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MACHINE FOR WINDING RESISTANCE COILS

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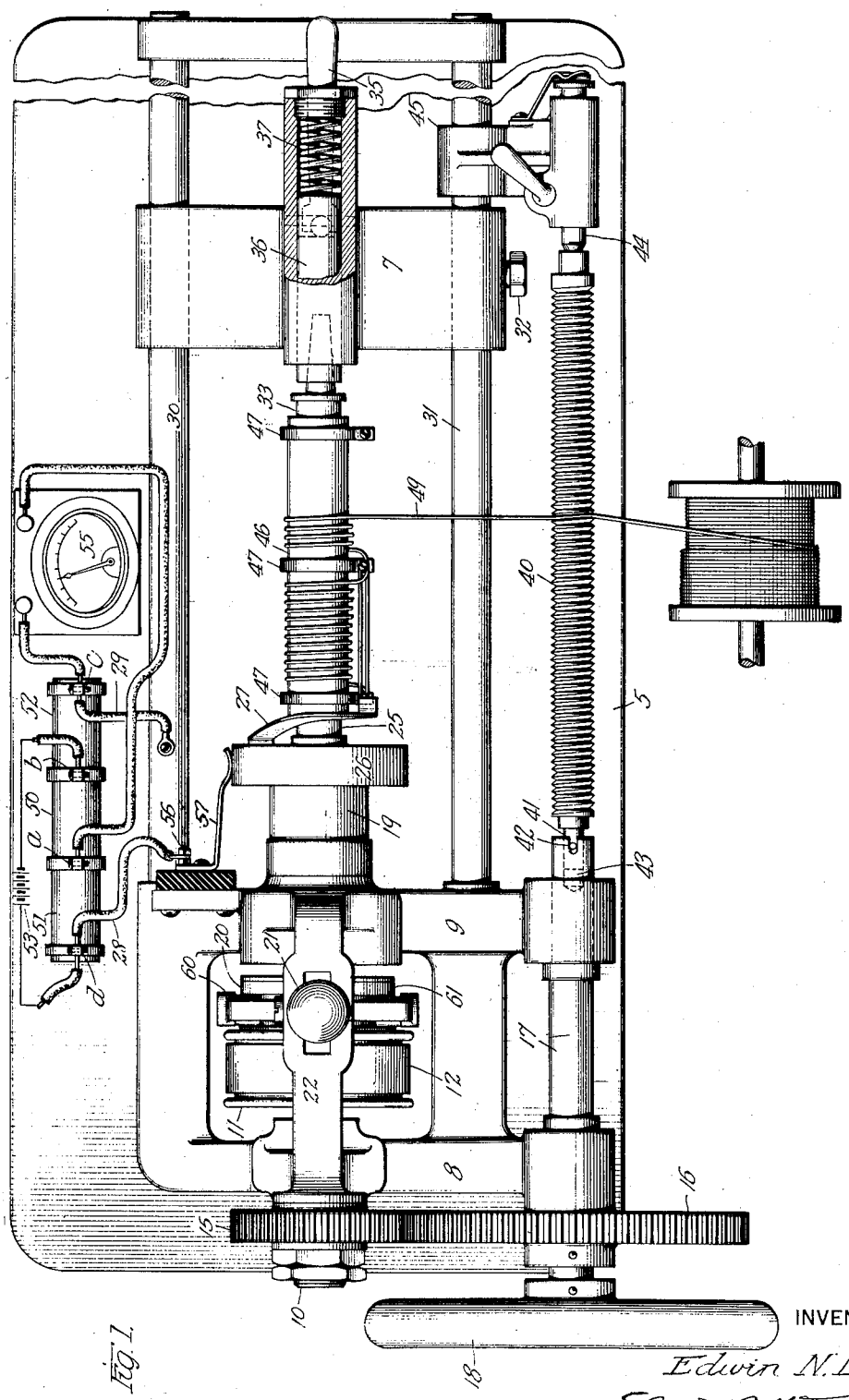


Fig. 1

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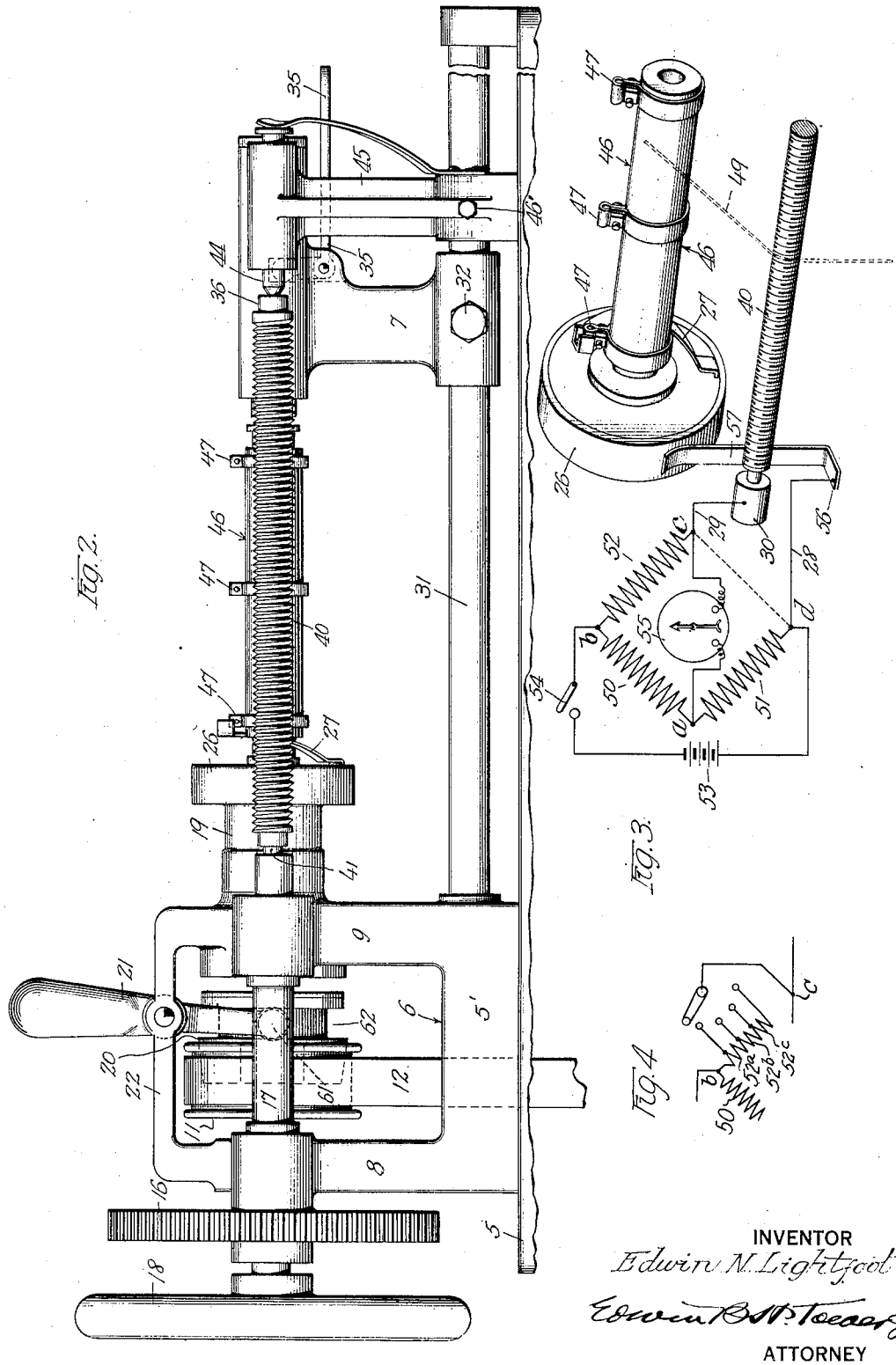


Fig. 2.

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR WINDING RESISTANCE COILS.

Application filed April 14, 1920. Serial No. 373,867.

This invention relates to machines for winding resistance coils.

An object of the invention is to provide an improved machine for winding resistance coils whereby the wire wastage is reduced to a minimum.

When resistance coils are wound by winding onto a supporting spool the number of calculated turns of wire to produce a coil of predetermined resistance, frequently the resistance of the coils so produced is less than the predetermined value. This is due to variations in composition and size of the wire. Furthermore, due to the variations in the wire it is practically impossible to determine in advance the number of turns of wire to produce a coil of the required resistance. It becomes necessary therefore to wind on more than the calculated number of turns to insure that a coil of the required resistance is produced. The resistance of such coils must then be measured and the surplus turns removed. Such practices not only result in wastage of the wire, but require needless and expensive handling of the coils.

The improved machine for winding resistance coils according to the present invention avoids this rehandling of the coils after once wound and the wastage of wire.

One embodiment of this invention is illustrated in the accompanying drawings, in which:

Figure 1 is a top plan of the winding machine.

Fig. 2 is a front elevation of the machine shown in Fig. 1.

Fig. 3 is a wiring diagram of electrical connections between the winding machine and cooperating Wheatstone bridge circuit.

Fig. 4 is a fragmentary view showing a modified form of the device illustrated diagrammatically in Fig. 3.

As shown in the drawings, the winding machine comprises in general, a lathe in which may be mounted a spool upon which the resistance wire is to be wound, and associated with which is a Wheatstone bridge circuit, one arm of which contains an element of known resistance against which the resistance wire may be balanced as it is being wound upon the spool.

The lathe comprises a bed 5 upon which are mounted a head stock 6 and a tail stock 7. The head stock 6 comprises a base 5' having uprights 8 and 9 joined at the top by a cross head 22. A shaft 10 is journaled in the upright 8. A driving pulley 11 is secured to one end of the shaft 10, and a gear 15 is secured to the other end. A belt 12 passes over the pulley 11 for driving the shaft 10.

A spindle 19 is journaled in the upright 9 and is in alignment with the driving shaft 10. A clutch 20 is slidably mounted upon one end of the spindle 19. This clutch is adapted to engage the inner periphery of the driving pulley so that the spindle may be rotated.

In order that the clutch may be moved into and out of engagement with the driving pulley a hand operated lever 21 is pivoted intermediate its ends in the cross head 22. The lower end of this lever is formed into an inverted U on the free ends of which are inwardly extending pins 60 and 61 which extend into the groove 62 formed in the periphery of the clutch 20.

The right end of the spindle 19 is provided with a chuck 25 for holding one end of a spool 46 upon which the wire is to be wound, and for causing the spool to rotate with the spindle. The other end of the spool 46 is supported by a positioning pin 33 which is secured in the end of a spring pressed stud 36 slidably mounted in the upper end of the tail stock 7, as shown in Fig. 1.

In order that the position of the tail stock 7 may be varied to accommodate supporting spools of different lengths two rods 30 and 31 supported by the bed of the lathe extend through openings provided near the base of the tail stock. These rods 30 and 31 guide the tail stock when it is moved along the bed. The tail stock 7 may be locked in adjusted position by means of a set screw 32.

The lateral movement of the positioning pin 33 and its supporting stud 36 with respect to the tail stock 7 is controlled by a pivoted bell crank lever 35. The short arm of this lever engages an opening near the end of the stud 36. This lever 35 is adapted to move the stud 36 and the positioning pin 33 against the action of the coiled spring 37 which maintains the positioning pin 33 in engagement with one end of the spool 46.

In order that the resistance wire may be wound evenly upon a spool and with a different length of lay there is provided a lead

screw 40, one end of which is provided with a reduced portion 41 carrying a radially extending pin 42 which engages a slot 43 in the end of a shaft 17. The shaft 17 is journaled in the uprights 8 and 9, and is rotated by a gear 16 carried thereby and meshing with the spur gear 15 on the driving shaft. The other end of the lead screw or guide 40 is supported by a spring pressed stud 44 mounted in the upper end of a supporting block 45, which is slidably mounted upon the rod 31. The supporting block 45 after being properly positioned on the rod 31 may be locked in such position by means of a set screw 46'.

A handwheel 18 is mounted at one end of the shaft 17 to provide means for rotating the spool 46 and the feed screw by hand.

Associated with the winding machine is a Wheatstone bridge circuit by means of which the resistance of the wire may be measured as it is being wound upon the spool. This Wheatstone bridge circuit comprises the usual ratio arms *a d* and *a b* containing resistance coils 51 and 50 and a third arm *b c* which may comprise a standard coil 52 of the resistance to which coils are to be wound by the winding machine with which the Wheatstone bridge circuit is associated. This standard coil is of known resistance. Instead of a standard coil, an adjustable resistance may be employed in the third arm of the bridge. Then when coils of a predetermined resistance are to be wound, the resistance of the third arm may be adjusted to this value. The fourth arm *c d* of the bridge is made up of the resistance wire being wound upon the spool and comprises an arm of unknown resistance. The usual source of current 53 and a switch 54 in circuit therewith are connected across the bridge points *b* and *d* while the usual detecting instrument such as a galvanometer 55 is connected across the bridge points *a* and *c*.

In order that the wire which is being wound upon the spool may be properly connected with the bridge as the arm of unknown resistance thereof the bridge point *d* (see Fig. 3) is connected by means of a conductor 28 with a terminal 56 mounted upon but insulated from the upright 9 of the head stock. A contact spring 57 connected at one end with this terminal 56 has its free end in frictional engagement with the periphery of a collector ring 26. The collector ring 26 is mounted upon the spindle 19 and rotates therewith. One end of a conductor 27 is connected with the collector ring 26. The spool 46 may be provided with two or more band terminals 47 depending upon the number of coils to be wound upon the same spool. The free end of the conductor 27 and the end of the resistance wire 49 are connected with the band terminal 47 provided at the left hand end of the spool. The bridge point *c* is connected by means of a conductor 29 with the rod 30. This bridge point *c* is therefore in electrical engagement with the metallic lead screw 40. The spool containing the resistance wire is supported below the lead screw 40. The resistance wire is therefore in electrical contact with the lead screw 40 as the wire is being wound on the spool 46. The fourth arm *c d* of the bridge may therefore be traced from the bridge point *c* of the Wheatstone bridge through conductor 29, the rod 30 and the lathe frame, the lead screw 40, resistance wire 49, the left hand band terminal 47, conducting strip 27, collector ring 26, contact spring 57, terminal 56, and the conductor 28 to the bridge point *d*.

The resistance wire is of comparatively high resistance while the parts associated with the lathe which are in this fourth arm of the bridge are of practically zero resistance. Since these parts are of such low resistance their resistance need not be considered when balancing the resistance of the wire being wound upon the spool against that of the known element in arm *b c* of the bridge.

When starting to wind coils a standard coil of the resistance to which other coils are to be wound is connected in arm *b c* of the bridge and a spool 46 is mounted in the chuck 25 and the positioning pin 33 of the lathe. The conductor 27 and the end of the resistance wire 49 are then connected with the left hand band terminal 47 on the spool. The switch 54 in the battery feed circuit for the bridge is then closed and the spool rotated to wind the wire thereupon. When starting the winding of a coil the needle of the galvanometer 55 will be deflected due to the unbalance of the bridge but as more wire is wound upon the spool the needle will gradually move to zero position. When the needle reaches zero position the resistance of the wire between the left hand terminal 47 and the lead screw 40 equals that of the standard coil 52 connected in arm *b c* of the bridge. Observing the position of the needle the operator stops the further rotation of the spool by moving the clutch 20 out of engagement with the driving pulley 11. If but one coil is to be wound upon the spool the resistance wire is cut at the lead screw and the free end of the wire forming the coil is connected to the other band terminal on the spool. Usually when but one coil is to be wound upon a spool, the spool will have but two band terminals, one at each end thereof. However, if more than one coil is to be wound upon the same spool then when the needle of the galvanometer indicates that sufficient wire has been wound upon the first coil the resistance wire is connected to the middle or second band ter-

minal 47 and then looped back over the left hand band terminal 47 to short circuit the coil between these terminals before starting the second coil. The operator may then proceed to wind the resistance wire on the second section of the spool continuously balancing the resistance thereof against that of the standard coil. It will be seen therefore that it is not necessary to cut the wire before starting the second coil. The wire forming the loops may be cut and removed after all of the coils have been wound.

Frequently, it is necessary to wind upon a support a large number of coils which vary in resistance. When it is desired to wind a large number of such coils upon the same support, a sample spool having coils of the requisite resistance wound thereon may be associated with the Wheatstone bridge circuit, as illustrated in Fig. 4. The first coil 52^a of the sample resistance spool may form the third arm of known resistance for the bridge, while winding the first coil onto the support in the winding machine. When the first coil is wound to the required resistance as determined by the balanced condition of the bridge, the resistance wire may be connected with the second hand terminal of the support. Then before proceeding to wind the second coil, the second coil 52^b of the sample resistance spool associated with the bridge is included in the third arm, so that the third arm is now made up of the first and second coils of the sample resistance spool. The operator may then proceed to wind the second coil upon the support positioned in the winding machine. When the wire to the desired resistance has been wound into a second coil, as determined by the balanced condition of the bridge, the wire is connected with the third band terminal. Then before proceeding to wind the third coil 52^c upon the support, the third coil of the sample resistance spool is added into the third arm of the bridge. So the winding proceeds, until all coils, each of the desired resistance, are wound. It is to be noted that the resistance wire is continuous from the first to the last band terminal on the support upon which a plurality of coils are wound. It is also to be noted particularly that when winding the coils by this method, all wastage of resistance wire is eliminated. This method of including an additional coil in the third arm of the bridge, before winding another coil onto a multicoil support may, of course, be employed where some or all of the coils are to be of the same or of different resistance values.

The machine illustrated and described for winding resistance coils produces coils of the desired resistance, the turns of which are evenly wound upon the spools. The wastage of wire is reduced to a minimum and the measuring of the resistance of the coils by a separate operation after winding is avoided thereby reducing the handling of the coils and the number of operations required to produce coils of the proper resistance. The manufacture of such coils is thus facilitated.

What is claimed is:

1. A machine for winding resistance coils having in combination adjustable means for supporting different sized spools upon which a plurality of series connected coils of resistance wire are to be wound, a plurality of terminals associated with the spool to which the wire may be connected sequentially, means for winding the wire upon the spool, a screw-threaded member arranged to rotate at a definite rate of speed with respect to said spool to guide the wire onto the latter and having electrical contact with the wire as it is wound upon the spool, and a detecting instrument for continuously measuring sequentially the resistance of the wire between the respective terminals and said guide member as the wire is being wound upon the spool.

2. A machine for winding resistance coils having in combination adjustable means for supporting different sized spools upon which resistance wire is to be wound, means for rotating the spool for coiling the resistance wire thereon, a rotating contact drum associated with the spool to which one end of the resistance wire is electrically connected, a screw-threaded guide member in electrical contact with the wire as it is being wound upon the spool, a Wheatstone bridge circuit having as one arm thereof an element of known resistance, circuit connections for including the resistance wire between the contact drum and element as an arm of unknown resistance in the bridge, a detecting instrument associated with the bridge for comparing the resistance of the unknown arm with that of the known element as the wire is being wound on the spool, and means for definitely increasing the known value of resistance in the first mentioned arm of said Wheatstone bridge circuit.

3. A machine for winding resistance coils having in combination means for supporting a spool upon which a plurality of series connected coils of resistance wire are to be wound, a plurality of terminals to be sequentially connected with the resistance wire, means for winding the resistance wire upon the spool, a screw-threaded guide member in electrical contact with the wire as it is wound upon the spool, a Wheatstone bridge circuit having the resistance wire between one terminal and the guide member forming an arm of unknown resistance thereof and having an element forming an arm of known resistance, a detecting instrument associated with the bridge for comparing the resistance of the unknown arm with that of

the known element as the wire is being wound on the spool, means for connecting said wire with another of said terminals, and means for adding a predetermined value of resistance to the known element of said Wheatstone bridge.

4. A machine for winding resistance coils comprising, in combination, adjustable means for supporting different sized spools upon which resistance wire is to be wound, end and intermediate terminals for the resistance wire on each spool, means for winding the resistance wire upon the spool to provide a plurality of series connected resistance coils, a Wheatstone bridge circuit having a resistance of known value forming one arm thereof, the wire being wound on said spool forming an arm of unknown resistance, and means for definitely increasing the resistance of known value after completion of one coil on said spool to provide accurate measurement of the resistance of another coil subsequently wound thereon.

In witness whereof, I have hereunto subscribed my name.

EDWIN N. LIGHTFOOT.