clutch 30, mounted in common assembly with slip clutch 24, is of the unidirectional or overrunning type and provides the feature of decoupling that chart-driving roll 13 from the motor 21 upon manual advancement of the chart in a manner hereinafter described.

A marker or pen 32 suitably driven by a cord or cable 33 is moved relative to the chart 10 in response to any condition under measurement to produce upon the chart 10 a record of the measured condition as presented by the line 34. In Fig. 1, a motor 35 through suitable gearing 36 and a drive shaft 37 moves the cable 33 to adjust the marker 32 in response to the magnitude of the condition which, as illustrated, may be temperature, the magnitude of which causes the production of an output signal from a thermocouple 38. The magnitude of the thermocouple signal is measured by a suitable measuring system 39, including slidewire 40, which may be of the type fully disclosed in Williams Patent 2,113,164. Such a measuring system includes means for controlling the motor 35 which is operated in sense and to extent corresponding with the change in voltage across the thermocouple 38. The motor 35 rotates a variable impedance, shown as the slidewire 40, relative to its associated contact to rebalance the measuring system 39 in a manner set forth in the aforesaid Williams patent.

In Fig. 2, the various elements comprising the motion-transmitting assembly 23 of the present invention are shown in operative relation. Reference may also be had to Fig. 3 during the following description for a more detailed illustration of the individual elements. In the preferred arrangement, the entire assembly 23 is mounted adjacent the takeup roll 17 on a stub shaft 41 having one end thereof connected to recorder frame structure 42 by the threaded end 41a of the shaft, a nut 43 and washer 44. The assembly 23 is secured on the shaft 41 as a unitary assembly by way of machine screw 46. The driven means or element 29, illustrated as a gear, is rotatably mounted on a rotary member or sleeve 45 which in turn is rotatably mounted on and concentric with the stub shaft 41. The sleeve bears against a bearing washer 47 formed of nylon or other material having a low friction characteristic. Interposed between a shoulder on the stub shaft and the recorder frame structure is a seat washer 47a.

The gear 29 is at all times mechanically connected to the motor 21, which may be of the synchronous type, by way of the idler gear 31 and the driving gear 22. The sprocket 26 is rigidly secured to one end of the sleeve 45 for rotation therewith and is mechanically coupled to the driven gear 29 by way of the unidirectional or overrunning clutch 30 preferably the helical spring type having one end connected to the sprocket 26. The connection between the spring 30 and the sprocket 26 may be effected by providing the sprocket with an aperture 26a for receiving an end 30a of the clutch spring 30. The helix of the spring 30 is formed about a hub portion 29a of the gear 29. Rotation of the gear 29 in one direction causes the helix of the spring 30 to tighten

about the hub portion 29a and thus effects a rigid driving connection between the driven gear, the sprocket 26 and the sleeve 45 to drive both the chart-drive roll 13 and the chart-takeup roll 17. Rotation of the sprocket 26, at a rate of speed exceeding that of the gear 29, as by manual driving of the chart-drive roll 13 causes the helix to expand and introduce slippage, thus to decouple the sprocket 26 and hence the chart-driving roll 13 from the gear 29 and motor 21.

The chart-driving roll 13 is driven at a rate slower than the rotational speed of the sprocket 26 and sleeve 45 by way of a speed-reducing means provided by making the sprocket 25 of larger circumferential size than the sprocket 26. Such a reduction in speed provides a portion of an arrangement for placing the chart 10 under tension during its advance independent from the amount of chart paper taken up on the roll 17 inasmuch as the takeup roll is adapted to rotate at the speed of the sleeve 45 in absence of slippage in the clutch 24.

Rotational motion is transmitted to the takeup roll 17 by way of the friction driving means or clutch 24, which is illustrated as a bidirectional type, comprised of a spring member 48 securely fastened as by staking to a hub 45a of the sleeve 45. In a preferred form, the member 48 is provided with three resilient contact fingers or leaves 48a (Figs. 2 and 3). A metallic disc 49 preferably of stainless steel may be interposed between the spring member 48 and the surface of the takeup-roll flange 18 to provide an even distribution of force between the flange and the spring and a more constant coefficient of friction in the drive connection between sleeve 45 and the flange which is usually formed of non-metallic material such as Bakelite. The disc 49 is locked against rotation relative to the hub 45 by way of an extending element 49a adapted to be received by a recess 45b formed in the hub. The flange 18 which is rotatably mounted on the sleeve 45 and held in position thereon by way of washer 50 and retaining ring 51 is adapted to be driven initially at the same rate of rotation as the sleeve 45 and hence at a faster rate of speed than the chart-driving roll 13. Accordingly, the takeup roll 17 will quickly tend to wind up the chart at a faster rate than it is being fed by the chart-drive roll 13. As the chart 10 becomes taut, slippage occurs between the disc 49 and the flange 18, and the rotational speed of the flange slows down while maintaining a substantially constant tension on the chart 10.

At times it is desirable to manually advance the chart 10 or to examine previously recorded portions of the chart stored on the takeup roll 17. The manual adjustment of the chart 10 is made readily attainable by the motion-transmitting assembly of the present invention which provides automatic decoupling of the takeup roll 17 and the drive roll 13 from the driving motor 21 when manual adjustment is effected. The advancement of the chart 10 is effected through manipulation as by rotating a knurled knob 52 (Fig. 1) which in turn rotates the driving roll 13 and sprockets 25 and 26. The sprocket 26 is rotated at a speed greater than the rotation of the driven gear 29 and causes a decoupling of this gear from the sprocket by effecting an expansion of the helical spring 30, thus disengaging the chart-driving roll 13 from a driving relation with the motor 21. The sleeve 45 rigidly connected to the sprocket 26 rotates freely therewith and transmits its rotation to the takeup-roll flange 17 through the slip clutch 24 to maintain the chart under tension during manual advancement.

Previously recorded portions of the chart 10 may be reviewed by turning a knurled knob 53 in a counter-clockwise direction. The knurled knob 53 is directly coupled to the flange 18 by way of the roll 17, and the roll is readily rotated free from the driving motor 21 due to slippage between the flange 18 and the disc 49 of clutch 24.

For small adjustments in the position of the chart

10 in a backward direction, there is provided a third clutch 54 mounted on the shaft of the driving roll 13. The clutch 54 is arranged to introduce slippage between the driving roll 13 and the sprockets 25 when the driving roll is rotated as by way of knob 52 in a counter-clockwise direction. Hence, through the operation of a single knob, it is possible manually to advance the chart paper or move it in an opposite or backward direction for the purpose, for example, to set a horizontal line in accordance with time.

A suitable clutch 54 is illustrated in Fig. 4 as comprised of a supporting member 55 secured to the drive-roll shaft 13a by way of set screws 56. The sprocket 25 is mounted on the supporting structure 55 and held against a hub portion thereof by means including a friction mat 57, spring washer 58, washer 59 and jam nuts 60. The ease with which slippage between the sprocket 25 and the supporting member 55 will occur can be adjusted by movement of the jam nuts 60 to increase or decrease the pressure applied to the sprocket by the friction mat 57 and the spring washer 58. In practice, adjustment is made such that during manual rotation of the driving roll 13 motion can be transmitted through the sprockets 25 and 26 to the takeup roll 17 without slippage of clutch 54 to advance the chart. Likewise, the adjustment is made so that no slippage will occur when motion is being transmitted from the driving motor 21 for advancing the chart. On the other hand, the adjustment is such that slippage will occur when the driving roll 13 is manually rotated in a counterclockwise direction. The force of such motion when transmitted to the sprocket 26 locks the clutch 30 to the driven element or gear 29 and thus the sprocket 25 is effectively locked in position and relative movement between the driving roll 13 and the sprocket may be effected to roll back a selected portion of the chart 10.

It will be understood that the clutch 54 is merely exemplary of one suitable type and that other types of clutches may be substituted therefor. In all cases the force required to cause slippage of the clutch 54 should exceed that required for slippage of clutch 24 and that of the clutch 30 when rotated in a clockwise direction.

What is claimed is:

1. A chart-driving mechanism for an indicating and recording instrument of the type in which chart paper is advanced by a chart-driving roll, and the recorded portions of the chart are stored on a chart-takeup roll, said driving mechanism comprising a driving motor, rotatable supporting means for one end of the chart-takeup roll, driven means mounted concentrically with respect to said supporting means and connected to said driving motor, a one-way clutch on said supporting means for providing a driving connection between said driven means and said supporting means, means for connecting said supporting means and the chart-driving roll to drive the chart-driving roll from said motor by way of said one-way clutch and said supporting means, said connecting means including speed-reducing means for driving the chart-driving roll at a rate of speed of rotation less than the speed of said supporting means, and a slip clutch mounted on said supporting means adjacent a side of said driven means opposite from said one-way clutch for imparting to the chart-takeup roll a rate of driving speed controlled by slippage in said slip clutch created by tension exerted upon the chart paper as it passes between the chart-driving roll and the chart-takeup roll.

2. In an indicating and recording mechanism of the type employing a strip chart movable between a chart-driving roll and a chart-takeup roll, the improvement which comprises driving means providing predetermined tension upon the chart paper, said driving means including rotatable supporting means for one end of the chart-takeup roll, a driving gear rotatable on said supporting means, a one-way clutch for mechanically connecting

said gear to said supporting means to transmit unidirectional rotation from said gear to said supporting means, means for transmitting the motion of said supporting means to the chart-driving roll to impart to said roll a speed of rotation less than that of said supporting means, a slip clutch having one element securely mounted on said supporting means adjacent a side of said gear opposite from said one-way clutch and effecting a frictional contact with the chart-takeup roll to impart to the chart-takeup roll a rotational speed determined by slippage of said slip clutch to place the chart paper under tension as it traverses the chart support, and means for imparting rotation to the chart-driving roll independently from said driving mechanism for advancing the chart paper, said one-way clutch providing a means for disconnecting said supporting means from said driving gear to permit independent adjustment of the chart paper by rotation of the chart-driving roll through said rotation-imparting means.

3. The chart-driving mechanism of claim 2 in which said one-way clutch is comprised of a helical spring having one end mechanically connected to said supporting means and the other end in frictional contact with said gear, said helical spring being contracted upon movement of said driving gear in one direction to effect the coupling between said driving gear and said supporting means and being expandable upon movement of said supporting means in the same direction at a rate in excess of the rate of said gear to disengage said supporting means from said driving gear to permit independent adjustment of the position of the chart paper.

4. In a strip chart recorder of the type having means supporting a chart-supply roll, a chart-driving roll, and means supporting a chart-takeup roll with overdrive means interconnecting said chart-driving roll and said chart-takeup roll supporting means, the improvement comprising driven means associated with a rotary member of the chart-takeup roll supporting means and imparting motion to the chart-driving roll solely through said rotary member in order to advance said chart as a function of a variable, said driven means being mounted for free rotation about said rotary member, an overdrive element fixedly mounted on said rotary member, a chart-takeup roll supporting flange mounted on said rotary member for rotation relative thereto, a unidirectional acting clutch between said driven means and said overdrive element and a bidirectional clutch between said driven means and said flange, and means connecting said rotary member and hence said overdrive element to a high torque transmitting clutch on said chart-driving roll positively thereby to provide said overdrive relation between said chart-driving roll and said chart-takeup roll in order to maintain tension on said chart, said unidirectional clutch between said chart takeup-roll overdrive element and said driven means permitting manual positioning of said chart in one direction by manual manipulation of said chart-driving roll.

5. In a strip chart recorder of the type including a chart-supply roll, a chart-driving roll, a chart-takeup roll with a driving connection between said chart-driving roll and a chart-takeup roll support means, and a bidirectional slip clutch between said chart-takeup roll support means and a chart-takeup roll flange, the chart-takeup roll being arranged to be driven at a higher rate of speed than the chart-driving roll thereby to maintain tension on a chart, the improvement comprising a driven element rotatably mounted on said chart-takeup roll support means, and a unidirectional clutch disposed adjacent a side of said driven element opposite from said bidirectional slip clutch and between said element and said driving connection, said unidirectional clutch functioning to provide a positive drive to said driving connection to rotate said chart-driving roll when said element is driven in a chart-advancing direction and to provide slip between said element and said driving con-

nection when said driving connection and said chart-takeup roll support means are driven in the same direction at a speed greater than that of said element.

6. The arrangement of claim 5 wherein said chart-takeup roll support means comprises an assembly including a rotatable element, a sprocket affixed to said rotatable element, said driven element comprising a gear with an extended hub portion rotatable about said rotatable element, a helical spring, one end of which is secured to said sprocket and the helix of which is wound on said hub, spring clutch elements secured to said rotatable element, and a chart-takeup roll flange secured for rotation about said rotatable element by a snap ring holding said flange against the working surface of said spring clutch elements.

7. A chart-driving mechanism for an indicating and recording instrument of the type in which chart paper is advanced by a chart-driving roll and the recorded portions of the chart are stored on a chart-takeup roll, said driving mechanism comprising a driving motor, coupling means for transmitting rotation of said driving motor to the chart-driving roll for advancement of the chart paper, said coupling means comprising a shaft for sup-

porting one end of the chart-takeup roll, a driven means rotatably mounted on said shaft and connected to said driving motor, a one-way clutch mounted on said shaft and engageable with said driven means for providing a driving connection between said driven means and said shaft, means for mechanically connecting said shaft and the chart-driving roll to drive the chart-driving roll from said motor by way of said driven means, said one-way clutch and said shaft, and means for driving the chart-takeup roll, said means comprising a bidirectional slip clutch having one element thereof secured for rotation with said shaft, the rate of rotation imparted to the takeup roll by said bidirectional slip clutch being controlled by slippage in said bidirectional slip clutch created by tension exerted upon the chart paper as it passes between the chart-driving roll and the chart-takeup roll.

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