June 29, 1965 C. A. BLAKESLEE ETAL 3,192,534

INDICATING APPARATUS

Filed Sept. 20, 1963 5 Sheets-Sheet 1

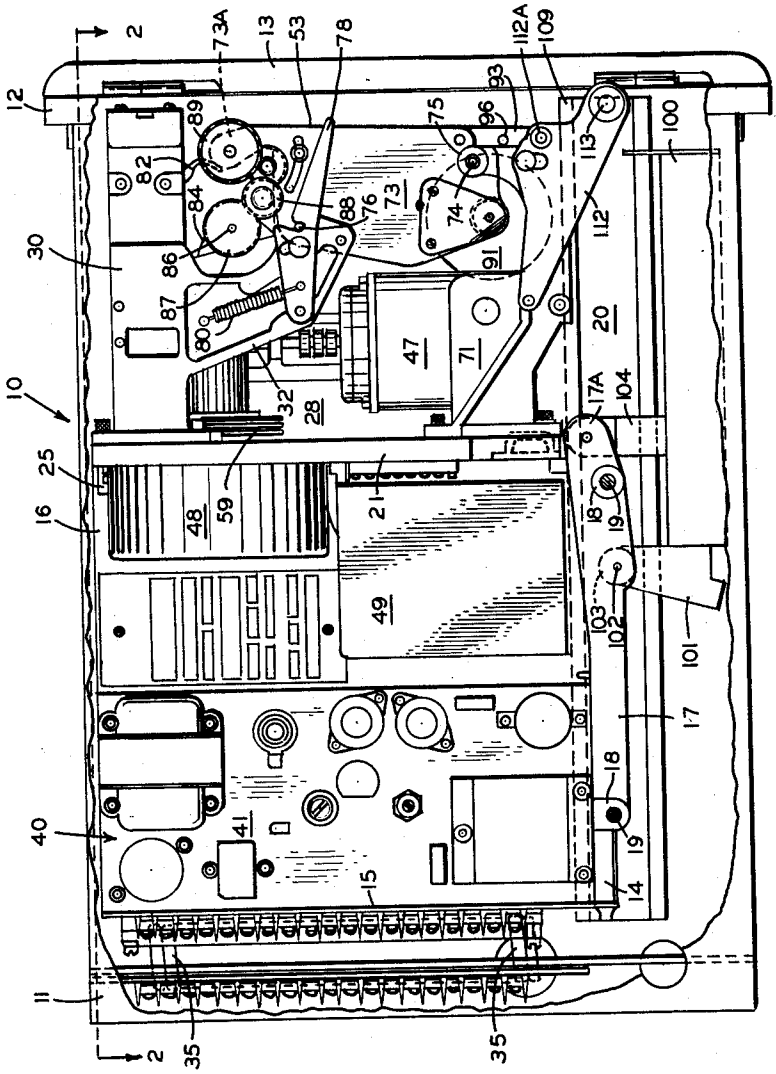


FIG. 1

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INDICATING APPARATUS

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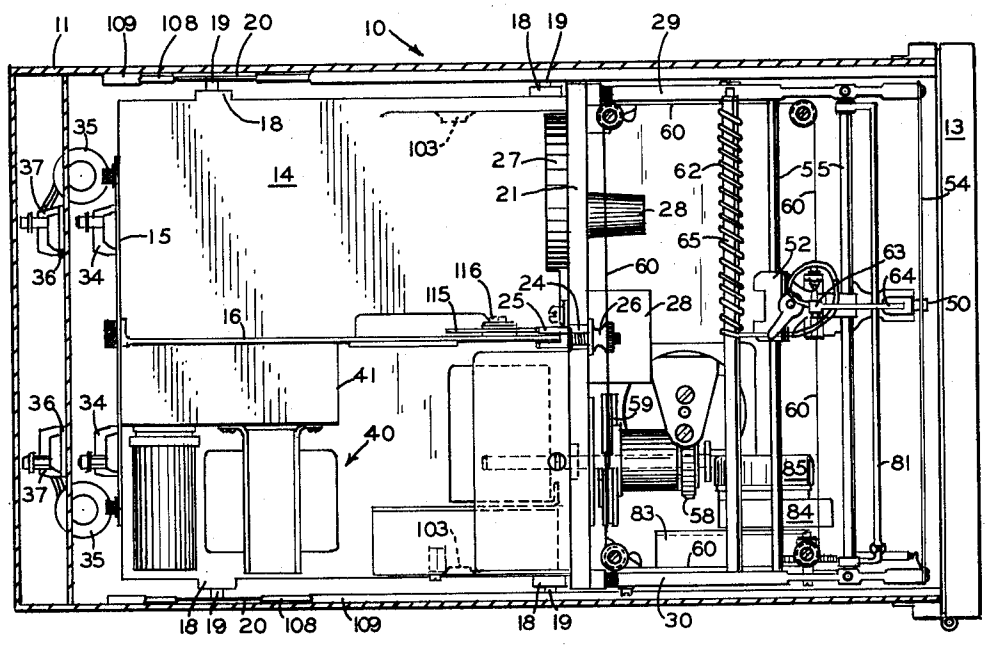


FIG. 2.

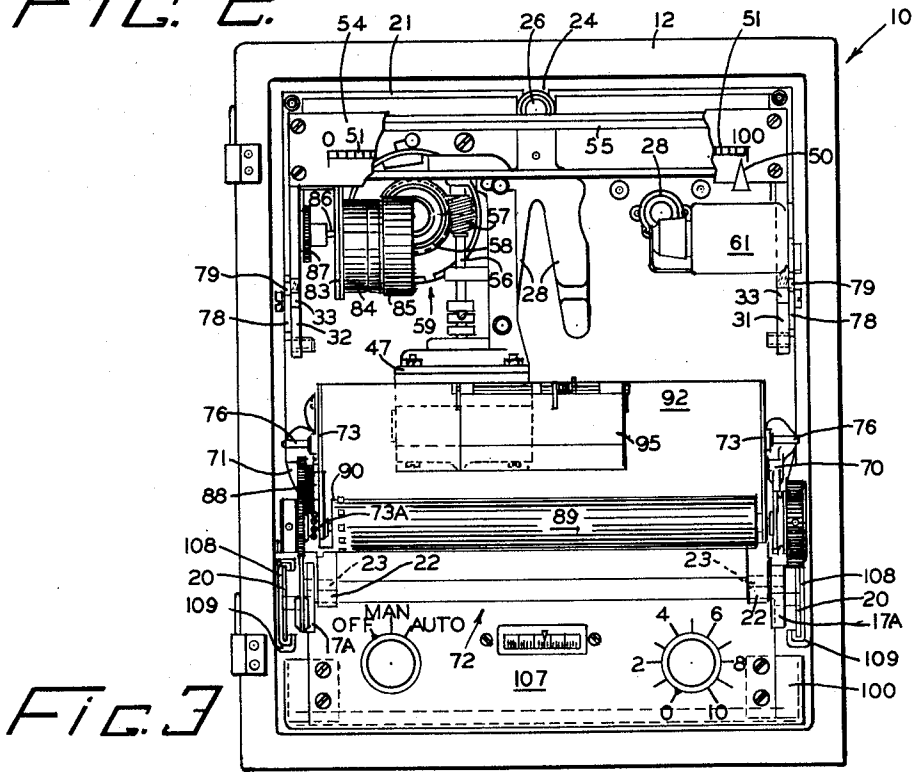


FIG. 3

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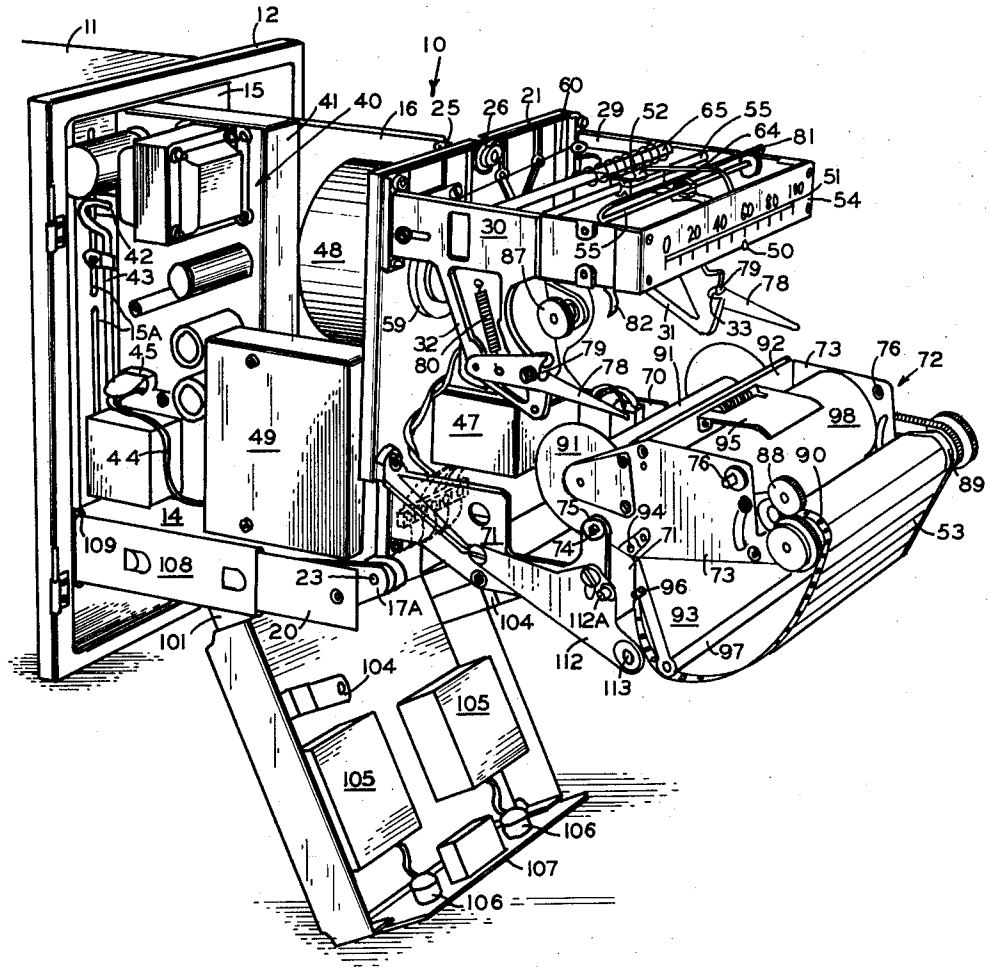


FIG. 4

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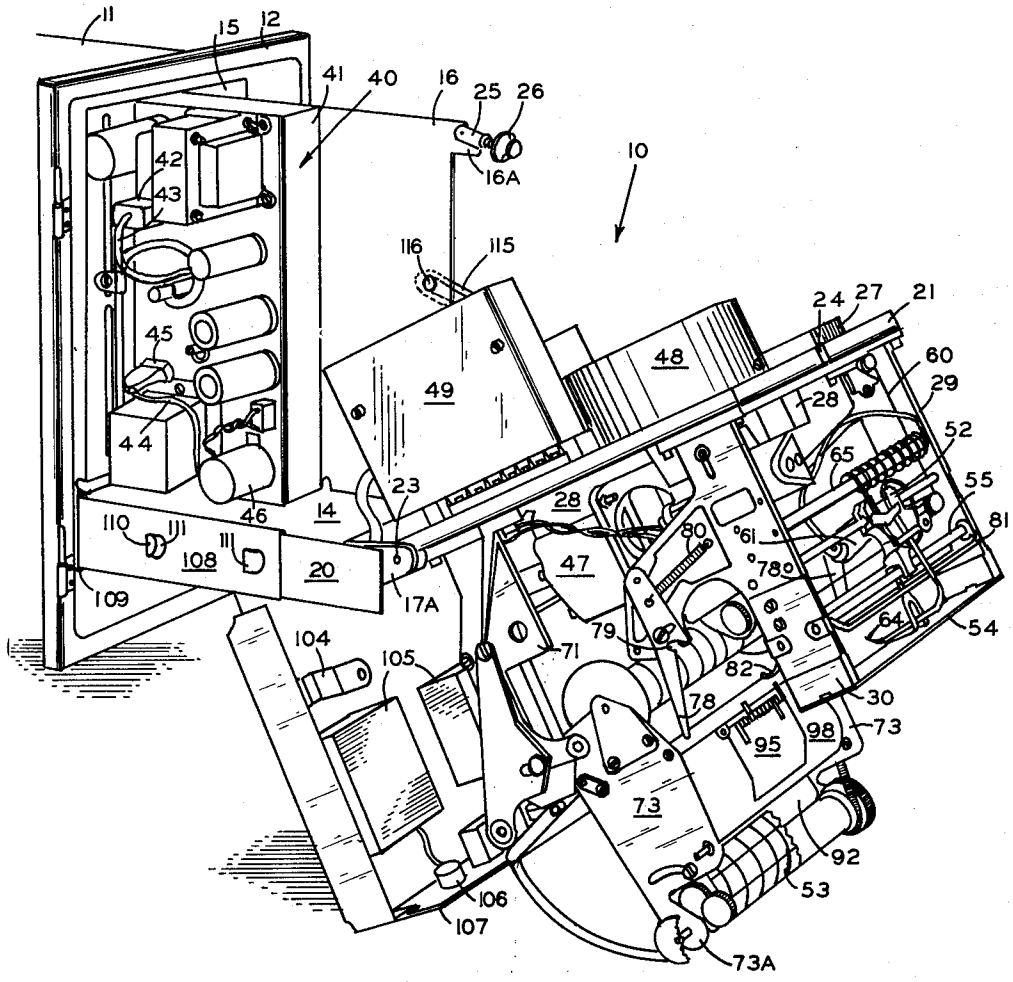


FIG. 5

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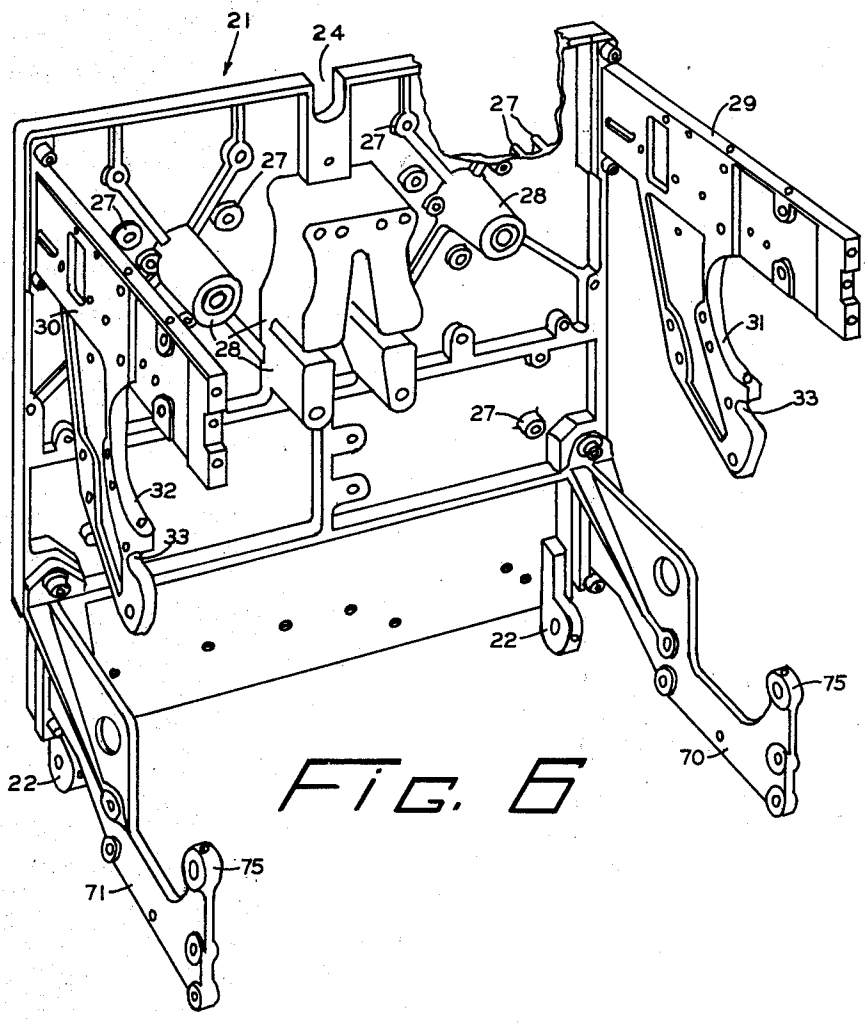


FIG. 6

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3,192,534

INDICATING APPARATUS

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Filed Sept. 30, 1963, Ser. No. 310,390
9 Claims. (Cl. 346—145)

This invention relates to panel-mounted instruments, and more particularly to "miniature" indicators, recorders, and controllers, or combinations of the same, adapted for removable installation in suitable mounting spaces provided in a panel structure.

In the operation and supervision of industrial processes, automation has resulted in larger and larger accumulations of instruments in centralized locations. This has led to the mounting of a multiplicity of instruments in more or less standardized panel structures for the purposes of facilitating access to control knobs, indicators, recorders, and the like for operation by supervisory personnel. The complexity and the large number of equipments necessarily present in such installations has led to a reduction in the size of the instruments. In order to reduce the panel area required by a given number of instruments, the trend has been to increase the front to back depth of standardized panel structures to receive a larger number of instruments of greater depth but substantially reduced frontal or panel area. Modern instruments are thus relatively long and narrow with a relatively small, usually square, panel projection.

It will be apparent that with a device of such proportions little in the way of servicing or adjustment can be done while the instrument is in place in the panel, necessitating its withdrawal for even such routine matters as inking the pen or changing the chart of a recorder. It is also evident that with a multiplicity of such long, narrow instruments, mounted in side-by-side and vertical relation in a panel structure, that all manipulations involved in servicing or adjusting an instrument must be effected from the front if there is to be a minimum of interference with adjacent units or the continued functioning of the instrument being worked on.

While substantial progress has been made in the provision of arrangements for facilitating the mounting, removal, and servicing of the larger instruments of the type described, such arrangements have left much to be desired particularly in the case of instruments of smaller frontal area.

It is, therefore, a principal object of the present invention to provide a new improved instrument for indicating, recording, and/or controlling one or more variable conditions in a process cycle.

A more specific object of the present invention is to provide an instrument of the above nature which is characterized by enhanced compactness and yet has a greater and unique degree of accessibility of the component parts thereof without interfering with its normal functioning.

Yet a further object is to provide a null-balancing potentiometer and bridge recording instrument of highly compact yet simplified construction in which the servo and recording components of the apparatus are so mounted with respect to the remainder thereof as to provide a unique degree of accessibility and ease in interchanging and servicing parts thereof.

A more specific object is to provide an improved mounting structure for a recording and indicating instrument which provides a remarkable degree of accessibility to the subcomponents of the instrument for inspection, servicing or repair with a minimum of interference with the operation of the instrument.

Further objects and advantages of the present invention will be apparent from the following detailed description of a preferred embodiment thereof and the accompanying drawings, in which:

FIGURE 1 is a side elevational view of apparatus constructed in accordance with the present invention and showing the parts fully seated within their case, part of which has been broken away;

FIGURE 2 is a sectional view taken through the line 2—2 of FIGURE 1;

FIGURE 3 is a front elevational view of the apparatus as shown in FIGURES 1 and 2 but with the chart drive assembly released and in its fully open position, the remainder of the instrument being fully seated within the case;

FIGURE 4 is a perspective view showing the apparatus fully advanced to its forwardmost operating position but with the chart drive assembly and a component-supporting tray both in their downward tilted position;

FIGURE 5 is a perspective view similar to FIGURE 4 but with the front assembly of the apparatus in its fully tilted position; and

FIGURE 6 is a perspective view of one of the members of the mounting structure.

Turning now to the drawings, the present invention will now be described in detail in connection with an electronic null-balancing potentiometer and bridge recording instrument utilizing a strip chart and a single pen. However, it is to be noted that the present invention is well suited for use with any desired type of indicating, recording, and/or controlling equipment. In particular, it is to be noted that the present apparatus may be readily modified for use with two recording pens. In addition, a circular chart may be utilized in place of the strip chart.

Recorder **10** is an indicating recording instrument comprising a casing **11** carrying a front frame **12** on which is removably hinged a door **13** having a transparent panel. In operation, recorder **10** is supported in a standardized panel structure (not shown) having an opening in which the front frame **12** of the casing is seated.

Removably mounted within casing **11**, as will be more fully pointed out hereinafter, is a main chassis assembly comprising a base **14**, an upstanding rear wall member **15**, and a generally centrally located partition member **16** extending from the back to the front of the chassis assembly.

Base **14** is conveniently formed as a casting and, as thus formed, is provided with a pair of rigidifying and supporting members **17**, one extending along each of its opposite sides. Each of the supporting members **17** is provided with a pair of bosses **18** (best seen in FIGURE 2) each of which is recessed to receive a stud **19** fixed to the adjacently disposed one of a pair of elongated slides **20**. Thus, base **14**, by its four bosses **18** is connected to and supported by the two oppositely disposed slides **20** by means of which the base **14** is freely movable into and out of case **11** while remaining connected thereto as will be more fully pointed out hereinbelow.

Supporting members **17** project forwardly of the base **14** and at their forward extremities form bearings **17A** to which is pivotally connected a transversely extending front frame wall member **21**. Wall member **21** may also be a die cast member and, as thus formed, is provided, at each of its opposite lower corners, with a boss **22** (best seen in FIGURES 3 and 6) in each of which there is fixed a pivot pin **23**. Each of the pivot pins **23** is rotatably supported in one of the bearings **17A**.

Extending downwardly from the upper edge of wall member **21** is a slot **24** formed in alignment with a projection **16A** (FIGURE 5) extending forwardly from the uppermost portion of partition **16**. Projection **16A** forms a convenient stop for wall member **21** when the

latter is in its raised position where it is releasably held latched by a threaded toggle 25 carrying a knurled nut 26 and pivotally connected to the projection 16A.

As has been pointed out, front frame wall member 21 is preferably a die casting and has integrally formed bosses 27 and standards 28 to facilitate the mounting of various operating components of the instrument yet to be described as well as a pair of forwardly extending upper support arms 29, 30. Support arms 29 and 30, preferably formed as die cast members, have downwardly extending extensions 31 and 32, respectively, each of which is formed with a forwardly presented notch 33. As in the case of wall member 21, arms 29, 30 together with the respective extensions 31, 32, as formed, are provided with suitably located bosses and openings to facilitate the mounting of various components.

Rear wall member 15 is preferably formed with a plurality of slots 15A, two of which are shown in FIGURE 4, to facilitate the mounting of binding posts 34. One or more multiple conductor extensible cables 35 are connected between the binding posts 34 and corresponding sets of binding posts 37 mounted on one or more brackets 36 fixed to the case 11. Cables 35 are each preset so as to form a compact coil when the instrument assembly is fully seated within the case 11. This may be facilitated, as in the present instance, by bringing one end of each of the cables 35 to the lower end of one of the vertical binding post arrays 34 on the rear wall member 15, the other end of the cable being connected to the upper end of the corresponding binding post array on one of the brackets 36 whereby, with the instrument assembly fully seated in its case, each cable 35 may form a vertically extending compact coil, as shown in FIGURES 1 and 2.

As has been pointed out, one instrument assembly in connection with which the present invention is especially advantageous is the illustrated null-balancing potentiometer and bridge recording instrument, the amplifier subassembly 40 of which, mounted on a subchassis 41, rests on base 14 and is connected to partition 16. As is most clearly shown in FIGURE 5, multiple pronged connector 42 on the end of multiple lead conductor 43 provides connections between the amplifier output terminals and the potentiometer balancing motor 47. The signal representative of the measured variable is led to the amplifier by means of conductors 44 and connector 45. The amplifier assembly which includes, among other things, a chopper 46, may be of any desired construction, the details of which form no part of the present invention and will, therefore, not be described further here. Suffice it to say here, that the output from the amplifier 40 is fed to the balancing motor 47 which operates to translate a movable contact (not shown) on a slide wire indicated generally at 48 forming part of the bridge network of the instrument enclosed within housing 49. At the same time, the balancing motor correspondingly shifts indicator 50 and the recording pen carriage 52 to provide an indication of the magnitude of the measured variable on a scale 51 and simultaneously draw a graph showing the variations thereof on the chart paper 53.

In the present instance, only the amplifier subassembly 40 is shown mounted on partition member 16 but it will be appreciated that other components as desired may also be mounted thereon. For example, when it is desired to have two recording pens in the instrument assembly, a second amplifier subassembly is readily mounted on partition member 16 and electrical isolation between the two is facilitated by mounting it on the opposite side of the partition member 16.

As has been pointed out, the front frame wall member has attached thereto oppositely disposed upper support arms 29 and 30 carrying extensions 31 and 32, respectively. The forwardly presented ends of the support arms 29 and 30 are interconnected and rigidified by a plate 54 which carries the scale 51. A pair of guide rods 55 are supported at their opposite ends by the upper support arms 29 and 30 and serve to support the recording pen and carriage 52 which is slidably mounted. The balancing motor which is supported on the forwardly presented surface of the wall member 21 is coupled through a suitable gear train to a drive shaft 56 (FIGURE 3) which in turn carries worm gear 57. The worm gear 57 is in mesh with a worm wheel 58 (FIGURE 3) secured to a pulley 59 to which the drive cord 60 is connected in the usual way for positioning the recording pen carriage 52 along its guide rods 55 in accordance with the direction and extent of rotation of the drive shaft 56. The indicator 50 is also fixed to the recording pen carriage 52 for movement therewith in relation to its scale 51.

An ink reservoir 61 mounted on the inwardly presented surface of the extension 31 provides a convenient supply of ink for the recording pen through a capillary tube 62 (FIGURES 2 and 5) loosely spirally wound around a support rod 65 supported by the upper support arms 29, 30 to the rear of the recording pen carriage 52, as is most clearly shown in FIGURE 2. The capillary tube 62 is connected as indicated at 63 (FIGURE 2) to the recording pen 64.

The front frame wall member 21 also has connected thereto a pair of oppositely disposed lower support arms 70 and 71, preferably formed as die cast members with suitably located bosses and apertures. These lower support arms 70 and 71 serve to pivotally support a chart drive assembly indicated generally at 72 as will now be described in detail. Except as will be pointed out hereinafter, the chart drive assembly may be a conventional construction, parts of which are mounted for mutual coaction from a pair of oppositely disposed side plates 73. Each of the side plates 73 has affixed thereto an outwardly extending pivot pin 74 which seats in a bearing 75 provided on each of the lower support arms 70 and 71. It will be noted that with the chart drive assembly in its operating position juxtaposed to the recording pen as shown in FIGURE 1, the pivot pins 74 are located in the vicinity of the lower forwardly presented portions of the side plates 73. Generally diagonally upwards and rearwardly from the pivot pins 74, each of the side plates 73 carries a latch pin 76 positioned to be received within the respective one of the notches 33 formed in the forwardly presented ends of the respective extensions 31 and 32. Pivotally mounted on each of the extensions 31 and 32 is a latching lever 78 having a notch 79 registering with the notch 33 formed in the associated extensions 31 and 32. Each of the latching levers 78 is biased by a spring 80 anchored to the associated one of the extension arms 31, 32. The latching levers 78 are biased upwards and serve to secure the latch pins 76 in their respective notches 33 on the extensions 31 and 32 to lock the chart drive assembly 72 in its vertical, normal operating position from which it is released by depressing the forwardly extending ends of the latching levers 78.

To avoid the possibility of damage or interference to the recording pen 64 when the chart drive assembly is released from its vertical position, a pen lifter 81, in the form of an elongated rod, is mounted for rotation about one of the guide rods 55 and is connected to a camming lever 82 (FIGURES 4 and 5) engaged by the curved portion 73A (FIGURE 3) of the left side plate 73. The pen lifter is spring biased so that when camming lever 82 is freed, then pen lifter 81 rotates counter clockwise, as viewed in FIGURE 4, to automatically raise the pen when the chart drive assembly is released from its vertical position. As the chart drive assembly is returned to its vertical position, curved portion 73A engages camming lever 82 to rotate the pen lifter clockwise and the pen returns to its normal inscribing position.

Referring to FIGURES 2 and 3, a support bracket 83 fixed to upper support arm 30 carries drive train hous-

ing 84 which is coupled to and supports a chart drive motor 85. The output shaft 86 of the drive train carries a gear wheel 87 which meshes with a gear wheel 88 mounted on the chart drive assembly. Gear wheel 88 through suitable gears drives a chart roller 89 having a toothed wheel 90, the teeth of which engage in the perforations provided along one margin of the chart paper 53. The chart drive roller 89 draws the chart paper from a supply spool 98 and feeds it past a platen to a rewind roll 91.

The platen has an upper portion 92 fixed between the side plates 73 and a lower portion 93 pivotally connected at 94 to each of the side plate 73 (only the connection to the left hand side plate 73 being visible in FIGURES 4 and 5). A spring biased friction plate 95 assists in maintaining the chart taut about the chart drive roll 89. The swingable platen portion 93 carries a pair of pins 96, each pin 96 projecting laterally outwardly from one of the opposite sides of the lower platen portion 93. These pins 96 engage and ride along the forwardly presented surfaces of the lower support arms 70, 71. When the chart drive assembly is released to drop forward and downward, the pins 96 moving along the lower support arms 70, 71 cause the lower platen portion 93 to pivot forwardly and upwardly relative to the fixed upper portion 92 of the platen. As most clearly shown in FIGURE 4, the chart guide bar 97 which extends along the lower edge of the platen portion 93 is brought closer to the chart drive roll 89 thereby slackening the chart to facilitate manipulation during servicing. The pivotal motion of the lower platen portion 93 also serves to reduce the extent of the downward and rearward displacement of the chart drive assembly when it is dropped from its normal operating position.

Additional components of the instrument may be conveniently mounted in auxiliary supporting means shown illustratively as a tray 100 pivotally mounted in front of the base 14 and below the chart drive assembly 72. Tray 100 at its rear carries a pair of oppositely disposed brackets 101 to which are fixed pivot pins 102. The pivot pins 102 are supported by bearings formed by bosses 103 formed on members 17. Tray 100 is provided with two upstanding resilient catches 104 which engage suitably located pins for holding the tray in its horizontal, raised position. In the present instance, range adjustment resistance spools indicated generally at 105 are mounted in the tray 100 and are connected to a potentiometer 106 mounted in a suitable face plate 107 removably carried by the tray 100 and extending across the front thereof.

As has been pointed out, the instrument is supported for movement relative to its case 11 by means of oppositely disposed slides 20. Each of the slides 20 is supported within a pair of nesting C-shaped rails 108 and 109. The outer C-shaped rails 109 are each fixed to the case 11, the inner C-shaped rails 108 being readily slidable within the rails 109 from the fully seated position shown in FIGURE 2 to the partially withdrawn position shown in FIGURES 4 and 5 where further movement of the rails 108 is arrested by suitably located releasable catches. Each of the slides 20 carries a resilient detent 110 which engages suitably located openings 111 formed in the rails 108 to arrest withdrawal of the instrument. One or more of the openings 111 may be formed in the rails 108 to provide convenient servicing locations to which the instrument may be withdrawn.

The instrument is held locked in its fully seated position within its case 11 by means of a pair of latches 112 carrying latch pins 112A. With the instrument fully seated within its case, as shown in FIGURE 1, the pins are engaged behind suitably located stops (not shown) fixed to the interior of the case 11 just above the rails 109. Latches 112 are spring biased and in order to withdraw the instrument from its case, it is only necessary to raise the finger pieces 113 in order to disengage the pins 112A from their stops.

While the instrument is in operation and fully seated within its case, the chart drive assembly may be released from its vertical position and lowered to the position shown in FIGURE 4 without withdrawing the instrument from the case or otherwise disturbing the instrument. Adjustment or renewal of the chart may be accomplished with the apparatus in this position. It is also to be noted that the instrument continues in operation and continuously displays the value of the measured variable along the scale 51.

When it is desired to have ready access to such parts as the bridge and slide wire or the amplifier subassembly, the finger pieces 113 are urged upwards and the instrument while continuing in operation, is withdrawn from its case to the required distance. Catches 104 are pressed outwards away from each other to disengage them and the tray 100 is lowered. The nut 26 is unscrewed thereby permitting toggle 25 to be freed from the front frame wall member 21 and the latter together with the chart drive assembly 72 which is supported thereby is lowered to the position shown in FIGURE 5 where it is held by a slotted link 115 connected at one end to the wall member 21 and slidably fixed to the partition 16 by a stud 116. With the front frame wall member 21, the chart drive assembly 72 and the tray 100 in their lowered position as shown in FIGURE 5, it is manifest that a unique degree of accessibility is provided for all of the components of the instrument without any need for taking the instrument out of operation. However, when it is desired to shut down the instrument, an off-on master switch (not shown) is conveniently mounted in a readily accessible position on one of the lower support arms 70 or 71. To reinsert the instrument in its case, the front frame wall member 21 is raised to its vertical position and reengaged by the toggle 25 and nut 26. Tray 100 may then be latched back in its horizontal position and the instrument can now be reinserted into the case. It is immaterial whether the chart drive assembly 72 is returned to its vertical position before or after the instrument is reseated in its case. In any event, it is only necessary to swing the chart drive assembly on its pivot pins 74 back to the vertical position where it is latched in place by the latching levers 78. The chart drive gear wheels 87 and 88 are preferably self-aligning so that they automatically mesh when the chart drive assembly is latched home. However, if for any reason the gear wheels 87 and 88 do not mesh, the arrangement is such that the operator is warned thereof by the fact that the latch pins 76 cannot seat in the notches 77. This condition may be readily corrected by a small rotation of the chart drive roll 89.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

We claim:

1. In an instrument for indicating the value of a variable magnitude, the combination of a base member having first means for receiving a variable signal representative of said magnitude and for providing an output representative of said signal, means for movably supporting said base member relative to a panel structure whereby said base member is selectively movable at will from a rearward position in which said base member is fully seated within said panel structure to progressively further forwardly withdrawn positions until said base member is fully withdrawn from said panel structure, a wall member transversely extending relative to and pivotally connected to said base member and movable therewith, second means carried by said wall member including indi-

cating means responsive to said output for indicating the value of said magnitude and a chart assembly cooperating with said indicating means, latching means for releasably securing said wall member in an upstanding position relative to said base member when the latter extends horizontally, means for pivotally connecting said chart assembly to said wall member with said chart assembly extending forwardly relative thereto, and means for maintaining said first and second means in operation when said base member is at least partially withdrawn from its fully seated position.

2. In an instrument as set forth in claim 1, auxiliary supporting means pivotally connected to and movable with said base member and extending below the same forwardly of said wall member, said auxiliary supporting means being swingable about its pivot from a closed position to an open position whereby to facilitate access to members supported thereon, and means for releasably latching said auxiliary supporting member in its closed position.

3. In an instrument as set forth in claim 1, a first pair of support arms connected in mutually spaced relation adjacent to one end of said wall member, a second pair of support arms connected in mutually spaced relation adjacent to the opposite end of said wall member for pivotally supporting said chart assembly, said support arms extending forwardly from said wall member, means operatively supporting said indicating means on said first pair of support arms, and means for releasably latching said chart assembly in juxtaposition to and for coaction with said indicating means.

4. In an instrument as set forth in claim 3 wherein said chart assembly includes platen means for supporting a chart in juxtaposition to said indicating means, said platen means including a pivotally mounted platen member movable relative to said chart assembly when the latter is swung about its pivot, and means for swinging said platen member from its normal operating position when said chart assembly is shifted about its pivot relative to said second pair of support arms.

5. In an instrument as set forth in claim 3, said indicating means including inscribing means cooperating with said chart, and means for automatically lifting said inscribing means when said chart assembly is released and pivoted on said support arms.

6. In an instrument for indicating the value of a variable magnitude having first means for receiving a variable signal representative of said magnitude and for providing an output representative of said signal as well as second means including a chart drive assembly and inscribing means responsive to said output for indicating the value of said magnitude upon a chart carried by said chart drive assembly, a base member, means for movably supporting said base member relative to a panel structure whereby said base member is selectively movable at will from a rearward position in which said base member is fully seated within said panel structure to progressively further forwardly withdrawn positions until said base member is fully withdrawn from said panel structure, said first means being supported on and movable with said base member, means pivotally connecting said chart drive assembly to said base member, means for releasably latching said chart drive assembly in operative relation to said inscribing means, said chart drive assembly including platen means for supporting a chart for coaction with said inscribing means, said platen means including a platen member pivotally supported on said chart drive assembly, means for swinging said platen member about its pivot relative to said chart drive assembly when the latter is pivoted relative to said base member, and means for maintaining said first and second means operative while said base member is in a partially withdrawn position and with said wall member pivoted relative to said base member.

7. A mounting structure for movably supporting, relative to a panel structure, an indicating and recording instrument having a plurality of subcomponents including a chart drive assembly and inscribing means, comprising a base member, means for movably supporting said base member relative to a panel structure whereby said base member is selectively movable at will from a rearward position in which said base member is fully seated within said panel structure to progressively further forwardly withdrawn positions until said base member is fully withdrawn from said panel structure, a wall member transversely extending relative to and movable with said base member and pivotally connected to the same adjacent to the front thereof for movement about a first horizontal axis, latching means for releasably securing said wall member in an upstanding position relative to said base member when the latter extends horizontally, upper and lower elongated support means connected respectively adjacent to the upper and lower ends of said wall member and projecting forwardly therefrom, means for pivotally supporting said chart drive assembly on said lower support means for movement about a second horizontal axis parallel to said first horizontal axis, means on said upper support means for supporting said inscribing means for coaction with a chart carried by said chart drive assembly, and means on said upper support means for releasably holding said chart drive assembly in its normal operating position with a chart carried thereby juxtaposed to said inscribing means.

8. A mounting structure as set forth in claim 7 wherein a partition member extends longitudinally along said base member and transverse to said wall member, and said wall member latching means includes a toggle connected to said partition and projecting forwardly therefrom for engaging said wall member.

9. A mounting structure as set forth in claim 8 wherein said base member has a pair of projections extending forwardly therefrom and forming bearings on opposite sides of said base member, and a pair of pivot pins one connected to each of the opposite sides of said wall member adjacent to the lower end thereof and rotatably supported in one of said bearings.

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LEO SMILOW, *Primary Examiner.*