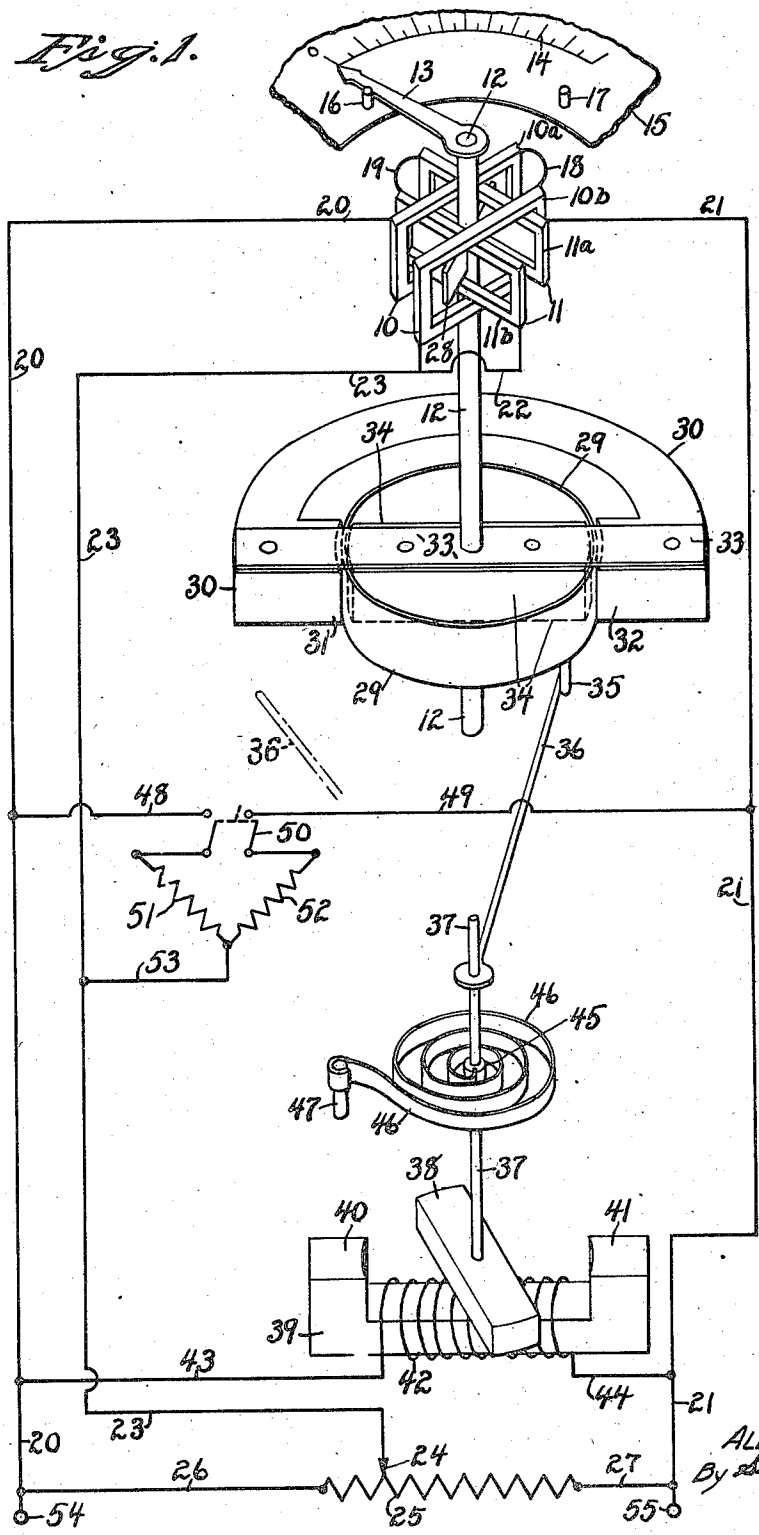
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ELECTRICAL MEASURING-INSTRUMENT

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Fig. 1.



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ELECTRICAL MEASURING INSTRUMENT

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The present invention relates to improvements in electrical measuring-instruments such, for instance, as ratio-meters, power-factor meters, and other electrical measuring-instruments in which it may be desired to automatically reset an indicator without normally imposing a load thereon.

One of the objects of the present invention is to provide a superior electrical measuring-instrument having simple, reliable and effective means for automatically resetting the indicator thereof without interfering with the accurate functioning of the instrument.

Another object of the present invention is to provide an electrical measuring-instrument with superior means of the character referred to, and which will function despite wide variations in the applied voltages.

A further object of the present invention is to provide a superior electrical measuring-instrument of the character referred to which will not appreciably fluctuate or hunt when sudden changes occur in the applied voltages.

Still another and more specific object of the present invention is to provide a superior ratio-meter having automatic means for resetting the indicator thereof, and so constructed and arranged as not to interfere with the accurate functioning of the ratio-meter.

A still further specific object of the present invention is to provide a superior ratio-meter having resetting-means of the character referred to, combined with means for minimizing the fluctuating or hunting effects of rapid changes in the applied voltages.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art and which are not claimed in any separate application.

In the accompanying drawing, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a schematic view of an electrical measuring-instrument in the form of a ratio-meter embodying the present invention.

The particular electrical measuring-instrument chosen for purposes of making clear one form of the present invention as illustrated in the accompanying drawing, includes two complemental coils 10 and 11 respectively divided into coil-sections 10*a*—10*b* and 11*a*—11*b*. The coil-sections 10*a* and 10*b* extend parallel with each other in laterally-spaced-apart relationship and are respectively located on opposite sides of a shaft or arbor 12. The coil-sections 11*a* and 11*b* of the coil 11 also extend in parallelism with each other on respective opposite sides of the shaft 12, but are obliquely disposed with respect to the coil-sections 10*a* and 10*b*.

In the instance shown, the coils 10 and 11 and hence their respective coil-sections 10*a*—10*b* and 11*a*—11*b* are of rectangular ring-like form and are so arranged that the coil-sections 11*a* and 11*b* extend obliquely through the coil-sections 10*a* and 10*b*. Thus, the shaft or arbor 12 extends vertically in parallelism with the faces of the coil-sections 10*a*—10*b* and 11*a*—11*b* and is "enclosed," so to speak, within the substantially-rectangular outline provided by the respective central portions of the four coil-sections above referred to.

The upper end of the shaft 12 is provided with a radially-extending rigid pointer or indicator 13 adapted to sweep over an arcuate series of indicia 14, which latter are printed or otherwise applied to the surface of a dial-plate 15.

Adjacent each of the ends of the series of indicia 14 the dial-plate 15 is provided with two upstanding stop-pins 16 and 17, which are adapted to be engaged by and to limit the movement of the pointer 13.

The coil-sections 10*a* and 10*b* of the coil 10 are electrically interconnected as at 18, while the coil-sections 11*a* and 11*b* of the coil 11 are similarly interconnected at 19. One terminal of the coil 10 is connected to a line-wire 20 which is the complement of a second line-wire 21, both of which lead to any suitable source of A. C. or D. C. voltage which it is desired to have applied to the electrical measuring-instrument shown.

The remaining terminal of the coil 10 is interconnected by a wire 22 to one of the terminals of the coil 11, and the said wire 22 is connected by means of a wire 23 to the adjustable contact 24 of a resistor 25. The remaining terminal of the coil 11 is, as shown, connected to the line-wire 21. The resistor 25 has its respective opposite terminals connected by wires 26 and 27 to the complemental line-wires 20 and 21.

The parts 10 to 19 inclusive, above described, compose what is commonly referred to as a "ratio-meter." In the instance shown, therefore, the forces respectively developed by the coils 10 and 11 at any given instant, while variable relative to each other, are, however, always such as to oppose each other in their respective efforts to move an armature 28 rigid

with and extending diametrically with respect to the shaft 12.

As schematically illustrated in the accompanying drawing, the lower portion of the shaft 12, which carries both the pointer 13 and the armature 28, has rigidly mounted thereon a damping-cup 29 which may be formed of aluminum or other suitable material in which eddy-currents may be readily generated. Embracing part of the periphery of the damping-cup 29 is a damping-magnet 30 having two opposed pole salients 31 and 32 respectively located at diametrically-opposite sides of the damping-cup 29. Extending transversely between the pole salients 31 and 32 and hence diametrically across the damping-cup 29, is a bridge-member 33 preferably formed of non-magnetic material and rigidly secured at its respective opposite ends to the pole salients 31 and 32 just referred to. Located within the damping-cup 29 and supported by the bridge-member 33 is a second or bar-like damping-magnet 34 having its respective opposite ends aligned with the pole salients 31 and 32 of the damping-magnet 30.

Preferably, both the damping-magnet 30 and the damping-magnet 34 are formed of a permanent magnet material, though one thereof may be formed of non-permanent magnet material such, for instance, as soft iron.

The inner face of the pole salient 31 and the adjacent face of the damping-magnet 34 are spaced from each other to freely accommodate between them the flange of the damping-cup 29. Similarly, the inner face of the pole salient 32 of the adjacent face of the damping-magnet 30 is spaced from the adjacent face of the bar-like damping-magnet 34 to also accommodate the flange of the damping-cup 29.

From the foregoing it will be seen that the turning of the cup in the gaps between the damping-magnets 30 and 34 will develop in the flange of the said cup, eddy-currents which oppose the rapid movement of the damping-cup and hence also oppose the rapid movement of the shaft 12 and pointer 13. The more rapid the movement, the greater the opposing force acting as a damper or brake. In this manner, undue fluctuations in the movement of the pointer 13 are eliminated without interfering with the correct functioning of the latter and its associated parts.

The damping-cup 29 is provided with a downwardly-extending restoring-pin 35, which latter is adapted to be engaged by the outer end of a restoring-arm 36 in a manner as will more fully hereinafter appear. The said restoring-arm 36 is in the instance shown, rigidly attached to the upper portion of a vertical shaft 37, located in a vertical plane forwardly (as viewed in the drawing) with respect to the plane of the shaft 12. The said shaft 37 (like the shaft 12) may be supported in any suitable bearing (not shown), and has rigidly attached to its lower end a bar-like retracting-armature 38. The path of movement of the retracting-armature 38 is "embraced," so to speak, by a U-shaped retracting-magnet 39 having laterally spaced-apart pole salients 40 and 41 which are adapted to attract the respective adjacent ends of the retracting-armature 38, all in a manner as will more fully hereinafter appear.

The central portion of the retracting-magnet 39 has extending therearound an energizing-coil 42 having one terminal connected by means of a wire 43 to the line-wire 20, and having its opposite terminal connected by means of a wire 44 to the line-wire 21. In instances where the measuring-instrument is to be used in connection with alterating current, it is preferred that the retracting-armature 38 and the retracting-magnet 39 be formed of sintered iron, or of laminated iron of soft steel, in order to avoid undue heating under the influence of such alternating current.

Intermediate the restoring-arm 3 and the retracting-armature 38, the shaft 37 is provided with a hub 45 rigidly connected to the said shaft and having connected to it in turn, the inner end of a spiral restoring-spring 46 having its outer end secured to a normally stationary pin 47. The restoring-spring 46 is of spiral form and corresponds generally in character to so-called "hair-springs" common in clocks and electrical instruments.

A wire 48 and a wire 49 respectively extend inwardly from the line-wires 20 and 21 to the complemental contacts of a double-pole switch 50. The blades of the said switch 50 are respectively connected to the adjacent ends of similar coils 51 and 52, while the opposite terminals of the said coils are connected together and jointly connected by means of a wire 53 to the wire 23 leading to the contact 24 of the resistor 25.

The coils 51 and 52 correspond in their respective impedances to the coils 10 and 11, and provide a duplicate or "dummy" load for purposes as will more fully hereinafter appear.

Preferably, all of these elements above described would be enclosed within a suitable single case, in which case the so-called line-wires 20 and 21 would be provided respectively with terminals 54 and 55, to which may be connected suitable wires providing the voltages which are to be applied to the instrument-assembly above described.

Under the conditions shown by full lines in the drawing, no voltage is applied across the terminals 54 and 55, and hence the restoring-spring is acting through the intermediary of the shaft 37, restoring-arm 36, restoring-pin 35, damping-cup 29 and the shaft 12, to turn the pointer 13 into zero (or other desired position) and against the stop-pin 16. It will be noted that under these conditions the retracting-armature 38 is out of registry with the pole salients 40 and 41 of the retracting-magnet 39.

As soon as suitable voltages are applied to the terminals 54 and 55, the retracting-magnet 39 will be energized through its energizing-coil 42 and will immediately draw the retracting-armature 38 into alignment with the pole salients 40 and 41. This action will swing the restoring-arm 36 in a counterclockwise direction over into the position in which it is indicated by broken lines and, therefore, out of position to in any way interfere with the movement of the restoring-pin 35 or the damping-cup 29 and its associated parts.

Thus, by the described movement of the retracting-armature 38 and associated parts, the tension of the restoring-spring 46 will be overcome to thus leave the ratio-meter or its equivalent free to function accurately and unhindered.

When the voltage across the two terminals 54 and 55 is cut off or reduced below a predetermined minimum value, the restoring-spring 46 will assert itself and will turn the shaft 37 in a clockwise direction (as viewed in the drawing), thereby causing the restoring-arm 36 to engage

with the restoring-pin 35 to thus effect the turning of the pointer 13 and its associated parts, back into the position in which they are shown by full lines in the drawing.

The energizing-coil 42 of the retracting-magnet 39 is preferably so proportioned, that despite wide fluctuations in the voltages applied across the terminals 54 and 55, the force developed by the retracting-magnet will be sufficient to maintain the retracting-armature 38 in alignment with the pole salients 40 and 41, and thus maintain the restoring-arm 36 or its equivalent in an inactive position against the ever present counter-urge of the restoring-spring 46.

And sudden changes in the ratios between the respective voltages applied across the terminals of the coils 10 and 11 of the instrument, would normally tend to cause a very rapid movement of the pointer 13 which would cause vibration of the latter in its "hunting" efforts to arrive at a proper value. Such rapid movement of the pointer 13 and the consequent hunting movements thereof, will be effectively damped-out by the eddy currents developed in the damping-cup 29 when the same is moved with respect to the damping-magnets 30 and 34. The shaft 12 and the parts connected thereto will not be prevented from functioning, but will merely be slowed down to thus avoid the undesirable effects before referred to.

In instances where two ratio-meters or the like would ordinarily be connected to a source of voltage, the cutting out of one such ratio-meter would be very apt to cause inaccuracies in the ratio-meter which remains connected. To counteract such effect and to enable a single ratio-meter or the like to give accurate indications, the dummy load comprising the coils 51 and 52 is provided. Thus, when another ratio-meter or the like is cut off from the voltage source supplying the terminals 54 and 55, the conditions may be restored by closing the switch 50, and thus, in effect, imposing a dummy load substantially equivalent to another ratio-meter.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. An electrical measuring-instrument, including in combination: an indicator; electrical actuating-means for deflecting the said indicator; a restoring-spring; restoring-means operated by the said restoring-spring and constructed and arranged to yieldingly hold the said indicator in a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; and a retracting-armature operatively connected to the said restoring-means and to the said restoring-spring and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-means into a retired position against the urge of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator.

2. An electrical measuring-instrument, including in combination: an indicator; electrical actuating-means for deflecting the said indicator; a restoring-spring; restoring-means operated by the said restoring-spring and constructed and arranged to shift the said indicator in one direction only into a predetermined position; a retracting electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; and a retracting-armature operatively connected to the said restoring-means and to the said restoring-spring and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-means into a retired position against the urge of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator.

3. An electrical measuring-instrument, including in combination: an indicator-shaft; an indicator carried by the said indicator-shaft; electrical actuating-means for deflecting the said indicator; a first restoring-abutment carried by the said indicator-shaft; a second restoring-abutment engageable with the said first restoring-abutment to shift the said indicator into a predetermined position; a restoring-spring operatively connected to the said second restoring-abutment and constructed and arranged to yieldingly engage the said second restoring-abutment with the said first restoring-abutment to shift the said indicator into a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; and a retracting-armature operatively connected to the said second restoring-abutment and located in the magnet field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said second restoring-abutment into a retired position against the tension of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator.

4. An electrical measuring-instrument, including in combination: an indicator-shaft; an indicator carried by the said indicator-shaft; electrical actuating-means for deflecting the said indicator; a restoring-abutment carried by the said indicator-shaft; a restoring-lever engageable with the said restoring-abutment to shift the said indicator into a predetermined position; a restoring-spring operatively connected to the said restoring-lever and constructed and arranged to yieldingly engage the said restoring-lever with the said restoring-abutment to shift the said indicator into a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; and a retracting-armature operatively connected to the said restoring-lever and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-

armature being constructed and arranged to automatically retract the said restoring-lever into a retired position against the tension of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator.

5. An electrical measuring-instrument, including in combination: an indicator-shaft; an indicator carried by the said indicator-shaft; electrical actuating-means for deflecting the said indicator; a restoring-abutment carried by the said indicator-shaft; a restoring-lever engageable with the said restoring-abutment to shift the said indicator into a predetermined position; a restoring-shaft located adjacent the said indicator-shaft and carrying the said restoring-lever; a restoring-spring operatively connected to the said restoring-shaft and constructed and arranged to turn the latter to yieldingly engage the said restoring-lever with the restoring-abutment of the said indicator-shaft to shift the said indicator into a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; and a retracting-armature operatively connected to the said restoring-shaft and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically turn the said restoring-shaft to retract the said restoring-lever into a retired position against the tension of the said restoring-spring when the said retracting electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator.

6. An electrical measuring-instrument, including in combination: an indicator; electrical actuating-means for deflecting the said indicator; a restoring-spring; restoring-means operated by the said restoring-spring and constructed and arranged to yieldingly hold the said indicator in a predetermined position; a retracting electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said restoring-means and to the said restoring-spring and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-means into a retired position against the urge of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator; a damping-member operatively connected to the said indicator; and a damping-magnet associated with the said damping-member to retard the rapid movement thereof.

7. An electrical measuring-instrument, including in combination: an indicator; electrical actuating-means for deflecting the said indicator; a restoring-spring; restoring-means operated by the said restoring-spring and constructed and arranged to shift the said indicator in one direction only into a predetermined position; a retracting electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said restoring-means and to the said restoring-spring and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-means into a retired position against the urge of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator, a damping-member operatively connected to the said indicator; and a damping-magnet associated with the said damping-member to retard the rapid movement thereof.

8. An electrical measuring-instrument, including in combination: an indicator-shaft; an indicator carried by the said indicator-shaft; a damping-member also carried by the said indicator-shaft; electrical actuating-means for deflecting the said indicator; a first restoring-abutment carried by the said indicator-shaft; a second restoring-abutment engageable with the said first restoring-abutment to shift the said indicator into a predetermined position; a restoring-spring operatively connected to the said second restoring-abutment and constructed and arranged to yieldingly engage the said second restoring-abutment with the said first restoring-abutment to shift the said indicator into a predetermined position; a retracting electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said second restoring-abutment and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said second restoring-abutment into a retired position against the tension of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator; and a damping-magnet associated with the aforesaid damping-member to retard the rapid movement thereof.

9. An electrical measuring-instrument, including in combination: an indicator-shaft; a damping-member operatively connected to the said indicator-shaft; an indicator carried by the said indicator-shaft; electrical actuating-means for deflecting the said indicator; a restoring-abutment carried by the said indicator-shaft; a restoring-lever engageable with the said restoring-abutment to shift the said indicator into a predetermined position; a restoring-spring operatively connected to the said restoring-lever and constructed and arranged to yieldingly engage the said restoring-lever with the said restoring-abutment to shift the said indicator into a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said restoring-lever and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-lever into a retired position against the tension of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means;

and a damping-magnet associated with the said damping-member to retard the rapid movement thereof.

10. An electrical measuring-instrument, including in combination: an indicator-shaft; an indicator carried by the said indicator-shaft; a restoring-abutment carried by the said indicator-shaft; a damping-member also carried by the said indicator-shaft; a restoring-lever engageable with the said restoring-abutment to shift the said indicator into a predetermined position; a restoring-shaft located adjacent the said indicator-shaft and carrying the said restoring-lever; a restoring-spring operatively connected to the said restoring-shaft and constructed and arranged to turn the latter to yieldingly engage the said restoring-lever with the restoring-abutment of the said indicator-shaft to shift the said indicator into a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said restoring-shaft and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically turn the said restoring-shaft to retract the said restoring-lever into a retired position against the tension of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical-actuating means; and a damping-magnet associated with the said damping-member carried by the said indicator-shaft to retard the rapid movement of the latter.

11. An electrical measuring-instrument, including in combination: an indicator; electrical actuating-means for deflecting the said indicator; a restoring-spring; restoring-means operated by the said restoring-spring and constructed and arranged to yieldingly hold the said indicator in a predetermined position; a retracting-electromagnet; connecting-means electrically interconnecting the said electrical actuating-means and the said retracting-electromagnet to provide for the concurrent energization of both thereof; a retracting-armature operatively connected to the said restoring-means and to the said restoring-spring and located in the magnetic field developed by the said retracting-electromagnet, the said retracting-armature being constructed and arranged to automatically retract the said restoring-means into a retired position against the urge of the said restoring-spring when the said retracting-electromagnet is energized coincidentally with the said electrical actuating-means of the said indicator; a dummy-load having a resistance substantially corresponding to the resistance of the aforesaid electrical actuating-means; and switch-means constructed and arranged to selectively connect the said dummy-load in parallel with the said electrical actuating-means.

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