March 8, 1960 M. A. NYE ET AL 2,927,744

WIRE DRAWING AND WINDING MACHINE

Filed Dec. 6, 1957 5 Sheets-Sheet 1

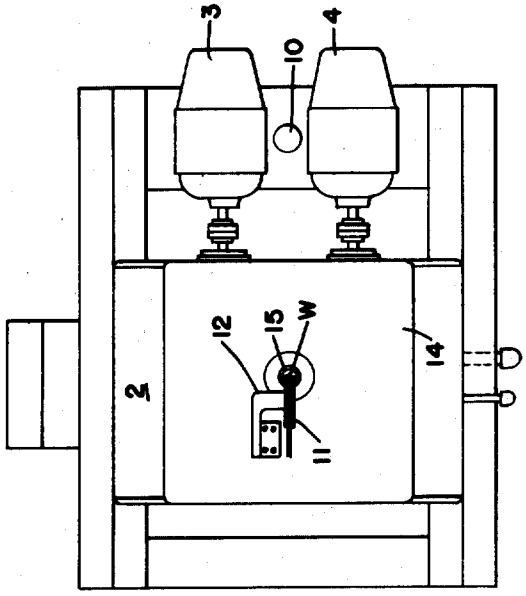


FIG. 2

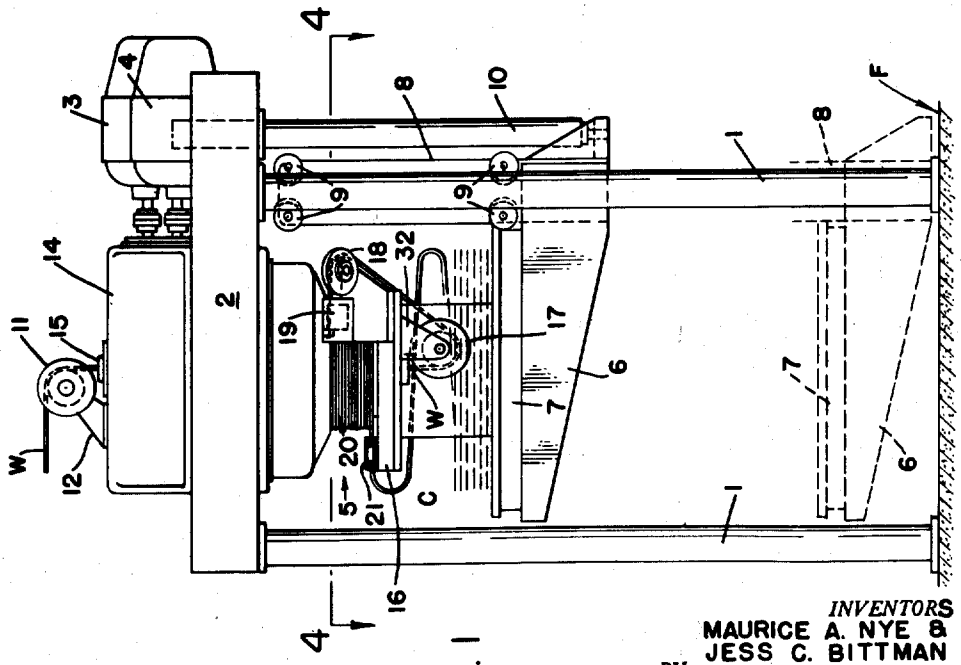


FIG. 1

INVENTORS
MAURICE A. NYE &
JESS C. BITTMAN
BY
Oberlin & Limbach
ATTORNEYS

March 8, 1960 M. A. NYE ET AL 2,927,744

WIRE DRAWING AND WINDING MACHINE

Filed Dec. 6, 1957 5 Sheets-Sheet 2

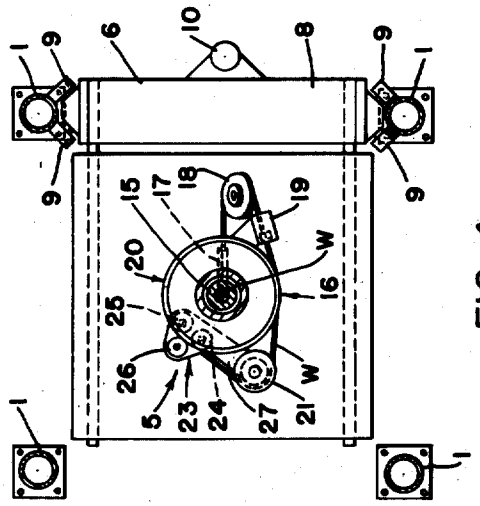


FIG. 4

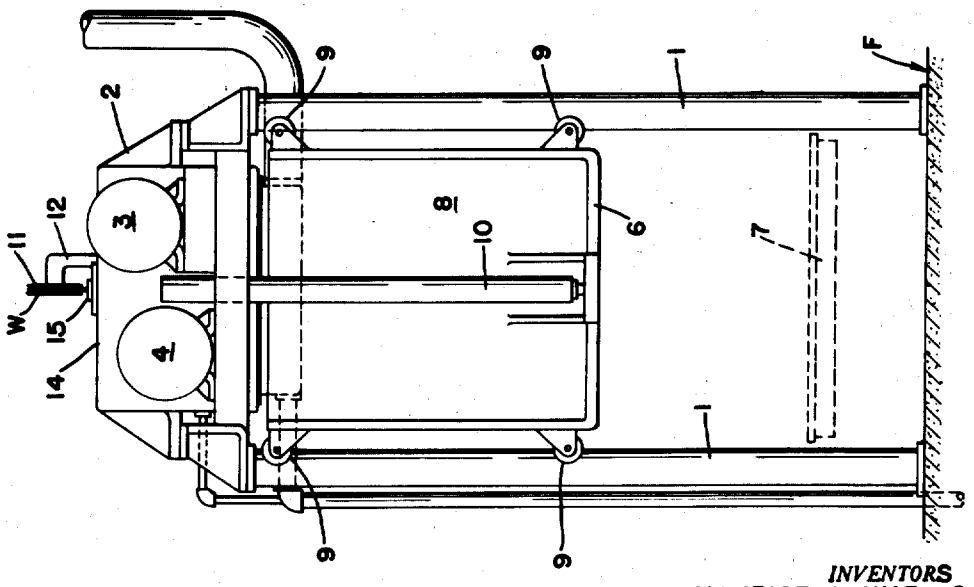


FIG. 3

INVENTORS
MAURICE A. NYE &
JESS C. BITTMAN
BY
Oberlin & Limbach
ATTORNEYS

March 8, 1960 M. A. NYE ET AL 2,927,744

WIRE DRAWING AND WINDING MACHINE

Filed Dec. 6, 1957 5 Sheets-Sheet 3

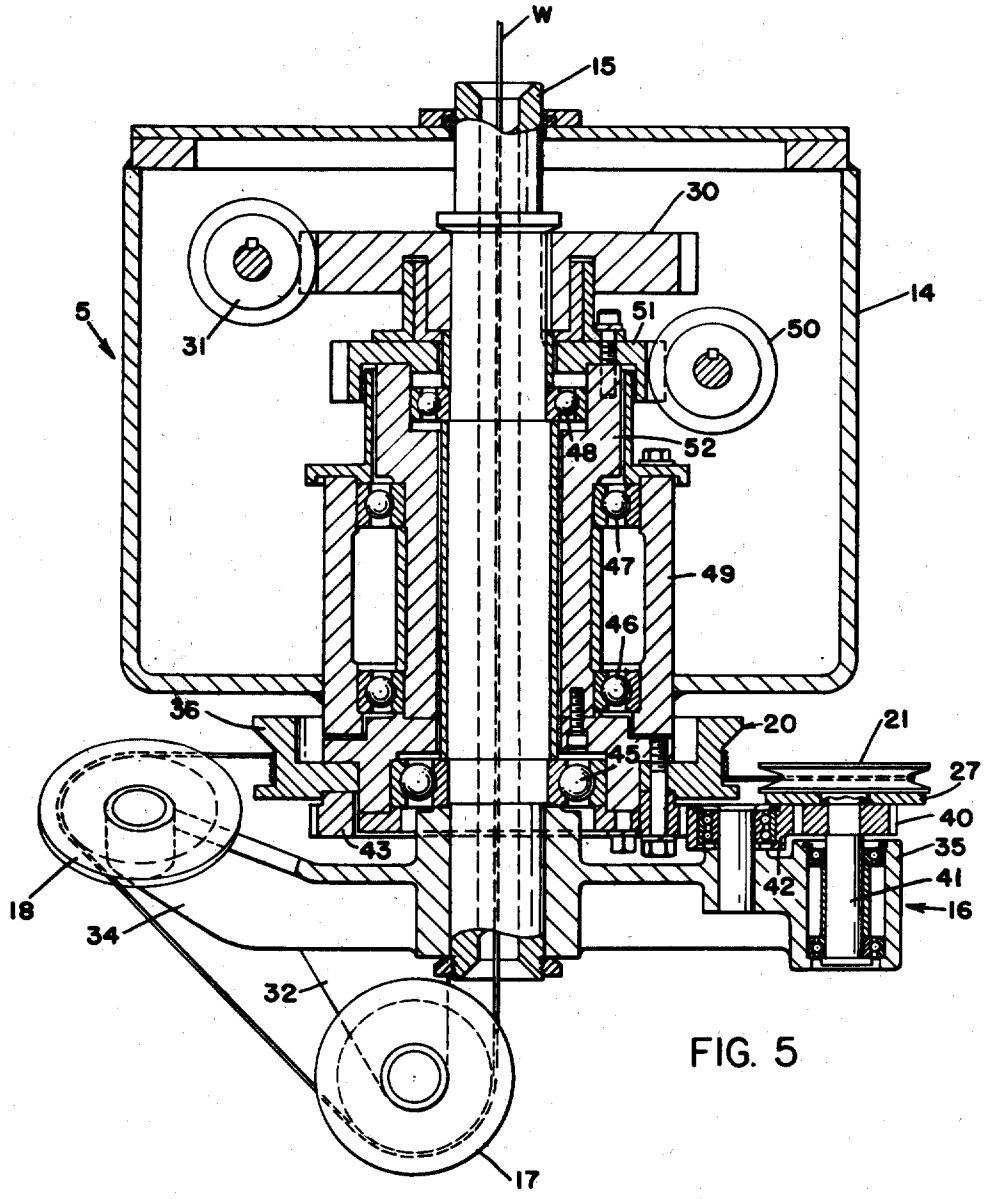


FIG. 5

INVENTORS
MAURICE A. NYE &
JESS C. BITTMAN
BY
Oberlin & Limbach
ATTORNEYS

March 8, 1960 M. A. NYE ET AL 2,927,744

WIRE DRAWING AND WINDING MACHINE

Filed Dec. 6, 1957 5 Sheets-Sheet 4

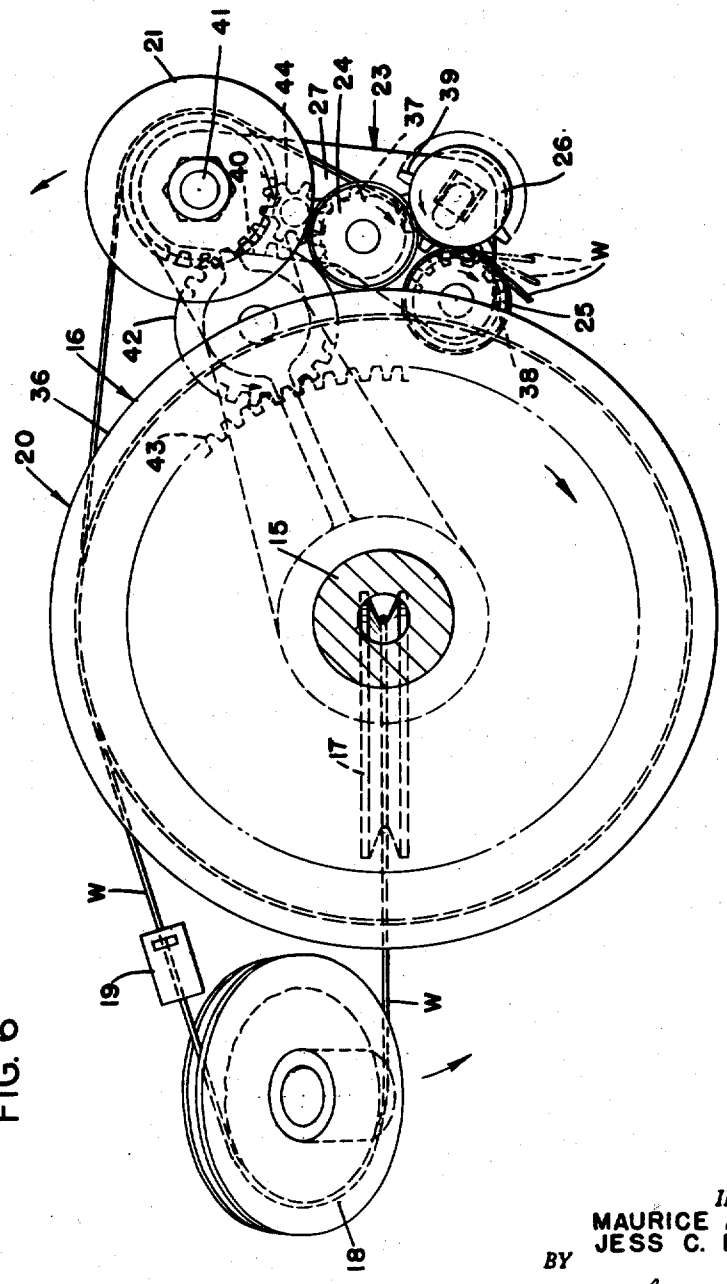


FIG. 6

INVENTORS
MAURICE A. NYE &
JESS C. BITTMAN
BY
Oberlin & Limbach
ATTORNEYS

March 8, 1960 M. A. NYE ET AL 2,927,744

WIRE DRAWING AND WINDING MACHINE

Filed Dec. 6, 1957 5 Sheets-Sheet 5

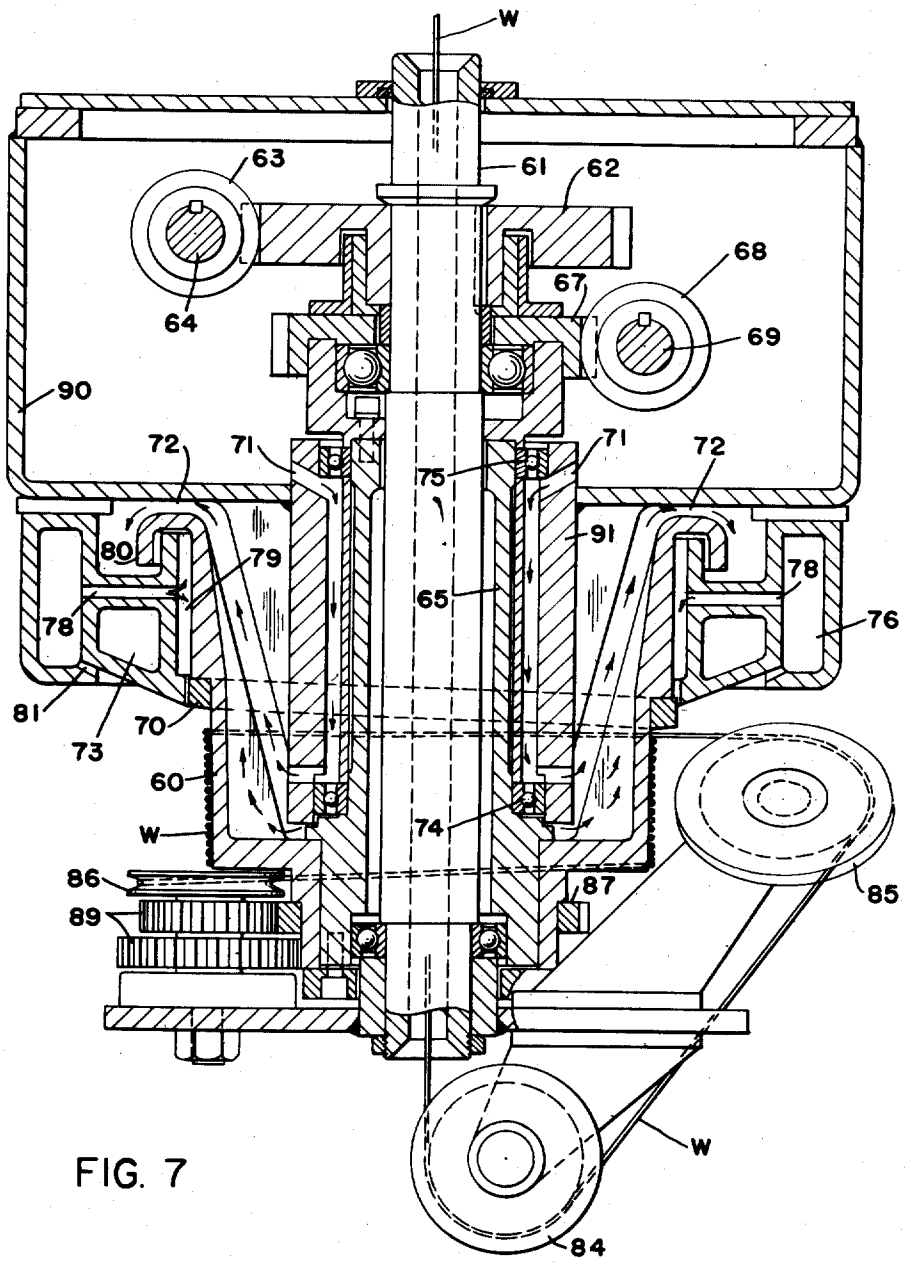


FIG. 7

INVENTORS
MAURICE A. NYE &
BY JESS C. BITTMAN

Oberlin & Limbach
ATTORNEYS

United States Patent Office 2,927,744 Patented Mar. 8, 1960

2,927,744

WIRE DRAWING AND WINDING MACHINE

Maurice A. Nye and Jess C. Bittman, Cuyahoga Falls, Ohio, assignors to The Vaughn Machinery Company, Cuyahoga Falls, Ohio, a corporation of Ohio

Application December 6, 1957, Serial No. 701,000

6 Claims. (Cl. 242—82)

The present invention relates generally as indicated to a wire drawing and winding machine and more particularly to a wire drawing and winding machine which utilizes the so-called dead coil packaging technique that is, one in which the package or coil need not be rotated during the winding operation.

Heretofore, it has been proposed to mount adjacent to the draw block or capstan of a wire drawing machine, a packaging unit which comprises a feeding capstan deriving power from the draw block and provided with wire setting rolls to desirably curve the wire, and a rotary packaging drum support which, in turn, is laterally adjacent to the feeding capstan and is driven by the latter. The drawn wire is fed from the feeding capstan through a guide tube into the drum on the support to form a coil in the drum, this method of winding being aptly referred to as live coil packaging. One disadvantage of live coil packaging is that the coil diameter is not variable because the relative speeds of the wire drawing capstan, of the feeding capstan, and of the drum support is fixed. Such live coil packaging apparatus furthermore occupies valuable floor space because the feeding capstan is disposed laterally of the wire drawing machine and the packaging drum support, in turn, is disposed laterally of the feeding capstan. Moreover, it is an expensive proposition to transmit power from the wire drawing capstan to the feeding capstan and from the feeding capstan to the drum support.

Accordingly, it is one principal object of this invention to provide a combination wire drawing and winding machine which is especially compact owing to the vertical coaxial arrangement of the wire draw block, the wire feeding means, and the coil or drum support.

It is another object of this invention to provide a wire drawing and winding machine which involves the winding of a dead coil, thereby eliminating the need for a separate drive means for the coil support.

It is yet another object of this invention to provide a wire drawing and winding machine by which coils of different diameters may be wound. In fact, with the present machine it is contemplated to wind coils in which the convolutions progressively spiral in and out whereby for a given diameter and height of package a greater length of wire is contained therein than in a package in which the convolutions are all of the same diameter.

Another object of this invention is to provide a wire drawing and winding machine that has a coil support which is moved vertically in accordance with the axial growth of the coil that is being wound.

It is another object of this invention to provide a wire drawing and winding machine that employs a novel variable speed drive means for winding coils of different diameters.

It is still another object of this invention to provide a wire drawing and winding machine in which the drawn wire is heated or cooled during the course of its travel about the draw block.

It is still another object of this invention to provide

a wire drawing and winding machine in which the drawn wire is heated or cooled by a gaseous blast and by conduction from the draw block during the course of its travel about the draw block.

It is still another object of this invention to provide a wire drawing and winding machine in which the draw block, contrary to established practice in the art, is provided with a push-down apron, the convolutions of the wire about the draw block starting at the downwardly facing apron and being progressively shoved downwardly along the draw block for take-off adjacent the lower end of the draw block. This inverted arrangement lends itself to the use of a deep cup-shaped draw block with many convolutions of wire thereabout and simplifies the circulation of heat treating liquid through the draw block for efficient heat-treatment of the wire in contact thereabout.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of a few of the various ways in which the principle of the invention may be employed.

Broadly stated, the present invention relates to a wire handling apparatus which comprises a draw block about which wire is adapted to be wrapped; a rotary flyer for simultaneously wrapping and unwrapping the wire onto and from the draw block responsive to relative rotation of the draw block and the flyer in opposite directions, said flyer carrying the drawing die and having wire feed means traveling in a circular path to impose tension on the wire thus to hold it in frictional driving engagement about the draw block; a support for the coil of wire that is formed as the wire is fed from the feed means; and drive means for relatively rotating the draw block and the flyer in opposite directions at speeds such that the lineal speed (the rate of drawing) of the wire may be maintained at a desired value despite operation of the flyer at reduced speed to wind a coil of larger diameter or at increased speed to wind a coil of smaller diameter. Stated in another way, the drive means for relatively rotating the draw block and the flyer in opposite directions is so arranged that the algebraic sum of the speeds of the draw block (less slippage of the wire thereon), and of the flyer, determines the lineal or drawing speed of the wire and in turn, the speed of the flyer, with reference to a prescribed lineal speed of the wire, determines the diameter of the convolutions of the coil which is being wound.

In said annexed drawings:

Fig. 1 is a side elevation view of one embodiment of the present invention;

Fig. 2 is a top plan view of the Fig. 1 embodiment;

Fig. 3 is a rear elevation view as viewed from the right-hand side of Fig. 1;

Fig. 4 is a horizontal section view taken substantially along the line 4—4, Fig. 1;

Fig. 5 is a central vertical cross-section view showing a coaxial arrangement of a draw block or capstan and a flyer, the wire being fed from the latter for winding into a coil;

Fig. 6 is a top plan view of the apparatus shown in Fig. 5 and corresponds generally with the Fig. 4 section view, except that Fig. 6 is drawn on much larger scale; and

Fig. 7 is a central vertical cross-section view of another embodiment of a coaxially-arranged draw block or

capstan and flyer, means being provided in Fig. 7 for heating or cooling the wire as it travels in contact around the draw block.

Referring now in detail to the drawings and first to Figs. 1 to 4, the embodiment of the invention there shown comprises a machine base which, if desired, may constitute the floor F of the building in which the lower ends of a plurality of posts **1**, herein four, are anchored, the upper ends of the posts **1** being arranged to support thereon a cross-head **2** which constitutes a support on which the electric drive motors **3** and **4** are mounted and from which the wire drawing and winding mechanism **5** is hung, as shown.

In the present case two of the posts **1**, herein the rear pair, constitute vertical guideways for a coil support or pallet **6**, which has a horizontal portion **7** disposed underneath the wire drawing and feeding mechanism **5** and an upstanding portion **8** equipped with rollers **9** or the like, which run along the posts **1** as best shown in Figs. 1, 3, and 4, the last-mentioned figure showing the roller arrangement most clearly.

Connected to the cross-head **2** and to the coil support **6** are the respective components of a fluid cylinder and piston assembly **10** which preferably is of the hydropneumatic type in which liquid such as hydraulic oil under the influence of air pressure is employed to move the coil support **6** to its upper position (solid line position in Fig. 1) while controlled escape of the liquid through an adjustable valve orifice may be used to control the rate of gravity descent of the coil support **6** in accordance with the rate of growth or buildup of the wire coil C thereon. While in Fig. 1, the coil C is shown as being accumulated directly on the horizontal portion **7** of the support **6**, it is to be understood that a drum or like package may be used to contain the coil therewithin. In any event, the use of such packaging drum does not make it necessary to drive either the drum or the support **6**. In the present machine the drawn wire W is lineally fed from a flyer which moves in a circular path and thus the wire W will form itself into a coil C of diameter as determined by the speed of rotation of the flyer with reference to the lineal speed of the wire.

As will be described in detail, the wire W to be drawn and coiled or drawn, heat-treated, and coiled enters at the top of the machine, passing over a sheave **11** that is carried in the sheave block **12** attached to the drive housing or gear box **14** on the crosshead **2**. In stringing up the machine (see Figs. 1 to 6), the wire W is passed downwardly through the tubular drive shaft **15** for the rotary flyer assembly **16**, the wire W emerging from the lower end of the drive shaft **15** and passing successively over sheaves **17** and **18** mounted on the flyer assembly **16**. From the last-mentioned sheave **18** the wire W passes through a drawing die assembly **19** mounted on the flyer assembly **16**.

From the die **19**, the wire W, after having been drawn, is wrapped a number of times around the draw block or capstan **20** and from the draw block **20** the wire W passes over another sheave **21** of the flyer unit **16** and thence through a feed unit **23** operative to impose tension on the wire W so as to hold it in frictional driving engagement with the draw block **20**.

As explained later in detail, the wire feed rolls **24**, **25**, and **26** are carried by a housing **27** which swings about the axis of the take-off sheave **21** of the flyer **16** so that the wire W fed from the feed unit **23** may be directed outwardly or inwardly to correspond with the diameter of the coil C which is to be wound as the flyer **16** travels in a circular path about the axis of the draw block **20**. One of the feed rolls, herein the idler roll **26**, is mounted for lateral movement with respect to the two power driven feed rolls **24** and **25** to direct the wire fed therefrom still further outwardly.

In the present case it is preferred to employ separate drive motors **3** and **4** for the flyer **16** and the draw block **20** respectively.

Referring now to one embodiment of the combined draw block and flyer assembly as illustrated in detail in Figs. 5 and 6, the tubular drive shaft **15** is driven by the worm wheel **30** keyed thereon and in mesh with the worm **31** on the drive shaft of the flyer drive motor **3**. Secured to the lower end of said tubular drive shaft **15** is the flyer **16** providing a sheave block **32** for the sheave **17**, another sheave block **34** for the sheave **18**, and still another sheave block **35** for the sheave **21**. As shown and as previously described, the wire W extends downwardly through the hollow drive shaft **15**, passes over the bottom sheave **17**, thence around the obliquely disposed sheave **18**, then is wrapped several times about the draw block **20** (after having been drawn through the die **19** carried on said flyer **16**), and finally, the wire W is unwrapped from the draw block **20** for passage over the last sheave **21**.

As best shown in Fig. 6, the wire W after having been drawn through the die **19**, is wound clockwise about the periphery of the draw block **20**, the first convolution engaging the downwardly facing tapered apron **36** provided at the upper end portion of the draw block. Successive convolutions are pushed down and the lowermost convolution is taken off from the draw block **20** and passes over the sheave **21** and thence into the feed unit **23** of which the rolls **24** and **25** are driven in clockwise direction by gears **37** and **38** thereof which mesh with idler gear **39**, the gear **37** being driven through the idler gear **44** which meshes with gear **40** on the shaft **41** of sheave **21**, an idler gear **42**, and drive gear **43** mounted on draw block **20**. The particular relationship of the speed of the drive of the feed rolls **24** and **25** necessary to impose a tension on the wire W is automatically maintained at all relative speeds of the draw block **20** and the flyer **16** because the power is derived from the main drive gear **43** of the draw block.

The wire W in being taken off the sheave **21** is engaged in peripheral grooves formed in the respective feed rolls **24** and **25** and the laterally adjustable idler **26** is provided to hold the wire W in frictional engagement with the feed rolls **24** and **25** while at the same time the wire W may be fed off at different angles as represented by the full lines and dot-dash lines in Fig. 6.

Several anti-friction bearings **45**, **46**, **47**, and **48** are mounted on the hollow drive shaft **15** and in the stationary tubular housing **49** to rotatably support the draw block **20** which herein is shown as being driven through a worm **50** on the drive shaft of the draw block drive motor **4** and a worm wheel **51** which is bolted onto the quill **52** that interconnects the draw block **20** with the worm wheel **51**.

It can now be seen that when tension is imposed on the wire W by the feed unit **23** and when the rotation of the draw block **20** is in a clockwise direction, as viewed in Fig. 6, the wire W will be drawn through the die **19**. Except for slippage between the wire W and the draw block **20**, the lineal speed of the wire W will be equal to the peripheral speed of the draw block surface with which the wire is frictionally engaged. The wire W thus will be lineally fed from the feed unit **23**. Without rotation of the flyer **16** the wire W will not be formed into a coil unless a rotary support or package is provided. However, in the present case the flyer **16** is driven in a counterclockwise direction, as viewed in Fig. 6, and as apparent, there is simultaneous unwrapping of the wire W from the draw block **20** and wrapping of the wire W onto the draw block **20**. It is apparent that for a specified lineal speed of the wire W, the slower the rotation of the flyer **16** the bigger the diameter of the coil C which is formed as the let-off point of the flyer **16** travels in a circular path. Because the flyer **16** does travel in a circular path, the coil support **6** (or drum, if used) need not be rotated and thus the present machine is a "dead"

coil winding machine. Conversely, as the speed of the flyer 16 is increased with reference to a specified lineal speed of the wire W the diameter of the convolutions of the coil C will become progressively smaller.

In the wire drawing art it is, of course, desirable and often necessary to draw the wire W through the die 19 at a specified lineal speed in order to produce the desired results. Furthermore, for sake of economy of operation, the machine should be operated at full capacity. For that reason, in the present embodiment of the invention separate variable speed drive motors 3 and 4 are employed so that as the flyer 16 is operated at reduced speed the draw block 20 may be operated at correspondingly increased speed to maintain a specified lineal speed of drawing of the wire W through the die 19 and feeding thereof from the feed unit 23.

With the instant mechanism by thus varying the speeds of rotation of the flyer 16 and of the draw block 20 in opposite directions as aforesaid, it is possible to wind coils C of variable diameter either smaller than, or larger than, the diameter of the draw block 20.

If the draw block 20 were stationary and only the flyer 16 were driven, the lineal speed of the wire W could be varied by varying the speed of the flyer 16, but obviously, regardless of the speed of the flyer 16, the diameter of the coil C would be fixed at a diameter equal to the diameter of the draw block 20. If, on the other hand, a single drive motor were employed with intergearing to revolve the draw block 20 and the flyer 16 in opposite directions, the lineal speed of the wire W could be varied by varying the speed of the drive motor but again the coil diameter would be fixed at a diameter equal to the diameter of the draw block 20. While in the present case separate drive motors 3 and 4 are preferred, it is, of course, possible to provide a single motor for driving either the draw block 20 or the flyer 16, as desired, and interposing a variable or multi-speed drive between the motor and the gearing for the flyer 16 or the draw block 20 drive. In that case, the lineal speed of the wire W may be varied by changing the speed of the motor and the diameter of the coil C which is wound may be varied by changing the speed of both the motor and the variable or multi-speed drive.

An advantage of the separate drive motors 3 and 4 is that the coil diameter is continually variable by continually changing the speeds of both motors 3 and 4 and in that case it is possible to wind a coil C in which the convolutions commence near the center of the coil and progressively increase in diameter and then progressively decrease in diameter. Such wire package for a specified outside diameter and height obviously will contain much more wire than a coil wound just to the specified outside diameter because each layer of the variable radius or spiral convolutions comprises a greater length of wire than each layer of the uniform diameter convolutions.

Referring now to Fig. 7, there is shown another embodiment of the draw block and flyer assembly in which the wire W may be heat treated (heated or cooled) as it travels around in contact with the draw block 60.

Basically, the Fig. 7 assembly is like that of Figs. 5 and 6 in that the flyer drive shaft 61 is hollow and has secured thereto a worm wheel 62 that is in mesh with a worm 63 on the drive shaft 64 of the flyer drive motor. Similarly, the draw block 60 is driven through a quill 65 and worm wheel 67, the latter meshing with a worm 68 on the drive shaft 69 of the draw block drive motor.

In this case, the push-down apron 70 of the draw block 60 is disposed obliquely and the draw block 60 is of hollow construction and of relatively great axial length to accommodate a large number of wraps of the wire W thereabout. The interior of the draw block 60 is webbed, as shown, and passages 71 are provided for the circulation of coolant, for example, as represented by the arrows, the coolest fluid in that case initially coming into contact within the generally cylindrical portion of the draw block 60 about which the wire W is wrapped. Spent coolant flows upwardly over an overflow channel 72 into an annular trough 73 from the bottom of which the fluid is returned to a reservoir (not shown) for re-cooling and re-circulation. When oil is used as the coolant it is circulated as indicated and, therefore, constitutes a lubricant for the quill bearings 74 and 75. Around the annular drain trough 73 is an annular air chamber 76 which is provided with one or more bleed passages 78 to build up an air pressure in chamber 79 which prevents leakage of oil up under the lip 80 of the draw block 60. The air chamber 76 is formed with an annular slit 81 which is directed obliquely inwardly and downwardly toward the periphery of the draw block 60 and thus the wire W is subjected to a continuous and uniform air blast as it travels around the draw block 60. Should it be desired to heat the wire W a heating fluid may be employed instead of a coolant. In the event that water is used as a coolant, separate passages should be provided to isolate the water from the bearings 74 and 75 and instead of returning the spent water back to a reservoir, it may be drained into a sewer or else returned to a cooling tower or the like from which it again is allowed to circulate through the hollow draw block 60.

The flyer 83 herein is essentially the same as flyer 16 except for details of construction. The sheaves 84, 85, and 86 correspond in function to sheaves 17, 18 and 21, respectively, and similarly the gears 87 and 89 correspond with the gear drive of Figs. 5 and 6 for driving the feed unit (not shown in Fig. 7). The gear box 90 may constitute a reservoir for oil coolant if the desired rate of circulation can be achieved by the head of the oil; otherwise oil pressure hoses or pipes may be secured to the sides at the upper end of the tubular housing 91. When water cooling is employed the passages 71 may be formed in the wall of said housing 91.

From the foregoing description of the structure and operation of the present wire drawing and winding machine it can be seen that the vertical coaxial arrangement of the draw block and of the flyer (carrying the drawing die and wire feeding means) which are disposed above the non-rotating coil support greatly contributes to the simplicity and compactness of the machine. Moreover, the provision of variable speed drive means for the draw block and the flyer enables winding of coils of any desired diameter, and, in fact, enables winding of coils in which the convolutions spiral in and out so as to form a compact package with reference to the amount of wire therein. Still another important feature of this machine is that it not only continuously draws and packages the wire but also subjects the wire to desired heat treatment without necessitating an increase in the size of the machine and without a decrease in the productive capacity of the machine.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

We therefore particularly point out and distinctly claim as our invention:

1. Wire handling apparatus comprising a housing; a quill journalled in said housing; a capstan mounted coaxially on said quill for rotation therewith; a tubular drive shaft journalled concentrically in said quill; a flyer mounted on said shaft for rotation therewith; a purality of sheaves on said flyer over which wire extending through said shaft is adapted to pass for wrapping around said capstan upon relative rotation of said capstan and flyer; wire feed means on said flyer travelling in a circular path about said capstan upon such relative rotation of said capstan and flyer and operative to hold such wire wrapped on said capstan in frictional engagement about said capstan; a support for the coil of wire that is formed as the wire is fed from said wire feed means; and drive

means operatively connected with said shaft and quill for rotating said capstan and flyer in opposite directions.

2. The apparatus of claim 1 wherein said drive means comprises separate variable speed motors operatively connected to said shaft and quill respectively.

3. The apparatus of claim 1 wherein intergearing is provided between said capstan and said feed means to lineally feed the wire in accordance with the speeds of said capstan and flyer.

4. The apparatus of claim 1 wherein said wire feed means comprises a pair of power driven feed rolls disposed laterally adjacent to each other, and an idler roll that is laterally adjustable with respect to said feed rolls to hold the wire in frictional engagement with the latter.

5. The apparatus of claim 1 wherein said drive means is of the variable speed type to rotate said capstan and flyer at different relative speeds to maintain a prescribed lineal speed of the wire while changing the diameter of the convolutions of the coil that is accumulated on said support.

6. The apparatus of claim 5 wherein said wire feed means is carried by a housing that is swingably mounted on said flyer to vary the radius of the circular path of travel of said wire feed means.

References Cited in the file of this patent

UNITED STATES PATENTS

627,722	Edwards	June 27, 1899
1,624,000	Honig	Apr. 12, 1927
1,871,391	Robson	Aug. 9, 1932
1,955,785	Arkema et al.	Apr. 24, 1934
1,964,529	Newton et al.	June 26, 1934
2,127,989	Barron et al.	Aug. 23, 1938
2,247,248	Morgan et al.	June 24, 1941
2,341,707	Fornwald	Feb. 15, 1944
2,712,381	Bruestle	July 5, 1955

FOREIGN PATENTS

718,233	Great Britain	Nov. 10, 1954
1,126,490	France	July 30, 1956