J. C. ANDERSON.

WINDING MACHINE.

APPLICATION FILED JUNE 18, 1920.

1,427,509. Patented Aug. 29, 1922.

3 SHEETS—SHEET 1.

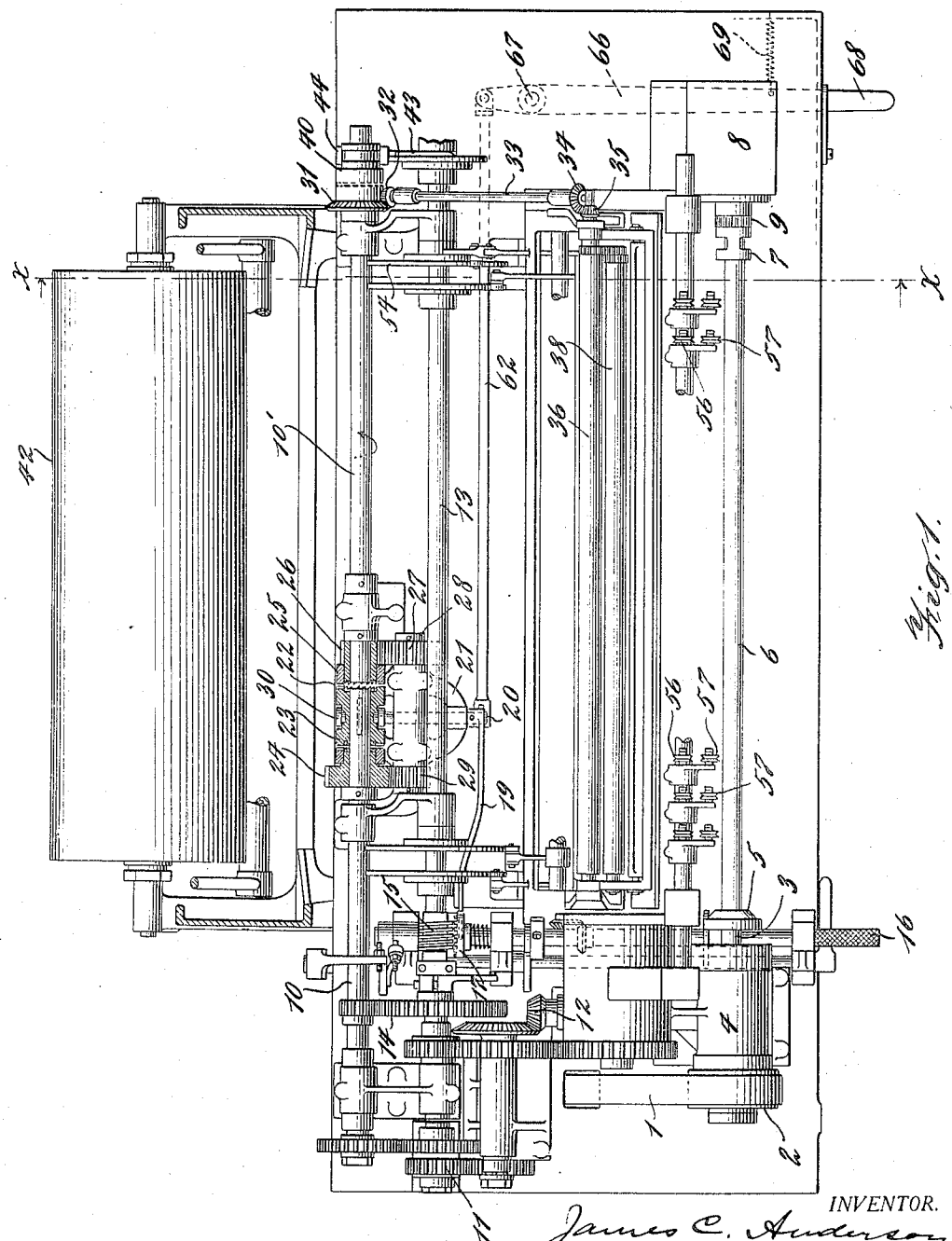

Fig. 1.

INVENTOR.

James C. Anderson

BY

Rosenbaum Stockbridge & Boost

ATTORNEY.

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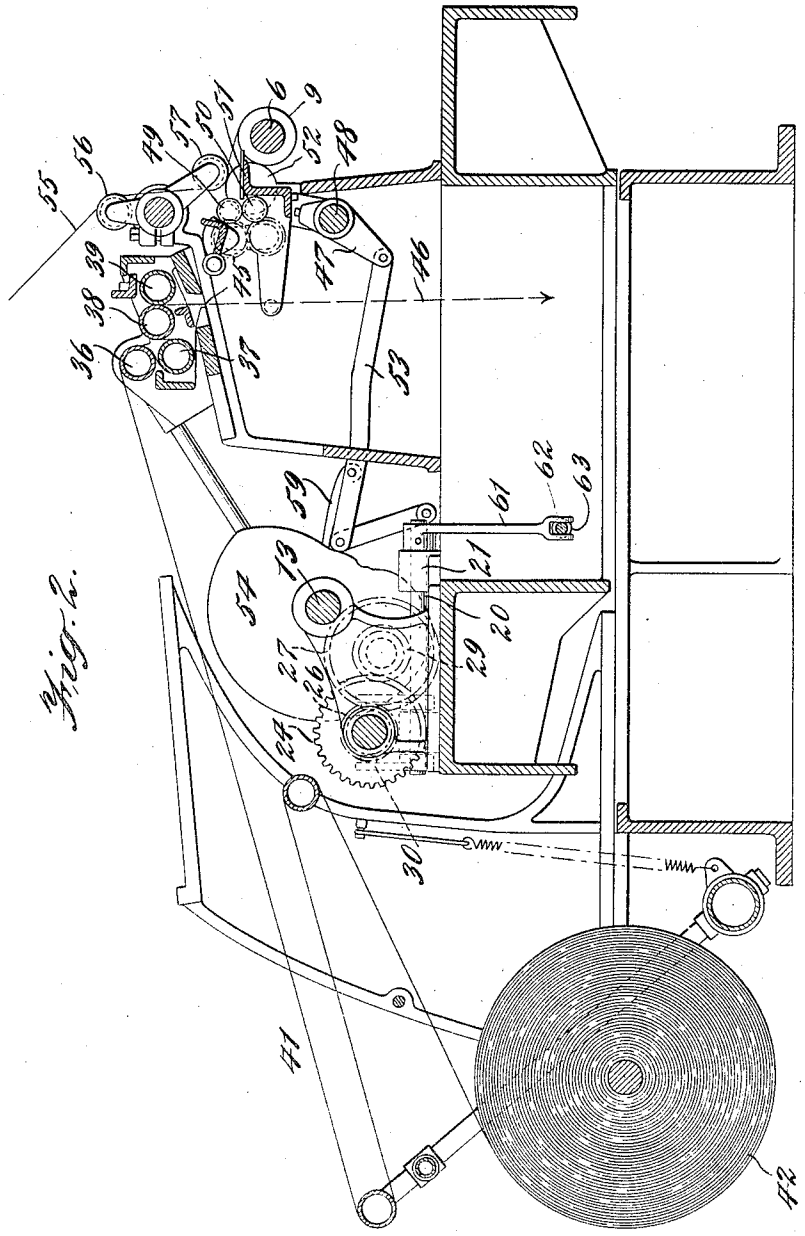

Fig. 2.

James C. Anderson — INVENTOR.

BY

Pennbaum Stockbridge & Root ATTORNEY.

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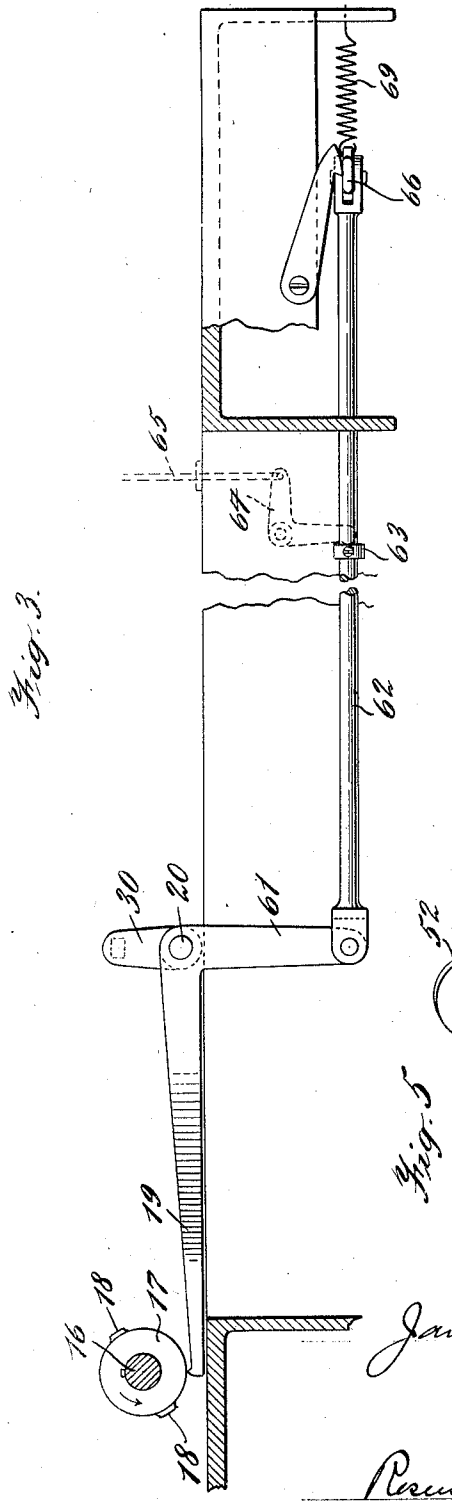

Fig. 3.

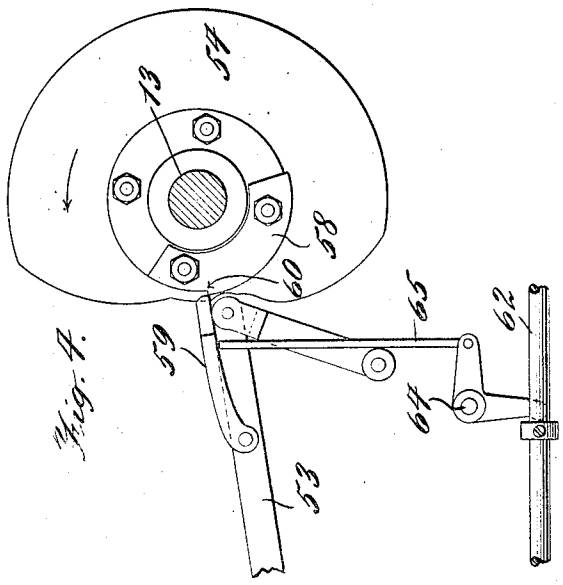

Fig. 4.

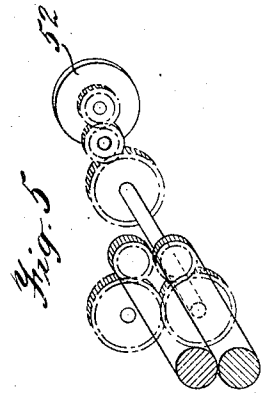

Fig. 5.

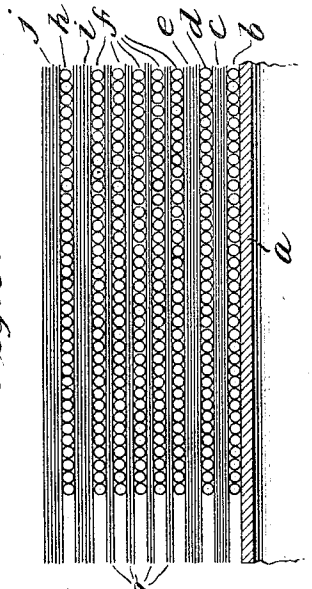

Fig. 6.

James C. Anderson

INVENTOR.

BY

Rosenbaum Stockbridge & Boost

ATTORNEY.

UNITED STATES PATENT OFFICE.

JAMES C. ANDERSON, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO VARLEY DUPLEX MAGNET COMPANY, A CORPORATION OF NEW JERSEY.

WINDING MACHINE.

1,427,509. Specification of Letters Patent. Patented Aug. 29, 1922.

Application filed June 18, 1920. Serial No. 389,864.

To all whom it may concern:

Be it known that I, JAMES C. ANDERSON, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Winding Machines, of which the following is a full, clear, and exact description.

This invention relates to machines for winding strands of material such as wire, thread, ribbon or filaments into coils, helices or bobbins, and has special reference to machines for winding copper wire into electric coils or helices for use in various kinds of apparatus. The particular machine herein described is of the same general class as that set forth in U. S. Patents #654,583 issued July 31st 1900 and #798,864 issued September 5th 1905.

In the patented machines mentioned a plurality of coils are wound simultaneously in separate zones upon a spindle, the convolutions of wire being wound in layers superposed one upon the other and the machine being adapted to introduce sheets of paper between the adjacent layers during the building up of the coils and while the spindle is in motion. Each layer in all of the coils is finished at the same instant and at that instant a sheet of paper of sufficient length to wrap once around the coil and of sufficient width to extend over all of the coils on the spindle, is delivered to the spindle and wound thereon as a foundation for the next succeeding layer. In an application for patent filed by me August 13th 1919, Serial No. 317,166 there is disclosed an improvement on the old patented machine with respect to the paper mechanism which is of such a nature that it provides for the simultaneous winding of a comparatively large number of coils by providing mechanism capable of feeding to the spindle successive sheets of paper of sufficient width to cover a large number of coils on the spindle and to inject said sheets into the coils and wind them thereupon evenly and smoothly to furnish individual foundations for the respective layers of wire. Such sheets of paper in accordance with said application, are measured and cut from a continuous web, of the proper length to make a plurality of turns or wrappings thereof between the adjacent layers of wire and to accomplish this at a high rate of spindle speed without wrinkling or producing other irregularities therein notwithstanding the fact that the paper is exceptionally thin.

The present improvement is specially directed to the machine described in the application referred to wherein a plurality of wrappings of the paper are applied between each two adjacent layers of wire. For electrical apparatus it is found desirable to insulate several layers of wire adjacent to the core of the helix and adjacent to the outer surface of the helix, more heavily than the layers which intervene between the core and the surface. This added insulation at the locations referred to can be furnished by winding an extra number of turns of paper between the inner layers and the outer layers of winding. That is to say, if the layers in the body of the helix are separated by three wrappings of paper, the added insulation between the inner and outer layers can be furnished by winding five, six or more turns of paper therebetween. The invention herein therefore consists broadly in a machine capable of measuring, cutting and feeding sheets of paper of long or short lengths as may be required for introduction into the various portions of the coil. More specifically the invention consists of the details of the machine for carrying out this general principle in a simple and practical manner.

The accompanying drawings depict a machine similar to that disclosed in the aforementioned application for patent, but only so much of the machine is illustrated as is required to disclose the improvement of the present application.

Referring to the drawings:

Fig. 1 is a plan of the machine with features relating particularly to the present invention shown in section.

Fig. 2 is a section along the line *x x* of Fig. 1.

Fig. 3 is an enlarged view in detail of the gear shifting mechanism.

Fig. 4 a detail of the adjustable paper injecting cam.

Fig. 5 is a conventional perspective of the gearing controlling the paper injecting rolls, and

Fig. 6 is a longitudinal section of one half of a single finished helix.

Referring first to Fig. 6 a portion of the tubular core of the helix is indicated at *a*. The first layer of wire wound thereon is in-

dicated at *b*. This layer is surrounded by six wrappings of paper *c* upon which the second layer of wire *d* is wound. This layer is succeeded by another six wrappings of paper *e* and following this are several layers of wire *f* which are separated by three turns or layers of paper *g*. Finally the outer layer of wire *h* is separated from the layer immediately beneath it by six turns of paper *i* and is externally surrounded by another six turns of paper *j*. It is the function of the present improvement to introduce these varying numbers of turns of paper at selected locations in the helix.

The machine is driven by a belt 1 which passes over a pulley 2 on a shaft 3 mounted in a housing 4. The shaft 3 carries a chuck 5 for the left end of the winding spindle 6, the right hand end of said spindle being held in a chuck 7 mounted to rotate in a bearing 8 rising from the frame. The right hand chuck 7 is provided with a collar 9 serving as a friction gear for a purpose which will hereafter appear. 10 is a shaft which is continuously driven through a train of gears 11, 12 from the shaft 3. Shaft 10 drives cam shaft 13 through pinion and gear 14. Shaft 13 makes one rotation for each layer of wire wound upon the spindle. This shaft carries a worm 15 which engages a worm gear immediately thereunder and not shown, but mounted loosely upon the shaft 16. A jaw clutch on said shaft is adapted to connect the worm gear thereto, the sliding and keyed member of said clutch being indicated by 17. The clutch is normally closed during the operation of the machine so that for each rotation of the shaft 13 which corresponds to the formation of one layer of wire on the spindle, the shaft 16 moves a fraction of a turn. On the periphery of the clutch member 17 may be placed at desired locations one or more projecting lugs 18 the outer operating faces of which may be of a length corresponding to one or more of the fractional movements of the shaft 16. During the step by step rotation of shaft 16, the lugs 18 come into contact with and force downward the end of a bell crank lever 19 which is attached to a rock shaft 20 mounted upon the main frame in a bearing bracket 21.

The shaft 10 extends across the rear of the machine but is in two parts separated at the point 22. The driving part of shaft 10 carries a sliding clutch member 23 having a clutch face at each end. The left hand face is adapted to engage the gear wheel 24 to drive the same while the right hand face is adapted to engage a collar 25 on the driven section 10′ of the shaft. Adjacent the collar 25 is a pinion 26 fixed upon the driven shaft section 10′ which is in mesh with a gear 27 on a shaft 28 which carries a pinion 29 in mesh with the gear 24. It will thus be seen that when the sliding clutch member 23 engages gear 24 it is then out of engagement with the collar 25 and the shaft section 10′ is driven from shaft 10 at a rate dependent upon the gear ratio of the train 24, 29, 27, 26. When the clutch member 23 is moved in the opposite direction to engage the collar 25 the shaft section 10′ is driven at the same speed as shaft 10 while the gear train rotates idly. The gear train is such that when the shaft section 10′ is driven therethrough it rotates at higher speed than when driven direct from shaft 10. Clutch member 23 is shifted by the movements of rock shaft 20 which carries a yoke 30 embracing a groove in the clutch member in the usual and well known manner. The shaft section 10′ carries at its outer end a bevel gear 31 which drives a pinion 32 on an upwardly inclined shaft 33, the shaft having on its other extremity a pinion 34, engaging a pinion 35 at the end of a paper feeding roller 36 comprising one of a train of paper feeding rollers the others being indicated by 37, 38 and 39. The bevel gear 31 at the end of shaft section 10′ is loose but adapted to be connected with the shaft by means of a clutch 40 at a certain point in the cycle of operations of the machine. When this clutch is thrown in, the paper feeding rolls begin to turn and the paper is drawn or measured from the continuous web 41 which proceeds from the roll of paper 42. It will be understood that at a certain point in the rotation of the shaft 13 the clutch 40 is closed through the mechanism indicated at 43 and which merely comprises a cam which actuates a rock shaft carrying a clutch shifting yoke 44.

Referring now to Fig. 2 it will be seen that the web of paper 41, passes from the measuring roller 36 then around the roller 37, then around the roller 38 against which it is finally pressed or gripped by the roller 39. From the two gripping rolls 38 and 39, the forward edge of the sheet normally extends downward to the point 45 at which location a severing knife (not shown) is located. When the feeding rolls operate, the end of the paper is fed downward until the free end occupies a position indicated by the dotted line 46 after which the sheet is severed at the point 45 and the portion cut off is conveyed to a position to be injected into the winding on spindle 6. For the purpose of thus transferring the sheet, there is used, as fully explained in the application before mentioned, a transfer frame 47 which is pivoted at 48 and carries two gripping rollers 49 and 50 immediately in front of which is a table or lip 51 upon which the forward end of the sheet rests and is guided on its way to the winding. The two gripping rollers 49 and 50 are driven through a train of gears shown in Fig. 5 from the

leather collar 9 on the winding spindle clutch which engages the friction wheel 52 at the proper time. The transfer frame 47 is adapted to be swung rearward from the position shown in Fig. 2 by means of the link 53 the end of which rides against the periphery of cam 54 on the cam shaft 13, a spring, not shown, serving to keep the end of link 53 against the edge of the cam. When the transfer frame 47 is thus swung to the rear, the gripping rolls 49—50 are at the same time separated so that they occupy positions on opposite sides of the dotted line 46 so that when the paper is fed downward it will pass between the two gripping rolls. The gripping rolls thereupon close upon the sheet, and their axes being in an oblique plane cause the upper edge to bend forward so that when the transfer frame is returned to the position shown in Fig. 2 the upper edge of the sheet will be presented at a tangent to the winding immediately under the strands of wire which are indicated at 55 as leading from the guide rolls 56 and 57 to the winding spindle. Cam 54 is provided with a supplemental peripheral cam 58 and the end of the link 53 is provided with a pivoted dog or pawl 59 the end of which stands in the plane of the cam 58 so that when the latter is presented to the pawl, the link 53 will be controlled by the cam 58 instead of by the cam 54 which for the time being is out of contact with the end of the link 53. Cam 58 is provided with a step 60 which when presented to the end of pawl 59 allows the latter together with the link 53 to be pulled towards the shaft 13 and thus impart a sudden forward movement to the transfer frame 47 which serves to bring the friction gear 52 into contact with the friction collar 9 on the spindle. While this contact is maintained the rolls 49—50 rotate and feed the paper to the spindle. Cam 54 therefore serves to swing the transfer frame to a position preparatory to the injection of the paper while cam 58 affords another additional forward movement of the frame to bring the gears into contact to actually inject the paper.

Referring now to Fig. 3, the bell crank lever 19 which is pivoted upon the rock shaft 20, has its arm 61 connected with a rod 62 which is provided with a collar 63 and adjacent to which is suitably pivoted upon the frame a small bell crank lever 64, one arm of which is adapted to be engaged by the collar 63 while the other is attached to an upwardly directed thrust rod 65 which reaches to a point immediately under the pawl 59. The extremity of rod 62 is engaged by a manually operable lever 66 which is pivoted to the frame at 67 and projects forward within reach of the operator at the point 68. The lever 66 is normally under the influence of a spring 69 which tends to hold the bell crank arm 19 in contact with the periphery of the clutch member 17.

The operation of the improvement is as follows: before winding of any set of coils is begun the step by step moving shaft 16 is turned backward by hand to a zero position, from which during the winding operation the shaft moves one step forward for each layer of winding. Assuming the lugs 18—18 on the periphery of clutch member 17, are located respectively at those points where immediately upon the first movement of said clutch member one of the lugs will engage and move downward the end of bell crank 19 and will hold the same in this depressed position while two layers of wire are being wound, and the other lug at an advanced position where it will engage the end of the bell crank after seven layers of wire have been wound and will then hold the layer depressed until the 8th or final bell crank lever 19 of the coil has been wound, such adjustment will render the machine capable of winding such a coil as is illustrated in Fig. 6. During the winding of the first layer the bell crank 19 will be held depressed and the clutch member 23 in engagement with gear 24; the shaft section 10′ will therefore be driven at the higher speed during the winding of the first layer of wire. At the proper moment in the cycle of operations the clutch 40 will be closed and the shaft 33 will be driven by the shaft section 10′ at the same high speed. This will cause the rotation of the paper measuring and feeding rolls 36 to 39, and the paper will be drawn from the roll 42 at a corresponding speed. The clutch 40 is opened at a definite time in the cycle of operations whereupon the feed of the paper stops and the gripping rolls 49 and 50 on the transfer frame close upon the paper, the paper is severed and the upper edge of the severed sheet is carried forward into a position to be injected and fed into the winding. At the same time that the clutch member 23 is thrown to the left the gear 63 and rod 62 is thrown to the right and the vertical thrust rod 65 are elevated to slightly raise the end of pawl 59. This causes the step 60 in cam 58 to be presented to the end of the pawl sooner than it would if the pawl had not been elevated, and the transfer frame is caused to move forward to engage the friction gears 52 and 9 and the sheet of paper is injected into the winding earlier than otherwise would be the case. The high gear remains in mesh and the pawl 59 remains elevated as long as the lug 18 is holding the bell crank lever 19 depressed, and as stated, in the present instance, this continues through the winding of the first two layers of wire. When two layers have been completed the lug 18 passes beyond the end

of the lever 19 allowing the latter to rise and reverse the position of the clutch member 23 and thus reduce the speed of shaft section 10′ so that during the winding of the next succeeding layers the paper feeding rollers 36, 37, 38 and 39 do not run so fast and less paper is drawn from the roll 42. The shorter sheet of paper is presented to the winding spindle in the same manner as the longer sheet but the instant of injection in the winding is slightly later than before because the pawl 59 has not been lifted and the step 60 does not arrive at the end of the pawl so early in the cycle of operations. The shorter sheet thus produced is, in the coil under consideration, only long enough to afford three wrappings around the helix. A corresponding short length of paper is thus measured off during the formation of each succeeding wire layer until the second lug 18 again depresses the end of bell crank lever 19 whereupon the speed of the paper feeding mechanism again changes and sufficient paper is measured off each time for six wrappings until the coil is finished. It is of course understood that the lugs 18 may be located at various positions upon the periphery of the clutch member 17 and that each lug may be of a length corresponding to one or more of the steps of movement of the clutch member, all depending upon the locations in the coil where the amount of insulation is to be increased or decreased and upon the total number of layers in the coil.

It will be seen that inasmuch as the clutch 40 is closed at the same point in the cycle of operations and likewise opened at the same point in each cycle, in order to vary the length of paper fed, it is necessary to vary the rapidity of the feed and that is what is accomplished by the change speed gear introduced in the shaft 10. A variable length of paper also necessitates a variable time to wind it upon the spindle and this is provided for by commencing to wind the longer sheets earlier than the shorter sheets since it is desirable to have the trailing edge of all sheets enter the coil at a given instant and with respect to the moment of reversal of the wire lead at the end of a layer.

I claim:

1. In a winding machine, the combination of a winding spindle, mechanism for winding strand material in successive superposed layers thereon to form a helix and mechanism for winding sheet material between the layers and for varying the number of turns thereof between the adjacent layers of the same helix.

2. In a winding machine, the combination of a winding spindle, means for continuously feeding strand material thereto, means for intermittently feeding sheet material thereto during the feeding of the strand material and means for increasing or decreasing the length of succeeding sheets of the sheet material.

3. In a winding machine, the combination of a winding spindle, means for continuously winding strand material thereon in superposed layers, means for feeding sheet material intermittently to the spindle, the duration of the feeding periods of which are uniform, and means for varying the rapidity of feed during selected periods.

4. In a winding machine, the combination of a winding spindle, means for presenting individual sheets of material at regular intervals to be wound thereon, feeding and measuring mechanism for predetermining the length of said individual sheets and means for varying the speed of the feeding and measuring mechanism with respect to that of the spindle.

5. In a winding machine, the combination of a winding spindle driven at uniform speed, means for predetermining the length of individual pieces of material to be successively wound upon the spindle and means for feeding different lengths of said material in uniform periods of time.

6. In a winding machine, the combination of a winding spindle, means for winding superposed layers of strand material thereon and variable speed mechanism for drawing from a continuous web portions thereof of varying length and means for winding such portions between the adjacent layers of strand material.

7. In a winding machine, a winding spindle, mechanism for winding strand material in successive superposed layers thereon, means for presenting individual sheets of sheet material at regular intervals to be wound thereon, feeding and measuring rolls for predetermining the length of the individual sheets, a rotary shaft through which said rolls are actuated, means for intermittently throwing said rolls into and out of operative relation to said shaft, a change-speed device for said shaft, and automatic means for throwing the same into and out of operation at predetermined intervals.

8. In a winding machine, the combination of a winding spindle, means for continuously feeding strand material thereto, means for intermittently feeding sheet material thereto during the feeding of the strand material, means for increasing or decreasing the length of succeeding sheets of the sheet material and means for varying the time of presentation of the sheet material to the spindle.

9. In a winding machine, the combination of a winding spindle, means for continuously winding strand material thereon in superposed layers, means for feeding sheet material intermittently to the spindle, the dura-

tion of the feeding periods of which are uniform, means for varying the rapidity of feed during selected periods and means for varying the time of presentation of the sheet material to the spindle.

10. In a winding machine, the combination of a winding spindle, means for presenting individual sheets of material at regular intervals to be wound thereon, feeding and measuring mechanism for predetermining the length of said individual sheets, means for varying the speed of the feeding and measuring mechanism with respect to that of the spindle and means for varying the time of presentation of the sheets to the spindle.

11. In a winding machine, the combination of a winding spindle driven at uniform speed, means for predetermining the length of individual pieces of material to be successively wound upon the spindle, means for feeding different lengths of said material in uniform periods of time and means for varying the time of presentation of the pieces of material to the spindle.

12. In a winding machine, the combination of a uniformly rotating winding spindle, means for successively presenting pieces of winding material to the spindle, means for increasing or decreasing the length of said pieces during the operation of the machine and means for varying the time of presentation of said pieces to the spindle in accordance with the length thereof.

13. In a winding machine, the combination of a winding spindle, means for winding superposed layers of strand material thereon and variable speed mechanism for drawing from a continuous web portions thereof of varying length, means for winding such portions between the adjacent layers of strand material and means for varying the time of presentation of said portions to the spindle.

14. In a winding machine, a winding spindle, feeding and measuring mechanism for sheet material to be wound upon said spindle, means for varying the speed of operation of said mechanism, injecting mechanism for presenting the sheet material to said spindle, and means for varying the time of operation of said injecting mechanism, whereby the latter will operate early or late in the cycle of operations of the machine in accordance with the length of sheet material introduced.

15. In a winding machine, a winding spindle, means for continuously feeding strand material thereto, feeding and measuring rolls for individual sheets of material to be wound on said spindle, injecting mechanism for introducing said sheets between the layers of strand material, means for varying the speed of the feeding and measuring rolls, and means for varying the time of operation of said injecting mechanism, whereby the latter will operate early or late in the cycle of operations of the machine in accordance with the length of the sheet material introduced.

16. In a winding machine, the combination of a winding spindle, means for winding strand material in superposed layers upon said spindle, means for feeding varying lengths of sheet material towards the spindle, a sheet material injecting mechanism adapted to introduce the lengths of sheet material between the layers of strand material and means for varying the time of operation of said injecting mechanism whereby the same will operate early or late in the cycle of operations of the machine depending upon the length of the sheet material introduced.

In witness whereof, I hereunto subscribe my signature.

JAMES C. ANDERSON.