Sept. 2, 1930. D. R. FRANCIS 1,774,880

DRIVING MEANS FOR WIRE STRANDING MACHINES

Filed Jan. 5, 1929 2 Sheets-Sheet 1

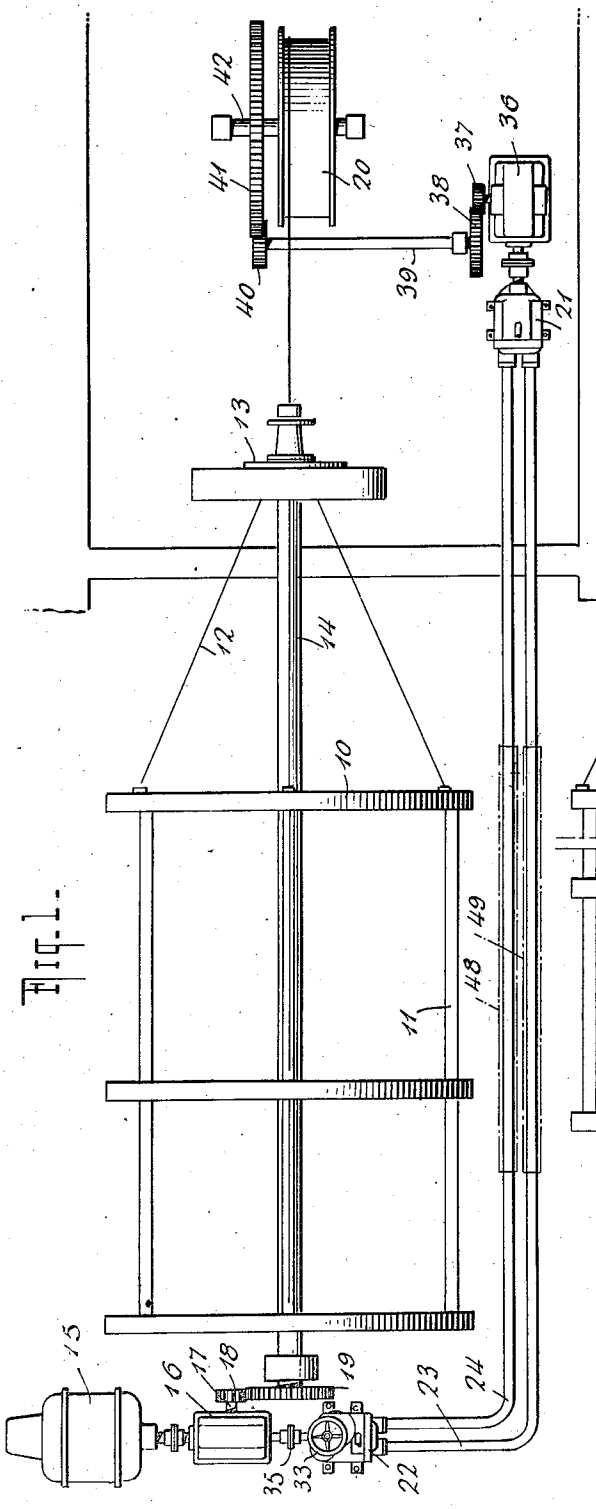

FIG. 1.

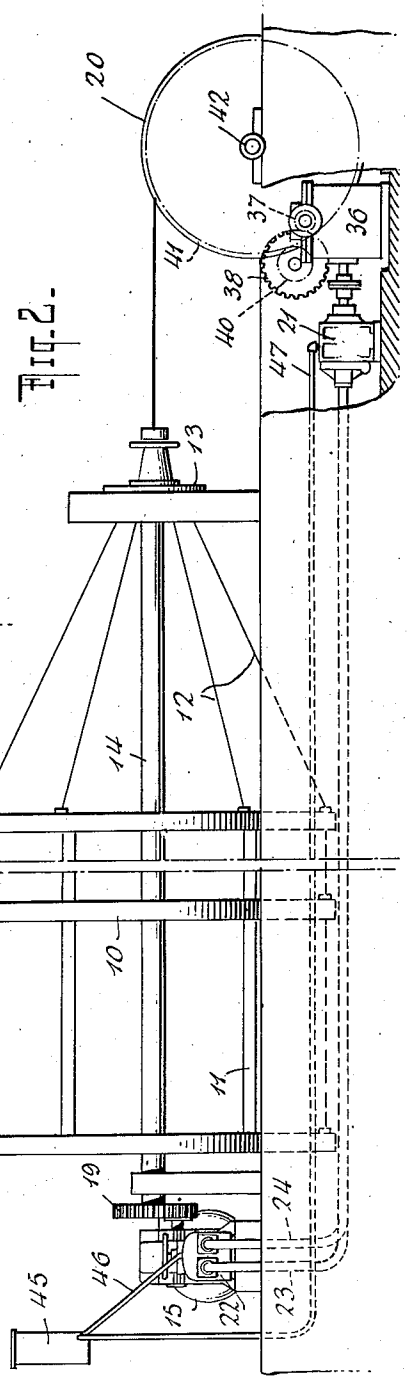

FIG. 2.

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FIG. 3.

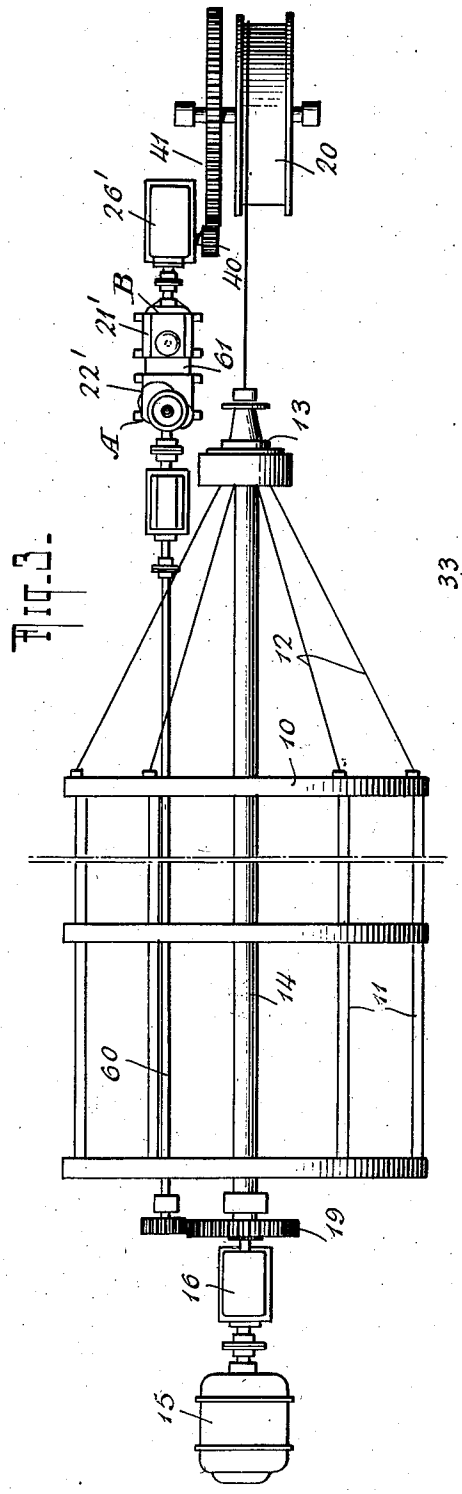
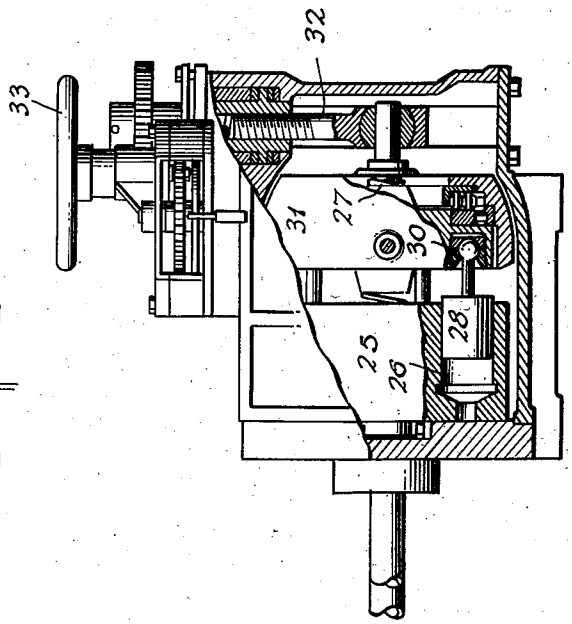


FIG. 4.



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UNITED STATES PATENT OFFICE

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DRIVING MEANS FOR WIRE-STRANDING MACHINES

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This invention relates to driving means for wire stranding machines. In the manufacture of wire rope on stranding machines it is customary to employ two separate drives for the stranding machine. One of these drives is used for rotating a spider which carries a plurality of spools of wire. This spider is ordinarily in the form of a cylindrical cage and may consist of one or more sections. A plurality of spools of wire are rotatably mounted at spaced points upon the cage-like spider adjacent to the periphery thereof and the wires from such spools are carried through a control die in which the wires are associated with a fibre core, the core usually being carried through a hollow shaft upon which the spider is mounted. The spider being revolved the wires are twisted about the core to form the wire rope in its finished form. The rope is passed around a capstan drum and the latter is revolved to draw the twisted rope through the die. The relative speeds of the spider and capstan determine the helix or pitch, or, as it is commonly called in the rope industry, the lay of the wire.

The proper proportioning of the speeds of the capstan drum and spider has always been a matter of great difficulty. It is absolutely essential that the relative or proportional speeds of these two members be accurately controlled in order to obtain the uniform finished product of definite standard properties. If the lay is not right, the wires will either close down on each other forming a tube-like structure around the core and not gripping it, or the wires will close down on the core and not be in contact with each other. In either case the rope will not have the desired properties. In order to produce high grade wire rope the lay must be so arranged that each strand of wire will be in contacting engagement with both the core and the two adjacent wire strands throughout the entire length of the rope.

It is the common practice in the art to drive the capstan by gearing from the same drive that turns the spider and in order to obtain the proper ratio between the capstan and the spider it is found necessary frequently to change the gear ratio of the drive. In the past this gear ratio has been changed by the substitution of different pairs of gears. This requires the carrying in stock of a great many pairs of gears. Frequently no gear ratio will give the proper capstan speed and then it becomes necessary to vary the speed of the spider. Such changes in the speed of the spider invariably are in the nature of speed reductions and consequently when the speed of the spider is reduced, a reduced production or output results. Even with this change of speed of the spider it is very seldom that exactly the proper ratio of the speeds of the spider and capstan be obtained.

The principal object of the present invention is to provide a new and improved construction of a driving means for a wire rope stranding machine by means of which the necessity for carrying the large stock of gears is avoided and by means of which the speed ratio of capstan to spider may be accurately controlled and very slight variations or changes in such speed ratio may be made through the entire speed range of the driving gear.

A further object of the present invention is to provide a new and improved drive of the type set forth which, when adjusted for any desired speed ratio, will maintain such ratio with absolute accuracy and uniformity.

Another object is to provide a new and improved driving means for a wire rope stranding machine that will be of marked simplicity, of compact and sturdy design and that will operate with certainty at all speeds within the limits of the machine.

The above and other objects will appear more fully from the following more detailed description and by reference to the accompanying drawings forming a part hereof and wherein Fig. 1 is a plan view of an installation embodying the principles of the present invention; Fig. 2 is a side view thereof; Fig. 3 is a plan view of a modified form of installation and Fig. 4 is an enlarged view partly in elevation and partly in section of one of the elements of the hydraulic gear which forms a part of the present invention.

As shown in the drawings, the numeral 10 indicates the cylindrical cage or spider of a wire rope stranding machine upon the members 11 of which, the customary spools (not shown) are mounted in any conventional manner. The wires 12 from the aforesaid spools pass through a control die 13 where they are united with a core which passes through the hollow shaft 14. The hollow shaft 14 is driven by any suitable source of power such as an electric motor 15, a speed reduction gearing such as indicated by the reference character 16 being interposed between the motor and shaft 14. The speed reduction gearing 16 has a shaft 17 projecting laterally therefrom upon which shaft is secured a pinion 18 the latter meshing with and driving a gear 19 on the shaft 14.

The twisted or stranded rope formed in the die 13 is drawn through the die by means of a capstan drum 20 in accordance with the usual construction of wire rope stranding machines.

In accordance with the principles of the present invention the drum 20 is driven from a hydraulic motor 21 to which fluid under pressure is circulated from a fluid pressure pump 22 by means of the pipe lines 23, 24.

The fluid pressure pump and motor 22, 21 respectively, form the units of a hydraulic speed gear of the well known Waterbury type. In this type of speed gear the pump 22, or A-end, as it is usually called, supplies the fluid under pressure to the motor, or B-end, 21. Both the A and B ends are of similar construction in that each comprises a rotating barrel 25 having a plurality of cylinders 26 bored therein in parallelism with the driving shaft 27 of the unit. Each cylinder has mounted for reciprocation therein a piston 28 and said pistons are reciprocated through the piston rods 29 by the medium of a swash plate 30. The swash plate 30 is mounted for rotation within a tilting box 31. In the motor or B-end the tilting box is usually held at a fixed inclination while in the A-end the angle of inclination of the tilting box may be varied by means of a control shaft 32. The speed of rotation of the B-end or motor 21 is varied by changing the adjustment of the control shaft 32 and thereby the inclination of the tilting box 31 of the pump or A-end. When the tilting box or the pump is at right angle to the driving shaft 27 thereof, the pistons 28 will have no stroke, no fluid will be delivered by the pump and the gear is said to be in neutral position. When, however, the tilting box is inclined to the shaft 27, fluid will be pumped by the motor in one or the other direction according as the tilting box is tilted in either direction from its right angle or neutral position. In the particular constructional example disclosed the control shaft is actuated by means of a hand wheel 33 and any suitable means, such for example as that shown in U. S. Patent No. 1,680,975 granted August 14, 1928, is preferably provided for locking the hand wheel and control shaft in adjusted position so that the speed of the hydraulic gear and therefore the capstan speed can not be varied by any unauthorized person or attendant.

As shown in the drawings by way of illustration, the A-end or pump 22 of the speed gear is driven by the electric motor 15 through the speed reduction gear 16, any suitable, flexible coupling, such as indicated by the reference character 35, being interposed between the driving shaft 27 of the pump and the gear box 16.

The pump or A-end it will be noted is located, in the installation shown, immediately adjacent to, and is coupled to, the main driving means for the stranding machine, while the B-end or motor 21 is located some distance from the pump close to the capstan.

As shown, the pump 22 drives the capstan through a reduction gear of any suitable construction which gear is shown more or less diagrammatically in the drawings and is indicated by the reference character 36. A pinion 37 secured to a projecting shaft of the gear box 36 drives a spur gear 38 mounted on a jack, or counter, shaft 39. This shaft has secured to it a pinion 40 which meshes with a driving gear 41 secured to the shaft 42 of the capstan 20. In order to keep the fluid pressure system completely filled at all times with oil or other medium used as a pumping fluid, a reservoir 45 is located at a point higher than any point of the system and said reservoir communicates through the pipes 46 and 47, respectively, with the top points of the casings of the pump and motor. The reservoir serves not only to insure that both the pump and motor, as well as the pipe lines 23, 24 will at all times be filled with fluid, but also serves to compensate for contraction and expansion of the fluid due to temperature changes.

In order to guard against undue heating of the fluid contents of the pressure system, the pipes 23, 24 are preferably covered for a portion of their length by water jackets 48, 49 through which cooling water may be circulated.

The operation is as follows: Let it be assumed that the material which is to form the core of the wire rope has been passed through the hollow shaft 14 and control die 13 and the end of such material has been secured to the capstan drum 20 in any suitable way and furthermore that the wires 13 have been threaded through the control die in the usual manner. The motor 15 is set in operation and the spider 10 will therefore be driven from the motor through the gear reduction 16 and gears 17, 18. The driving shaft 27

of the A-end or pump 22 will also be placed in rotation and assuming that the control shaft 32 has been adjusted to cause fluid to be pumped to the motor 21, the driving shaft of the latter will be rotated at a speed and in a direction in accordance with the setting of the control shaft of the pump. The motor 27 will cause the capstan 20 to be rotated through the reduction gear 36, gears 37, 38, jack shaft 39 and gears 40, 41.

The speed of rotation of the capstan 20 and therefore the linear speed of travel of the completed wire rope which, it will be understood, is drawn through the die 13 by the action of the capstan 20 may be varied as desired by adjusting the position of the control shaft 32 of the pump 22. The pitch or lay of the strands can be controlled with mathematical accuracy as desired, because it is possible by slight changes of adjustment of the control shaft to secure very slight changes in the absolute speed of the capstan and therefore of its relative speed to the spider 10. The motor 15 may be of any suitable construction preferably designed to run substantially at a uniform speed. If, however, there should be any variation of the speed of the motor, no matter what the cause thereof, such variation will not affect the relative speeds of spider to capstan due to the fact that the pump 22 is also driven by the same motor 15. Therefore, when the control shaft 32 of the pump has been set to secure the desired speed ratio, such ratio will be maintained with absolute accuracy. The use of a hydraulic speed gear in the manner disclosed enables any desired speed ratio between capstan and spider to be obtained. As every possible speed of capstan may be secured, and the most minute speed variations of the capstan are obtainable, the lay necessary for any size or ply of rope or wire may be secured with great exactness.

In Fig. 3 the invention is shown as carried out by the use of a type C Waterbury speed gear. In this type of gear, motor and pump units are constructed to form parts of an integral unit instead of being located at spaced points from each other in the manner shown in the installations of Figs. 1 and 2. The wire rope stranding machine shown in Fig. 3 is identical in construction to that shown in Figs. 1 and 2. The hydraulic speed gear consists of a motor 21′ and a pump 22′ mounted immediately adjacent to each other to form in effect an integral structure. The pump is driven from the same driving shaft 60 that drives the spider 10. Fluid from the pump is circulated to the motor through a dividing plate 61, said plate being provided with suitable ports in accordance with the well known construction of hydraulic speed gears of the Waterbury type. The driving shaft of the motor 21′ is connected by means of a speed reduction gear 26′, a pinion 40, and a spur gear 41 with the capstan 20. The method of operation of the installation shown in Fig. 3 will, as can be readily understood, be practically identical to the manner of operation of the installation shown in Figs. 1 and 2.

It will be understood that the pump 22′ will be provided with a control shaft 32 and hand wheel 33 of the same construction as that shown in Figs. 1 and 2.

In both forms of the invention the A-ends of the speed gears are provided with suitable indicating means for indicating the capstan speed and so that the control shaft may be instantly set to secure the desired speed of capstan.

It will be understood that the specific constructional details and the exact location of the speed gears shown in the drawings are merely illustrative examples of satisfactory means for carrying out the invention and that many changes, variations and modifications of such details, locations, etc., may be made without departing from the spirit of the invention.

I claim:

1. In a wire rope stranding machine, a spider, driving means for rotating said spider, a control die, a capstan drum for drawing the stranded rope through said die, and means for rotating said capstan drum comprising a hydraulic gear consisting of a fluid pressure pump and a motor, driving connections between said pump and the spider driving means for causing said pump to be driven independently of the spider at a definite predetermined speed ratio relatively to said spider and driving connections between said capstan drum and said fluid pressure motor.

2. In a wire rope stranding machine, a spider, driving means for rotating said spider, a control die, a capstan drum for drawing the stranded rope through said die, and means for rotating said capstan drum comprising a hydraulic gear consisting of a fluid pressure pump and a motor, driving connections between said pump and the spider driving means for causing said pump to be driven independently of the spider at a definite predetermined speed ratio relatively to said spider, said pump being provided with an adjustable control device by means of which the amount of fluid pumped by said pump and therefore the speed of rotation of said motor and of said capstan drum may be varied infinitely within the range of said gear without effecting any change of speed of said spider.

3. The combination with a wire rope stranding machine of the type wherein a plurality of strands of wire are led from a rotatable spider and are associated by the action of a die in helical form upon a core, to form a stranded wire rope and said rope is pulled through said die by the action of a

capstan drum, of means for adjusting the linear speed of travel of said rope relatively to the speed of rotation of said spider thereby to regulate within precise predetermined limits the pitch of the helical wires, said means comprising a rotary fluid pressure pump, direct positive driving connections of invariable effect between the driving means for said spider and said pump, a rotary fluid pressure motor, positive driving connections of invariable effect between said motor and said capstan drum, and conduits connecting said pump and motor whereby said capstan drum is driven independently of said spider, said pump being provided with an adjustable control shaft by means of which the output of said pump may be infinitely varied within predetermined limits.

4. The combination with a wire rope stranding machine of the type wherein a plurality of strands of wire are led from a rotatable spider and are associated by the action of a die in helical form upon a core, to form a stranded wire rope and said rope is pulled through said die by the action of a capstan drum, of means for adjusting the linear speed of travel of said rope relatively to the speed of rotation of said spider thereby to regulate within precise predetermined limits the pitch of the helical wires, said means comprising a rotary fluid pressure pump, direct positive driving connections of invariable effect between the driving means for said spider and said pump, a rotary fluid pressure motor, positive driving connections of invariable effect between said motor and said capstan drum, and conduits connecting said pump and motor whereby said capstan drum is driven independently of said spider, said pump being located at a place remote from said motor, and being provided with an adjustable control shaft, a manually operable hand wheel and gearing connections including a reduction gear between said hand wheel and control shaft whereby a slight adjustment of said control shaft may be secured by a relatively large movement of said hand wheel.

In testimony whereof I have hereunto set my hand.

DANIEL R. FRANCIS.