March 22, 1960 J. COOK 2,929,193

SPEED CONTROL DEVICE FOR REELING MACHINES

Filed March 8, 1956 5 Sheets-Sheet 1

Fig. 1

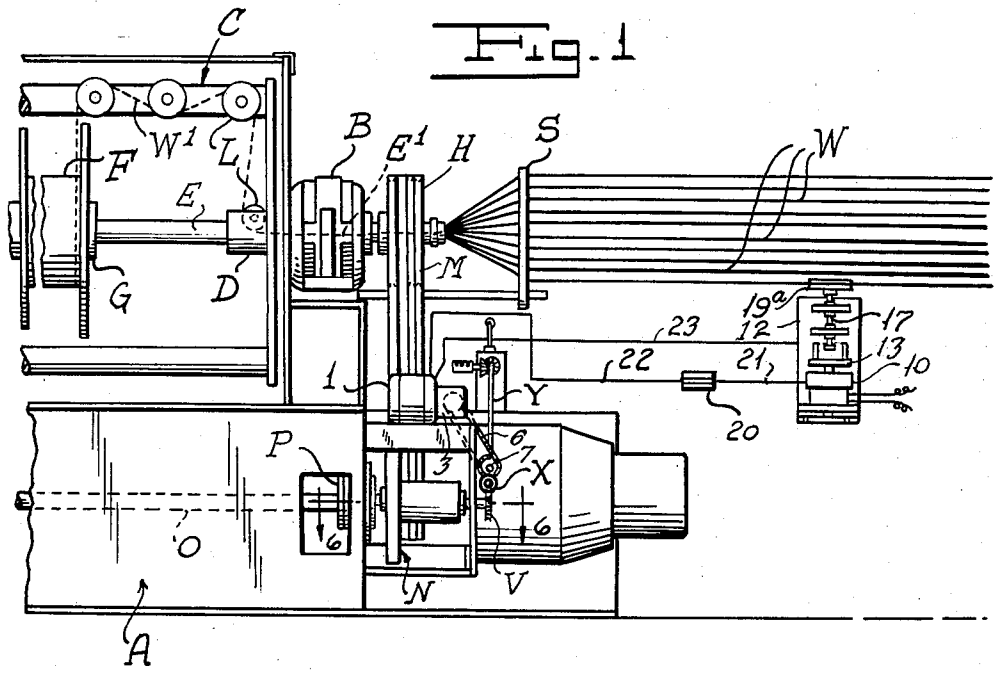
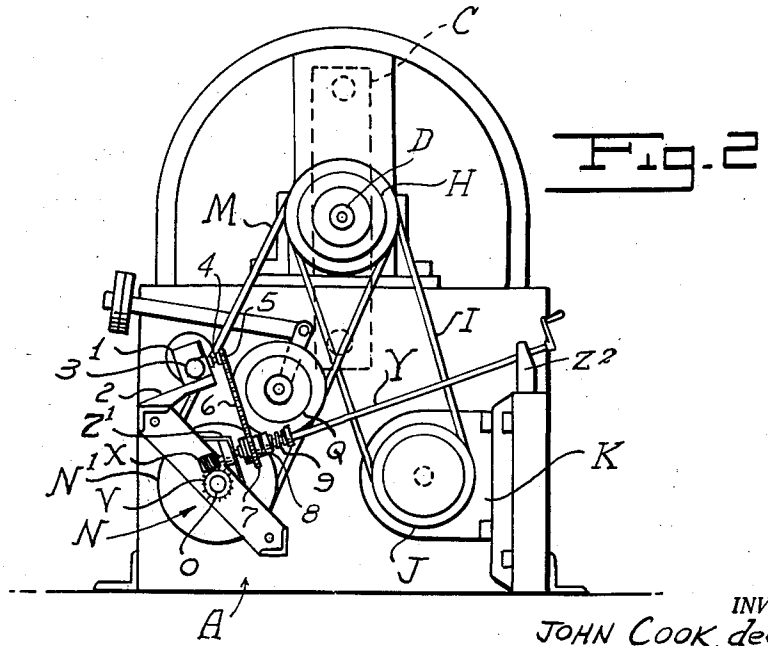


Fig. 2



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SPEED CONTROL DEVICE FOR REELING MACHINES

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Fig. 2A

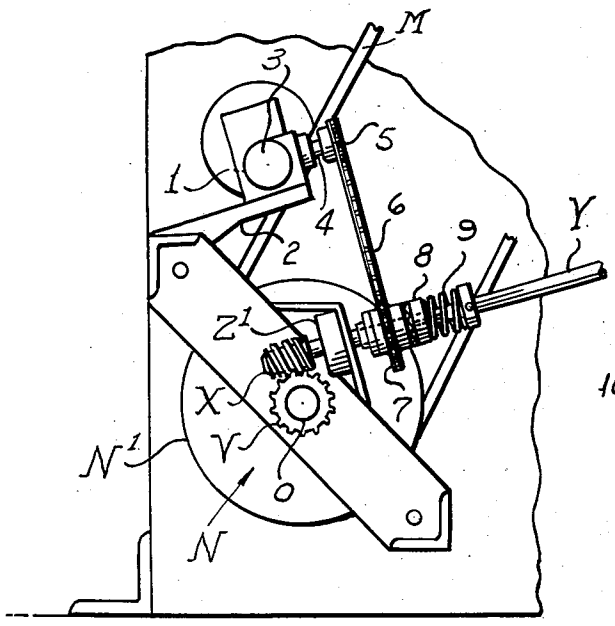
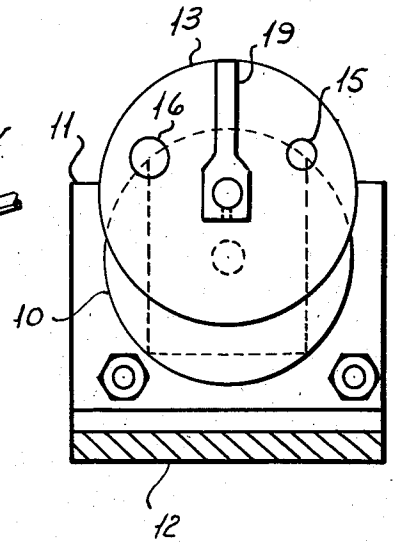


Fig. 5



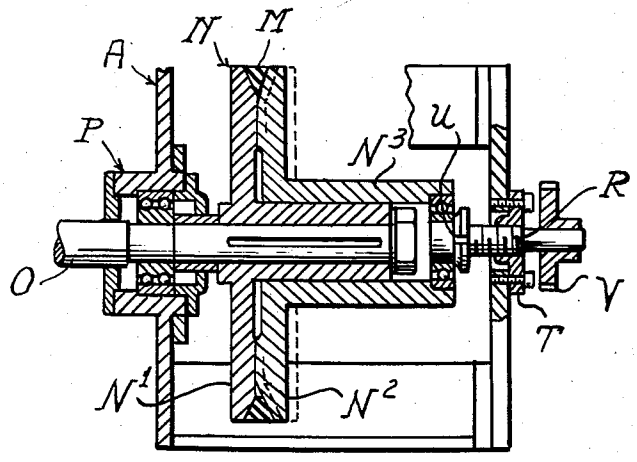


Fig. 6

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SPEED CONTROL DEVICE FOR REELING MACHINES

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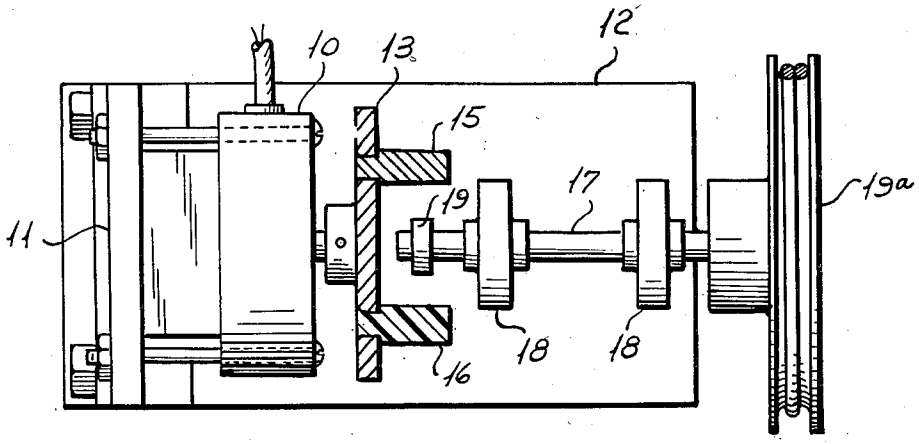
Fig. 3



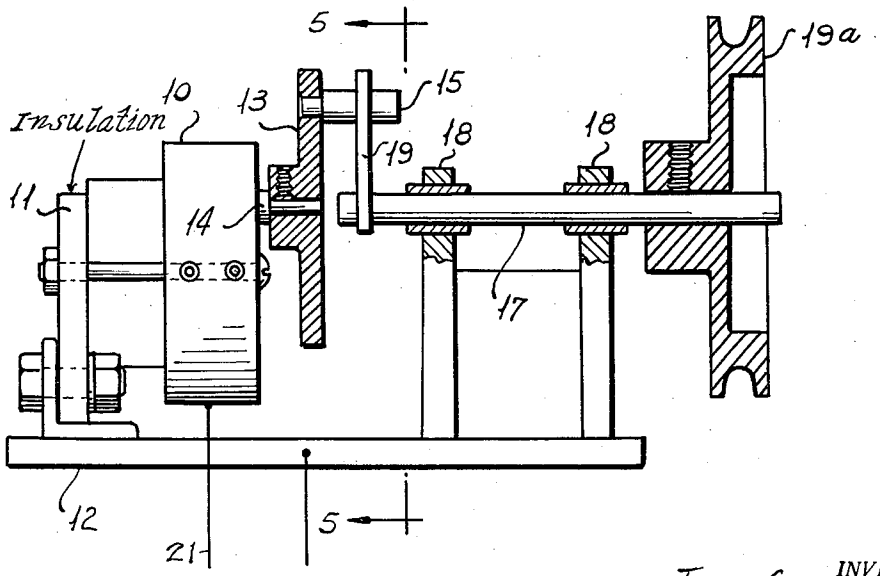


Fig. 4

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March 22, 1960 J. COOK 2,929,193

SPEED CONTROL DEVICE FOR REELING MACHINES

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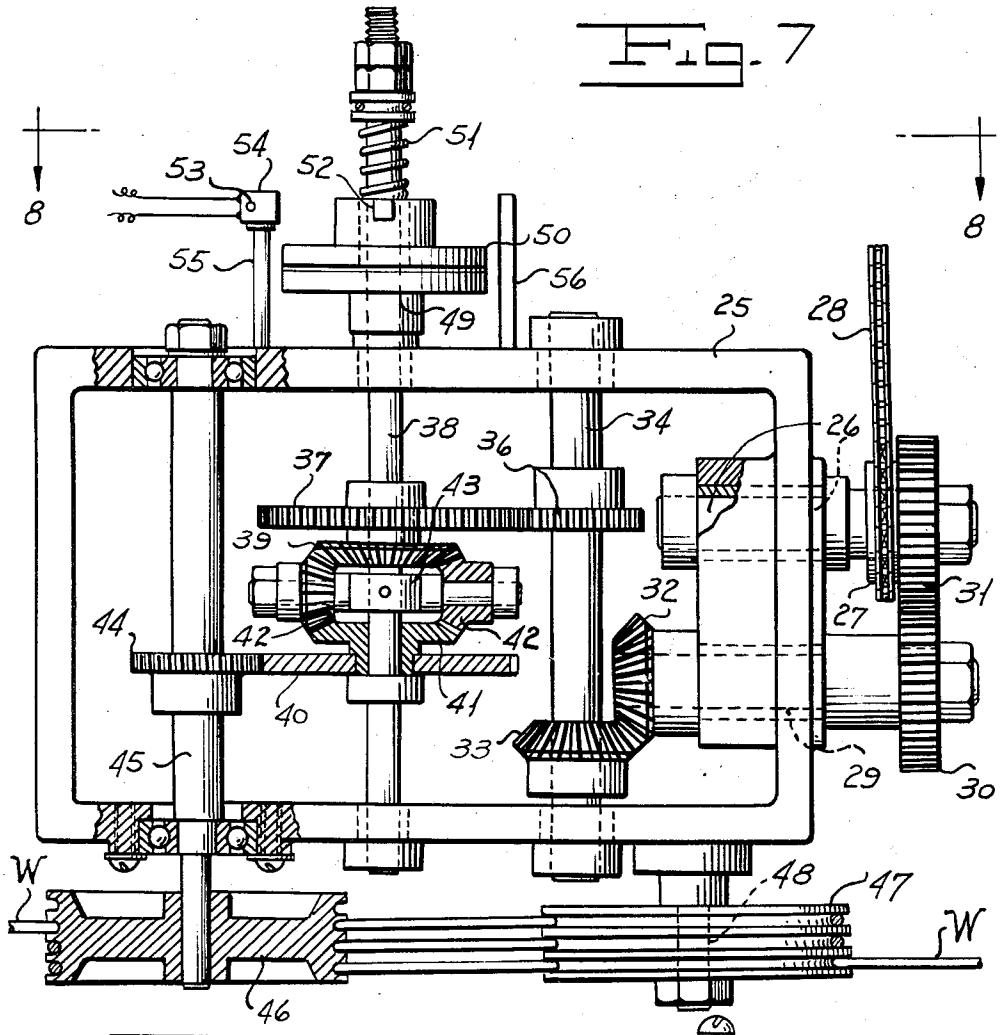
Fig. 7



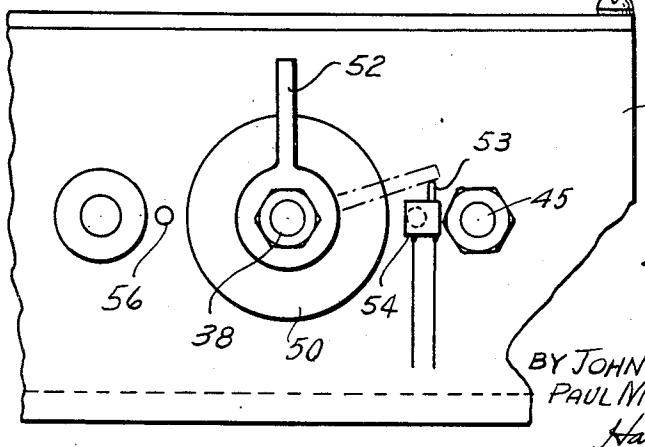


Fig. 8

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SPEED CONTROL DEVICE FOR REELING MACHINES

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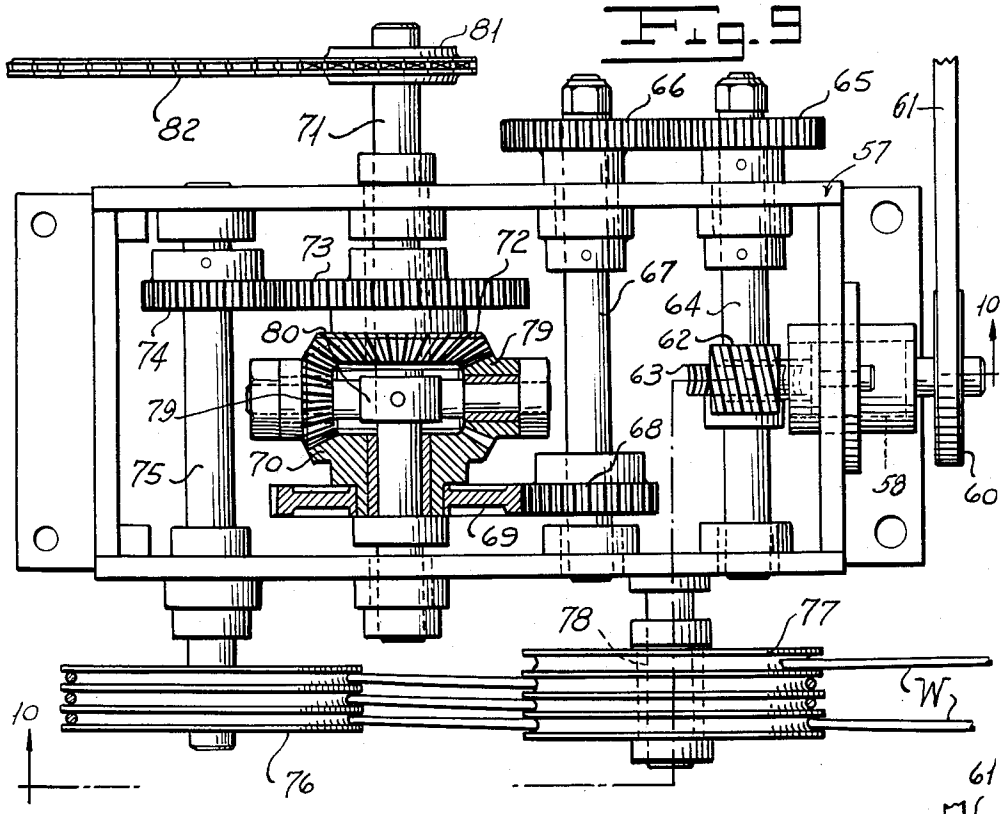
Fig. 9



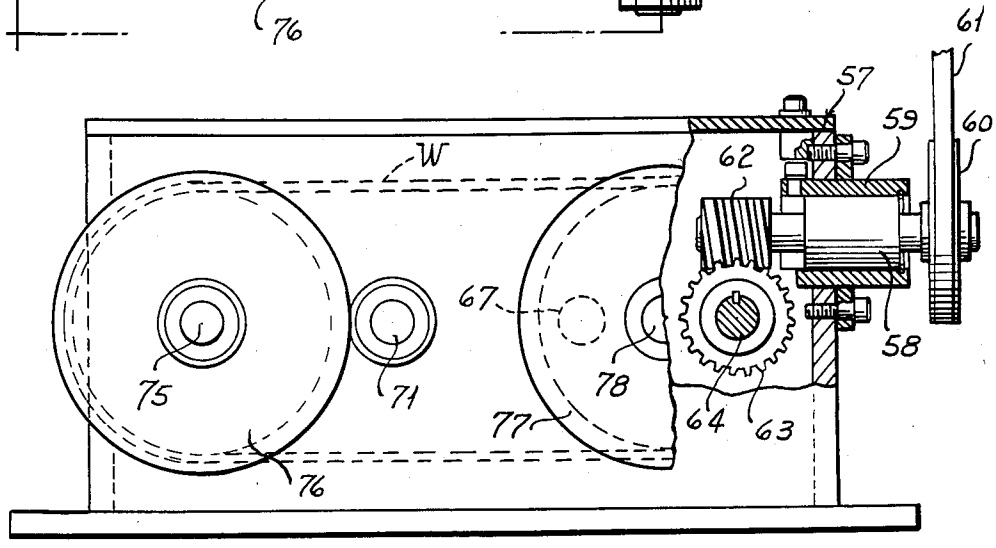


Fig. 10

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United States Patent Office 2,929,193
Patented Mar. 22, 1960

2,929,193

SPEED CONTROL DEVICE FOR REELING MACHINES

John Cook, deceased, late of Ridgewood, N.J., by John R. Cook, Williamstown, Mass., and Paul Maxwell Cook, Redwood City, Calif., executors, assignors to Cook Manufacturing Company, Paterson, N.J., a corporation of New Jersey

Application March 8, 1956, Serial No. 570,375

20 Claims. (Cl. 57—67)

This invention relates in general to means for controlling the linear speed of, for example, strips, webs, or ribbons of material, and wire, and more particularly the invention contemplates means for varying the speed of a winding reel in proportion to the increased diameter of the coil of material being wound on the reel. The invention is especially useful in wire stranding machines of the type shown in the pending application of John Cook, deceased, Serial No. 417,430, filed March 19, 1954, now U.S. Patent No. 2,817,948.

The machine described in said application comprises a base or frame, a flier rotatably mounted on the base, means for rotating said flier, a reel supporting member disposed coaxially with said flier to receive a winding reel thereon and to rotate said winding reel relatively to said flier, means for twisting said wire strands and for guiding the twister wire to and on said flier and to distribute said twisted wire onto said reel, a drive between said flier and said reel supporting member to positively control relative rotation of said flier and said reel, manually operable means for varying the ratio of said drive during the winding of twisted wire on said reel so that the speed differential between the flier and the reel is proportional to the diameter of the coil of wire on the reel. This machine makes it possible to twist the wire strands uniformly under relatively light and uniform tension throughout the twisting operation, as distinguished from wire-twisting machines which involve capstans which in many instances impart considerable and variable tension in the wire strands incident to the differential speed of rotation of the flier from the reel.

While the high tension in the old capstan machines is not seriously objectionable when winding heavy gauge wire, high tension must be avoided in winding light gauge wire in order to avoid breaking of the wire; and many efforts have been made to control the speed of rotation of the winding reel in accordance with variations in said tension on the wire. Nevertheless these prior art machines fall short of solving the problem of reeling the wire under light and uniform tension.

The machine of the aforesaid application has successfully solved said problem by providing positive driving means for both the flier and the winding reel, driven from the same motor, in combination with means for varying the ratio of the drive of said flier and said reel during the winding of the wire on the reel. A prime object of the present invention is to provide automatic means for varying said speed differential in accordance with the linear speed, as distinguished from the tension, of the wire being wound or reeled, although the invention may be embodied with equal advantage in other variable speed devices where linear speed is to be controlled.

Another object of the invention is to provide automatic control mechanism of the general character described which shall include a part continuously moved at constant or uniform speed, another part driven by or movable in accordance with the linear speed of the element,

such as wire being reeled, whose speed is to be controlled, said parts being cooperative to control the means for moving said element, for example, for driving a reel for winding wire.

A further object of the invention is to provide such control mechanism which shall include a part continuously rotated by a synchronous electric motor, a part continuously rotated by the moving element such as wire being reeled, cooperative with the first-mentioned part for controlling power actuated mechanism to vary the speed of the means for moving said element, for example the drive for a reel for winding wire to vary the ratio between the speed of the flier and the speed of the reel in a wire twisting machine.

Still another object is to provide control mechanism of the general character described which shall include a part rotated at substantially uniform speed, for example, by the motor that drives a wire twisting machine, another part rotated continuously by the element such as wire whose speed is to be controlled, differential gearing connecting said two parts, means operated by the output shaft of said differential gearing to control the means for moving said element, such as the drive for a wire winding reel, to vary the linear speed of said element.

Other objects, advantages and results of the invention will be brought out by the following description in conjunction with the accompanying drawings.

For the purpose of illustrating the principles of the invention, the invention has been shown in conjunction with the wire stranding machine disclosed and claimed in the aforesaid copending application Serial No. 517,403 filed March 19, 1954, but only so much of that machine as is necessary for an understanding of the present invention is illustrated in the accompanying drawings in which—

Figure 1 is a fragmentary side elevational view, similar to Figure 2 of the above-mentioned application, of a wire stranding machine and a schematic illustration of an automatic control mechanism embodying the invention;

Figure 2 is an end elevational view of the wire stranding machine and a portion of the automatic control mechanism embodying the invention;

Figure 2A is an enlarged fragmentary end elevational view of the power driven speed changing mechanism for the winding reel;

Figure 3 is an enlarged top plan view, partially in section, of the constant speed part and the variable speed part of the control mechanism;

Figure 4 is a central vertical sectional view, with portions shown in side elevation of the parts illustrated in Figure 3;

Figure 5 is a transverse vertical sectional view on the plane of the line 5—5 of Figure 4;

Figure 6 is an enlarged fragmentary vertical sectional view, similar to Figure 5 of the aforesaid pending application, of speed changing mechanism for the reel drive;

Figure 7 is a top plan view with portions shown in section of a modified form of the combination of the constant speed device and the variable speed device;

Figure 8 is an end elevational view approximately from the plane of the line 8—8 of Figure 7;

Figure 9 is a view similar to Figure 7 showing a further modification of the invention; and

Figure 10 is a combined end elevational and sectional view approximately on the plane of the line 10—10 of Figure 9.

The wire stranding machine of the aforesaid application includes a main frame or base A which has two upstanding portions for supporting bearings one of which is designated B. Opposite ends of the flier C are provided

with trunnions for mounting the flier in said bearings, and one of said trunnions is designated D and has relatively rotatably supported therein one end of a shaft E, the other end of which is journaled in another bearing (not shown) on the frame. A winding reel F is mounted on a tubular shaft G that is longitudinally slidable on the shaft E. The flier is rotated by a pulley H fastened to the trunnion D and connected by a belt I to a pulley J on an electric motor K that is mounted on the base of frame A. A plurality of strands of wire W to be twisted are fed from a plurality of spools through a spider S as usual and through a coaxial bore E^1 in the trunnion D, around pulleys L on the flier and thence to the reel F as usual. The reel F is rotated from the same motor K through a belt M that is connected to a pulley N on a lay shaft O which is journaled in suitable bearings in the frame A one of which is designated P. The shaft O has a belt and pulley connection (not here shown) with the tubular shaft G whereby the reel is rotated relatively to the flier.

Means (not here shown) is provided for moving the shaft G and reel F back and forth along the shaft and relatively to the flier for directing the convolutions of the twisted wire W^1 onto the reel in successive layers. The pulley N comprises two sections N^1 and N^2 that provide a V-shaped groove between them on their peripheries for the V-belt M, and one section N^1 is formed with a hub that is keyed on the shaft O. The other section has a tubular hub N^3 telescopically slidable on the hub of the section N^1. The section N^2 is adjustable toward and from the other section to vary the diameter of the bearing surface in the V-groove and consequently vary the speed of the lay shaft O, it being understood that there is a suitable tension-maintaining roller Q for the belt M. As shown, a screw R has a screw threaded connection with a nut portion T in the frame A and has a swivel connection U with one end of the hub portion N^3. A worm gear V is fast-connected to the screw R and meshes with a worm X on a shaft Y which is journaled in suitable bearings Z^1 and Z^2 on the base of the machine.

The automatic control mechanism of the invention includes a servo-electric motor 1 mounted on a bracket 2 on the base of the machine and connected through speed reducing gearing 3 to the output shaft 4 which has a sprocket 5 connected by a chain 6 with a sprocket 7 that is rotatably mounted on the shaft Y and forms a part of a slip clutch, the other part 8 of which is keyed on and movable longitudinally of the shaft Y and normally held in frictional contact with the sprocket 7 by a compression spring 9.

This power driven speed changing mechanism for the winding reel is controlled in accordance with the linear speed of the wire strands W which in turn varies with the diameter of the coil of twisted wire on the reel. As shown in Figures 1, 3, 4 and 5, one type of control mechanism includes an electric synchronous motor 10 which is mounted on an insulating bracket 11 that in turn is secured to an electricity-conducting base plate 12 which may be fixedly mounted at any suitable point. A disk 13 of electricity-conducting material is keyed on the shaft 14 of the motor and has a conducting stud 15 rigidly secured thereto and projecting from the outer face thereof. A stud 16 formed of electrical insulating material is secured to and projects from the same face of the disk in spaced relation to the conducting stud 15. When the motor 10 is operating, the disk and pins will be continuously rotated at a constant or uniform speed.

A variable speed shaft 17 of conducting material is journaled in electrical conducting bearings 18 on the base plate 12 coaxially with the motor shaft 14 and has a conducting arm 19 projecting radially therefrom between the studs 15 and 16. On the shaft 17 is secured a pulley 19*a* around which passes one of the wire strands W so that the shaft 17 is rotated by the wire as the wire strand is pulley longitudinally into the twisting machine. It will be understood, of course, that where the controlling element is something other than a wire strand, that element will be arranged to rotate the shaft 17 during longitudinal movement of the element.

The arm 19 and pin 15 form a switch and are connected in circuit with the servo motor 1, preferably through a known type of relay mechanism 20 so that the motor 1 is connected in circuit with the switch 19, 15 for a predetermined period of time, for example two seconds, thereby to prevent excessive increase in the speed of rotation of the winding reel F. As shown, the motor casing is connected by a wire 21 to the relay 20 which is in turn connected by a wire 22 to one terminal of the motor 1 the other terminal of which is connected by a wire 23 to the base plate 12. The motor 10 is connected in any suitable circuit as usual. Preferably the circuit through the contacts 15, 19 will be of a low voltage and which may be obtained in known way by use of a transformer from an ordinary industrial electric circuit.

With this construction, it will be understood that with the stud 15 normally rotating at constant speed and the speed of rotation of the arm 19 increasing in accordance with the increases in the diameter of the wound coil on the reel F, the arm 19 will contact the stud 15 and thereby start the servo motor 1 to rotate the shaft Y and thereby change the diameter of the pulley N so as to reduce the speed of rotation of the lay shaft O, and, through the driving connection betwen said shaft O and the tubular shaft G, reduce the speed of rotation of the reel F. The gradual increase in the size of the wire coil on the reel is thus compensated so as to maintain a substantially uniform and light tension on the wire. The insulating stud 16 in conjunction with the arm 19 ensures that the proper relationship between the stud 15 and the arm 19 shall be maintained regardless of the differences in speeds of rotation of the motor shaft 14 and the shaft 17.

From the foregoing it will be seen that the linear speed or speed of longitudinal movement of the wire or other elongated element, is effectively controlled by the combination of the variable speed drive means, i.e., the drive for the reel, the mechanism, i.e., the clutch 7, 8, shaft Y, and motor 1, for varying the speed of the said drive means, and the control means, i.e. the part driven at constant speed and the part driven in accordance with the speed of the wire.

A modification of the invention is shown in Figures 7 and 8 and includes a rectangular frame 25 in one side of which is journaled a stub shaft 26 to which is rigidly connected a sprocket 27 which is adapted to be connected by a chain 28 to another sprocket driven at substantially constant speed by a suitable means, such as the machine motor K. A second stub shaft 29 is journaled in said side of the frame and has fast connected thereto a pinion 30 with which meshes a pinion 31 on the stub shaft 26. The stub shaft 29 also has a bevel gear 32 connected thereto and meshing with another bevel gear 33 on a jack shaft 34 which is journaled in the frame in perpendicular relation to the stub shafts 26 and 29 and has rotatable therewith a pinion 36 which meshes with a gear 37 which is fast connected to a bevel gear 39 that is rotatable on a shaft 38 which is journaled in the frame in parallel relation to the shaft 34.

Another gear 40 is fast connected to a bevel gear 41 which is rotatable on the shaft 38 in spaced relation to the bevel gear 39. Between and meshing with the gears 39 and 41 are two small bevel pinions 42 that are journaled on a support bracket 43 which is keyed to the shaft 38. The gear 40 meshes with a gear 44 that is fast connected to a variable speed shaft 45 which is journaled in the frame parallel to the shafts 34 and 38. On one end of the shaft 45 is a pulley 46, and a similar pulley 47 is journaled on a stud shaft 48 which is rigidly mounted on the outside of the frame 25. Preferably the pulleys 46

and 47 have a plurality of grooves and the wire strand W or the like passes around the pulleys several times with each pass in a different groove to provide adequate friction for driving the pulley 46.

Outside the frame 25 on one end of the shaft 38 is fixed one section 49 of a slip clutch the other section 50 of which is rotatable on the shaft and is normally pressed into frictional engagement with the section 49 by a compression spring 51 in the usual manner. The section 50 carries a contact arm 52 to coact with the actuating plunger 53 of a micro-switch 54 which is connected in the circuit which controls servo motor 1. The switch 54 is mounted on a long stud 55 which projects from the frame parallel to and at one side of the shaft 38.

With this construction, it will be observed that the gear 37 will be driven at a substantially constant speed from the chain and sprocket drive 27, 28, while the gear 40 will be driven at varying speeds through the pulley 46 by the wire strand W. The differential gear 39—43 will rotate the shaft 38 at a speed representing the differential in the speeds of the gears 37 and 40. Accordingly, when the machine is running, the contact arm 52 normally will be spaced from the micro switch 53 as shown by solid lines in Figures 7 and 8 but when the diameter of the wire coil on the winding reel increases the increase in linear speed of the wire strand W will cause the crank arm 52 to be swung into engagement with the micro-switch plunger 53, as shown by broken lines in Figure 8 so as to actuate said switch and cause energization of the servo motor 1 and thereby reduce the speed of rotation of the winding reel.

To limit rotation of the shaft 38 in the other direction and thereby ensure that the contact arm 52 shall always be in proper relation to the micro-switch 54, an insulating stop stud 56 is provided at the side of the shaft 38 opposite the stud 55.

Both of the control mechanisms so far described will cause a variation in the speed of rotation of the winding reel only in one direction, that is, to reduce the speed. Figures 9 and 10 show another modification of the invention through which the speed of rotation of the winding reel can be either increased or decreased. Here a gear box 57 has a stub shaft 58 journaled in a bearing 59 in one vertical wall of the gear box. A pulley 60 is fastened on one end of said stub shaft to rotate therewith and is connected by a belt 61 to, for example, the shaft of the machine motor K so as to be rotated approximately at a constant speed. At the other end of the stub shaft 58 is a worm 62 meshing with a worm gear 63 on a countershaft 64 which is journaled in bearings in the opposite side walls of the gear box. A gear 65 on the countershaft 64 meshes with a similar gear 66 on a jack shaft 67 which is journaled in the walls of the gear box parallel to the shaft 64. Fast connected to the shaft 67 is a pinion 68 which meshes with a gear 69 fast connected to a bevel gear 70 which is rotatable on an output shaft 71 which is also journaled in the walls of the gear box parallel to the shafts 64 and 67. Also rotatably mounted on the shaft 71 is a second bevel gear 72 with which is fast connected a spur gear 73 which in turn meshes with a pinion 74 on a variable speed shaft 75 which is journaled in the walls of the gear box parallel to the shaft 71. A grooved pulley 76 is mounted on the outer end of the shaft 75 and a similar grooved pulley 77 is mounted on a stud shaft 78 secured to one wall of the gear box. The pulley 76 is driven at varying speeds and the bevel gear 72 is driven at corresponding variable speeds. The bevel gear 70 is driven at a substantially constant speed from the drive shaft 58, and a pair of bevel pinions 79 are journaled coaxially diametrically opposite each other on a bearing bracket 80 which is keyed to the shaft 71, with the two pinions 79 meshing with both the bevel gears 70 and 72. Thus during operation of the mechanism, the shaft 71 will be rotated at a speed that represents the differential between the speed of the shaft 75 and the speed of the shaft 58. The output shaft 71 is directly connected to speed varying or control mechanism without the interposition of the servo motor 1 or the like, and in the present instance may have a sprocket 81 thereon connected by a chain 82 to the shaft Y. Of course, if desired, the chain could be connected to the sprocket of an electrical controlling mechanism, such as a switch, for governing the operation of a servo motor which in turn could be connected to a speed varying mechanism for operating the latter.

Obviously the invention could be utilized for maintaining a particular desired linear speed of for example the twisted wire. The variable speed parts of the mechanism could be driven in accordance with the speed of any desired device or unit to control the speed of any other device, unit or element.

While several of the now preferred embodiments of the invention have been illustrated and described, this is primarily for the purpose of illustrating the principles of the invention, and the structural details of the control apparatus may be widely modified and changed and the control apparatus of the invention may be embodied in other types of machines, all within the spirit and scope of the invention.

What is claimed is:

1. The combination with a wire stranding machine comprising a base, a flyer rotatably mounted on said base, means for rotating said flyer, a reel supporting member disposed coaxially with said flyer to receive a winding reel thereon and to rotate said winding reel relatively to said flyer, means for guiding wire strands to and on said flyer and to distribute said strands onto said reel, and a drive between said flyer and said reel supporting member to positively control relative rotation of said flyer and said reel, and means for varying the ratio of said drive during the winding of wire on said reel comprising a revoluble part continuously revolved by one of said wire strands as the strand moves toward said reel, and at a speed corresponding to the speed of movement of said wire strand for operating said means for varying the ratios of said drive during the winding of the wire on the reel.

2. The combination as defined in claim 1 wherein said means for varying the ratio of said drive comprises a second part movable at approximately a constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said means for varying the ratio of said drive.

3. The combination with a wire stranding machine comprising a base, a flyer rotatably mounted on said base, means for rotating said flyer, a reel supporting member disposed coaxially with said flyer to receive a winding reel thereon and to rotate said winding reel relatively to said flyer, means for guiding wire strands to and on said flyer and to distribute said strands onto said reel, and a drive between said flyer and said reel supporting member to positively control relative rotation of said flyer and said reel, and means for varying the ratio of said drive during the winding of wire on said reel comprising a movable part actuatable by one of said wire strands as the strand moves toward said reel, and at a speed corresponding to the speed of movement of said wire strand, and a second part movable at a constant speed relatively to the first-mentioned part and coactive with the first-mentioned part upon variations in the diameter of the wire coil being wound on said reel to operate said means for varying the speed ratio of said drive during the winding of wire on the reel.

4. The combination as defined in claim 3, wherein said means for varying the ratio of said drive includes a power-operated means for actuating it, and said parts cooperate to cause operation of said power operated means upon variations in the diameter of the wire coil being wound on said reel.

5. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part continuously revoluble at approximately constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism.

6. The combination as found in claim 5 wherein said speed-varying mechanism includes a power operated device for actuating it, and said control means controls said power operated device.

7. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed and engageable with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism.

8. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed, and power-operated means for actuating said speed-varying mechanism, said parts being cooperative upon a difference between the speeds of said parts for controlling said power-operated means.

9. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed, and engageable with the first-mentioned part upon a difference between the speeds of movement of said parts, and a power operated device for actuating said speed-varying mechanism controlled by said engagement of said parts to cause operation of said speed-varying mechanism.

10. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed, and engageable with the first-mentioned part upon a difference between the speeds of movement of said parts, and a power operated device for actuating said speed-varying mechanism controlled by said engagement of said parts to cause operation of said speed-varying mechanism, the control means including a synchronous electric motor for rotating said second part, said first-mentioned part including an electrical contact member, said second-mentioned part including a second electrical contact member, said speed-varying mechanism including an electric motor for actuating it, and a circuit including said motor and both said contact members for controlling said motor.

11. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means including a second part movable at approximately a constant speed, and a member responsive to the speed differential between said parts and controlling operation of said speed-varying mechanism.

12. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means including a second part movable at approximately a constant speed, and a member responsive to the speed differential between said parts and controlling operation of said speed-varying mechanism, said speed-varying mechanism including an electric motor for actuating it, said control means including a circuit-closing device and a circuit including said motor and said circuit-closing device, and said member closing said circuit-closing device upon occurrence of said speed differential to start said motor.

13. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means including a second part movable at approximately a constant speed, and a member responsive to the speed differential between said parts and controlling operation of said speed-varying mechanism, and a driving connection between said member and said speed-varying mechanism for actuating said mechanism.

14. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said variable speed drive means including a motor-driven shaft and a counter-shaft, said mechanism including a friction clutch having one section fast-connected to said counter-shaft and another section rotatable relatively to said counter-shaft, a driving connection between one of said sections and said motor-driven shaft, and said control means including apparatus for varying the frictional engagement of said sections upon a change in the speed of movement of said part.

15. The combination of variable speed drive means for moving an elongated element longitudinally, speed-

varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism and wherein said variable speed drive means including a motor-driven shaft and a countershaft, said mechanism including a friction clutch having one section fast-connected to said countershaft and another section rotatable relatively to said countershaft, a driving connection between one of said sections and said motor-driven shaft, and said control means including apparatus for varying the frictional engagement of said sections upon said coaction of said parts.

16. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said variable speed drive means including a reel for said elongated element, a motor having a driving shaft, a countershaft connected to said reel for rotating the reel, and said speed-varying mechanism including a variable speed driving connection between said motor and said countershaft controlled by said control means.

17. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism, and wherein said variable speed drive means include a reel for said elogated element, a motor having a driving shaft, a countershaft connected to said reel for rotating the reel, and said speed-varying mechanism includes a variable speed driving connection between said motor and said countershaft controlled by said coaction of said parts.

18. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said variable speed drive means including a reel for said elongated element, a motor having a driving shaft, a countershaft connected to said reel for rotating the reel, and said speed-varying mechanism comprising a driving connection between said motor and said countershaft having a speed-changing device, and power-operated means controlled by said control means for actuating said speed changing device.

19. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism, and said variable speed drive means including a reel for said elongated element, a motor having a driving shaft, a countershaft connected to said reel for rotating the reel, and said speed-varying mechanism comprising a driving connection between said motor and said countershaft having a speed-changing device, and power-operated means controlled by said control means for actuating said speed-changing device.

20. The combination of variable speed drive means for moving an elongated element longitudinally, speed-varying mechanism for varying the speed of said variable speed drive means, and control means including a revoluble part engaged and continuously revolved by said elongated element during said longitudinal movement of the element at a speed corresponding to the speed of said movement to operate said mechanism for changing the speed of said drive means, said control means comprising a second part movable at approximately a constant speed and coactive with the first-mentioned part upon a difference between the speeds of movement of said parts to cause operation of said speed-varying mechanism and wherein said variable speed drive means includes a reel for said elongated element, a motor having a driving shaft, a countershaft connected to said reel for rotating the reel, and said speed-varying mechanism includes a variable speed driving connection between said motor and said countershaft and a member movable responsive to the speed differential between said parts, and a driving connection between said member and said speed-varying mechanism.

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