Feb. 20, 1934. H. HILL 1,947,775

MACHINE FOR PRODUCING WIRE STRANDS

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Fig. 1.

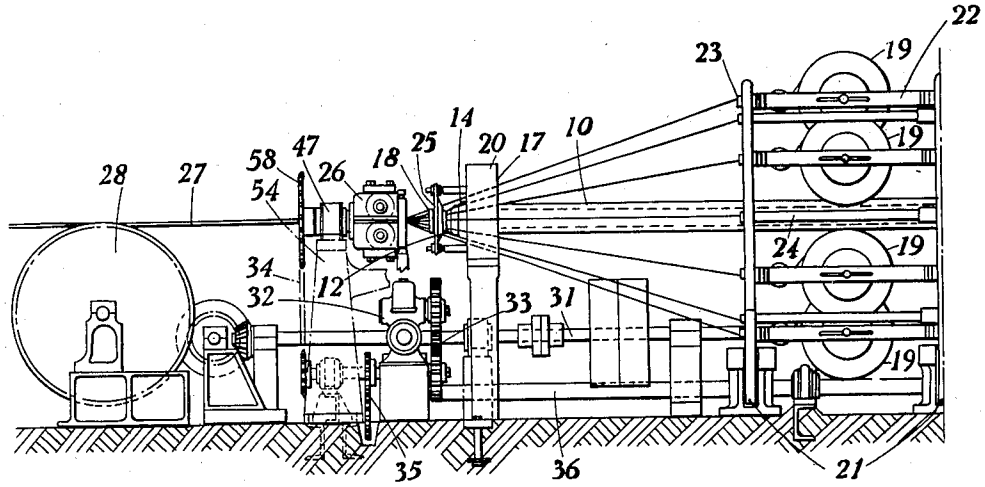
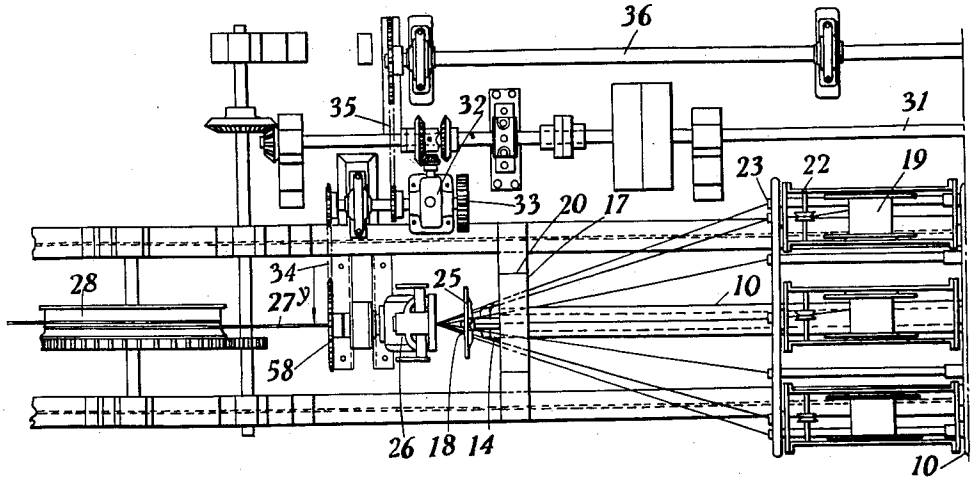


Fig. 2.



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Fig. 1. cont.

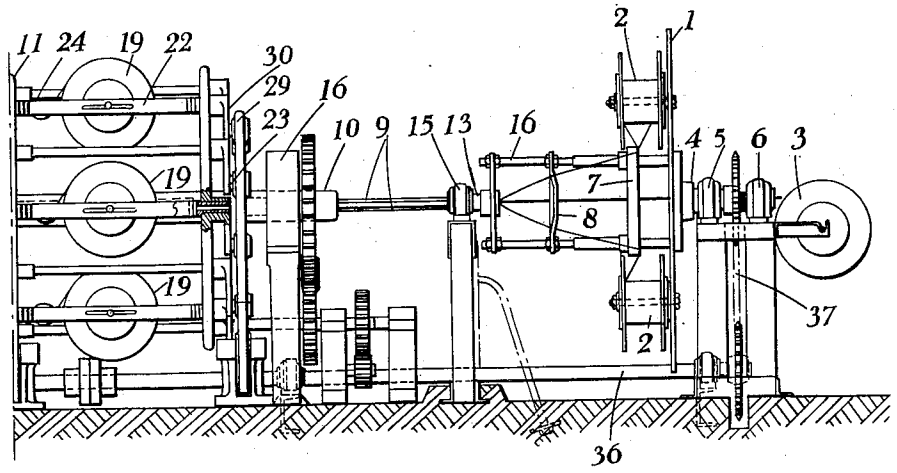
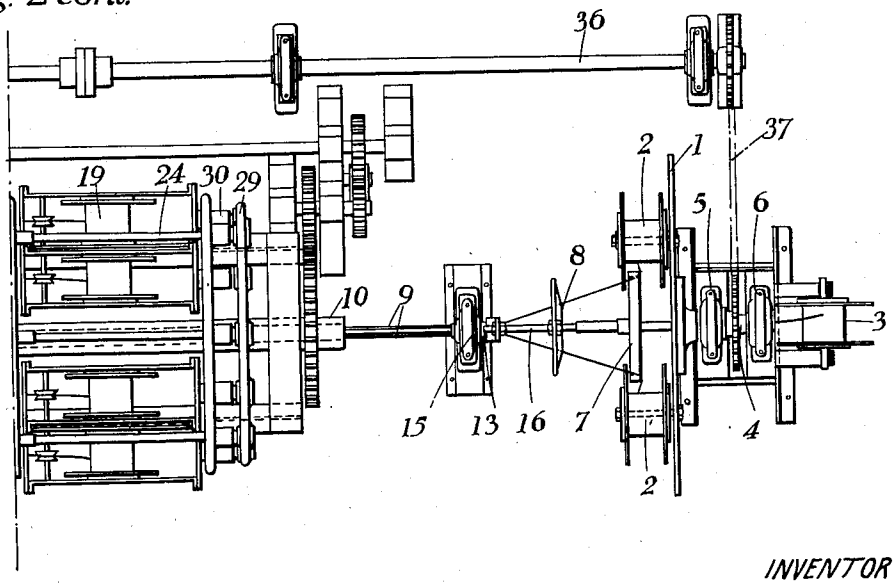


Fig. 2 cont.



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Fig. 3.

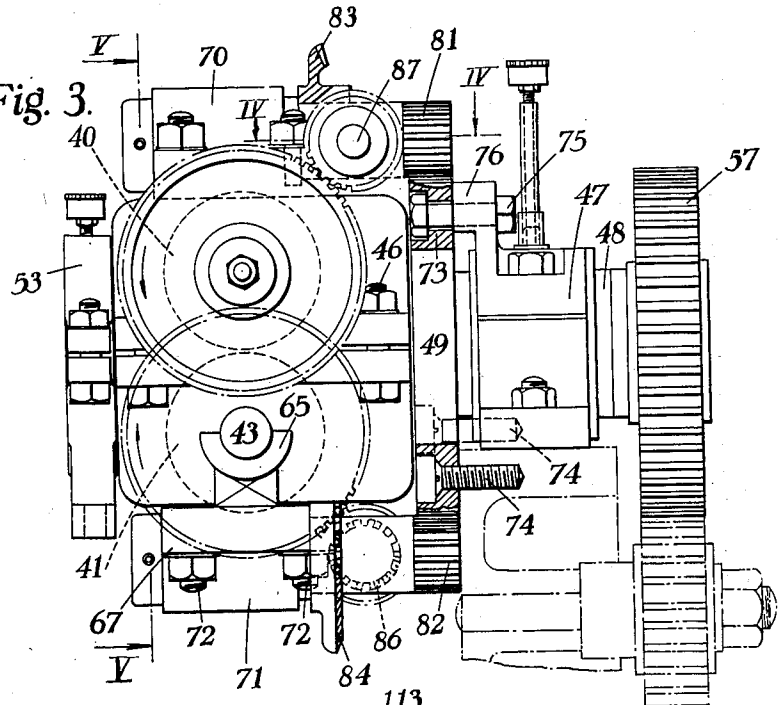
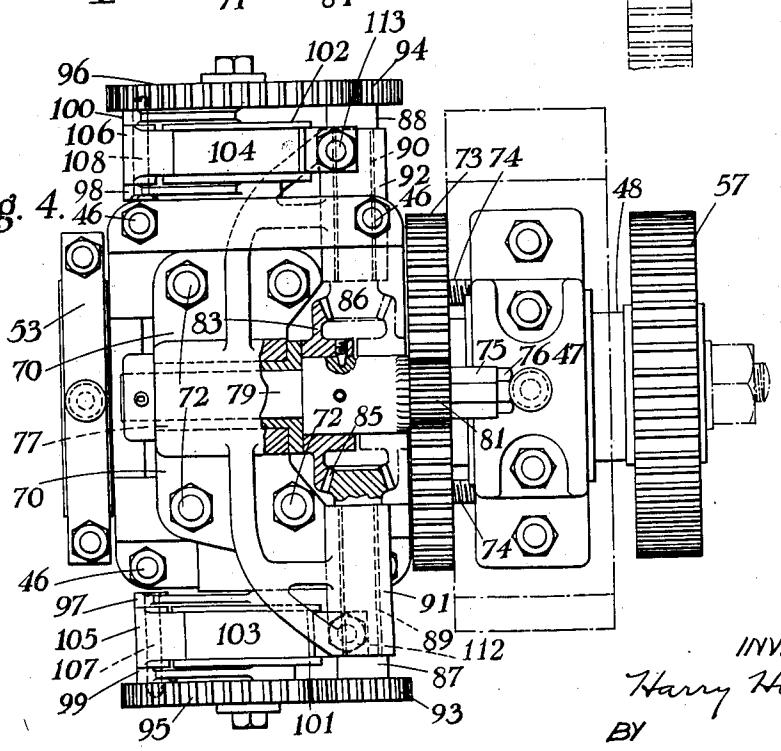


Fig. 4.



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Fig. 5.

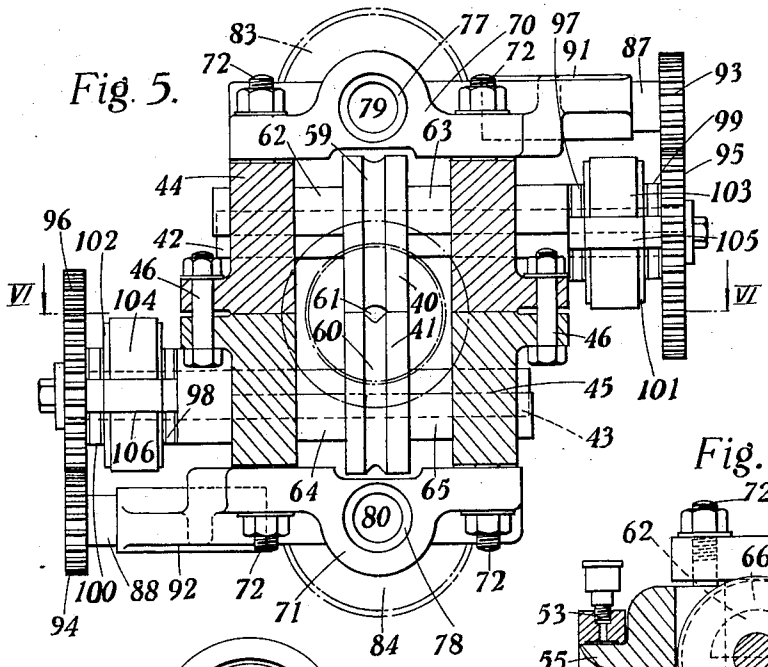


Fig. 7.

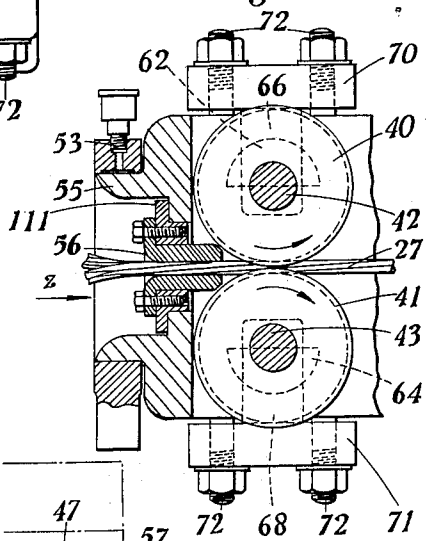
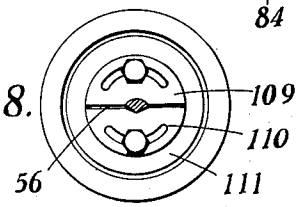


Fig. 8.



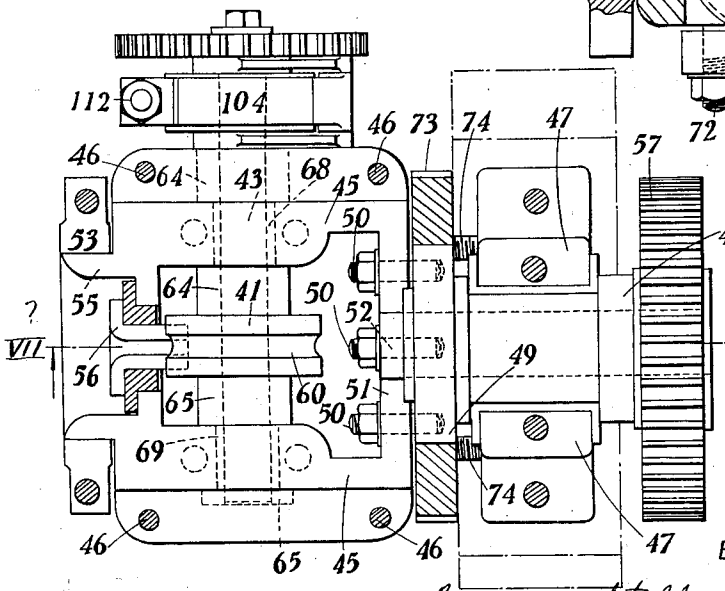


Fig. 6.

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UNITED STATES PATENT OFFICE

1,947,775

MACHINE FOR PRODUCING WIRE STRANDS

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Application June 5, 1931, Serial No. 542,259, and in Great Britain June 21, 1930

5 Claims. (Cl. 117—20)

This invention relates to machine for making ropes and electric cables by stranding together a number of wires and in particular it deals with the manufacture of pre-spiralled non-circular strands.

In such machines the component wires are drawn off from their bobbins, some or all of which are carried in a rotating frame or frames. The wires when drawn off are led through a die box or head in which is located a die of the form required to give the desired shape to the finished strand. This die is frequently formed of a pair of rolls, each having a groove in its surface; these two grooves combining to give the shape to the strand. The head carrying these rolls rotates at a speed considerably slower than the speed of rotation of the bobbin carriage or frame about an axis passing through the die. At some point in front of the rotating stranding die means, such as a draw-off capstan, are provided to restrain the strand from its tendency to rotate as a whole at the same angular speed as the stranding die. Accordingly, there is imparted to the strand a helical formation the pitch and diameter of which is such that the axis of the helix lies always within the strand. A strand of this form is usually referred to as a pre-spiralled strand and is adapted to combine with other similarly formed strands to make a complete rope or cable when laid up together, no additional twisting but only a slight bending of the strands being necessary during laying-up.

In manufacturing non-circular pre-spiralled strand it has hitherto been the practice for the wires to be drawn into and through the rotating stranding die and for the strand to be drawn off by means of tension applied to the finished strand. This tension may be applied by a draw-off capstan round which the wire has been given the necessary number of turns, in this case the capstan provides the necessary means for angularly anchoring the finished strand. By this arrangement practically the whole of the power required for drawing forward the wires and combining them into the strand is applied by way of the draw-off capstan or its equivalent and is transmitted through the finished strand in tension.

I have found that a very considerable proportion of this power is utilized at the forming rolls and in accordance with the invention I make direct application of the drive to these rolls in addition to driving the take-up capstan and distribute the power in appropriate proportions between the two places of application, namely the rolls and the capstan. I find that this distribution can readily be obtained by inserting in the drive for the rolls a slipping coupling which is set to such a value of torque that the transmitted power is limited to an appropriate value and the movement forward of the strand is dependent upon the capstan exerting the required tension.

In cases where the die is formed by two rolls I prefer to drive both of them and then preferably use a slipping coupling in each of the drives rather than a single coupling transmitting to both rolls. This point is of importance where the two rolls have not the same effective diameters, which is generally the case where the grooves are of different shape in the two rolls as, for instance, in producing strands of a shape approximating to a triangle.

By way of example, a stranding machine incorporating directly driven die rolls and which is suitable for the manufacture of pre-spiralled stranded cable of a cross sectional shape approximating to a triangle, is illustrated in the accompanying drawings wherein:—

Figure 1 is an elevation of the complete machine referred to above,

Figure 2 is a plan of the machine illustrated in Figure 1,

Figure 3 is an elevation on an enlarged scale of the die box when viewed in the direction of the arrow Y in Figure 2 and when the die box is in what will be termed, for convenience of description, its vertical position,

Figure 4 is a plan of the die box shown in Figure 3, a fragmental section on the line IV—IV being taken in order to show more clearly the bevel gear transmission.

Figure 5 is a sectional elevation of the die box taken through the line V—V in Figure 3, with the exception that the two spur wheels are shown in elevation.

Figure 6 is a sectional plan of the box taken through the line VI—VI in Figure 5 with the exception that the driving spur wheel and its shaft are not in section,

Figure 7 is a fragmental sectional elevation of the box taken through the line VII—VII in Figure 6, and

Figure 8 is a view in the direction of the arrow Z in Figure 7 of the preliminary shaping die and its seating.

The general arrangements of the stranding machine illustrated in Figures 1 and 2 will first be described. As shown, the machine is set up to manufacture an approximately triangular

shaped strand of nineteen wires and to give the strand a helical form to render the completed and subsequently insulated strand suitable for laying up together with two other similar strands to make a three core cable. The stand thus manufactured consists of seven wires forming a core about which are stranded twelve outer wires. Referring now to Figures 1 and 2 of the drawings, the back plate 1 of the stranding machine is secured to the shaft 4 turning in bearings 5 and 6. To provide the seven inner wires of the strand seven bobbins are required, six of these, 2, are mounted on spindles secured to the back plate 1 and parallel to the axis thereof, whilst the seventh bobbin 3 is conveniently carried by a support secured to the pedestals supporting the bearings 5 and 6. The six bobbins 2 are symmetrically located on the back plate but to avoid confusion, only two bobbins are shown in each of Figures 1 and 2. The seven wires withdrawn from these bobbins are guided through a guide ring 7 and a guide plate 8 each to enter one of seven tubes 9. These tubes 9, bunched together and so secured by being welded together at intervals, pass through the hollow mandrel 10 of the frame or cage 11 which is in axial alignment with the back plate and have fitted over their end parts and secured thereto sleeve members 12 and 13 running in ball-bearings, the sleeve 12 in the ball-bearing 14, the case of which is secured to the runner head 17, and the sleeve 13 in the ball-bearing 15. The sleeve 13 is coupled to the frame 16 carrying the guide plate 8 and ensures that the nest of tubes 9 rotates within the hollow mandrel 10 at the speed of the back plate 1 and absolutely independently of the mandrel rotation. This effectively prevents any entanglement of the wires which might otherwise be produced during their passage through the mandrel 10. The sleeve 12 carries a die plate 18 through dies in which the seven wires are guided after their passage through the tubes 9. In the machine under consideration the dies in this die plate 18 are arranged in two parallel rows in one of which are four dies and in the other of which are three. From this die plate the wires converge until, as they enter the die in the head 26, they are in close contact but still maintaining the same relative formation as was imparted to them by the die plate 18.

The twelve outer wires of the strand are withdrawn from twelve bobbins 19 carried within the cage 11. This cage is of the usual type and comprises three discs carried on a hollow mandrel 10 which is supported at the rear end in a bearing 16 and at the front end by a bearing 20 in which the runner head 17 turns. The cage is additionally supported by roller supports 21 (shown only in Figure 1) upon which two of the discs rest. Each compartment of the cage contains six symmetrically disposed bobbins 19, each of which is supported in the usual manner, that is to say, in a cradle 22 secured at one end to a stub shaft 23 turning in a bearing in one of the discs and at the other end to a spindle 24 supported in bearings in the other two discs, the wire from each bobbin being led through the hollow stub shaft if the bobbin is in the front compartment of the cage (or through the hollow spindle if the bobbin is in the back compartment), through the appropriate apertures in the runner head 17, and through the die plate 25 secured thereto. From this die plate the wires converge to enter the die in the revolving head 26 in which they and the inner seven wires are stranded and from which the completed strand 27 is drawn off by means of tension applied to it by the draw-off capstan 28.

To avoid the individual wires from the bobbins 19 being given a twist of 360° with each revolution of the cage, the axis of the bobbins are maintained always horizontal. This is effected in a known manner by means of the disc weight 29 to which the rear ends of the stub shafts 23 supporting the cradles in the rear compartment and those of the spindles 24 supporting the cradles in the front compartment are connected by cranks 30 keyed on to them.

A die box having directly driven shaping rolls in accordance with my invention and illustrated in detail in Figures 3 to 8 inclusive of the drawings will now be described with reference to these drawings. The body of the die box has the form of an open ended rectangular box which, for convenience in assembly, is made in two halves 44 and 45 bolted together by four bolts 46 passing through flanges on these parts. Two of the four walls of the die box carry stub shafts 48 and 55, the axes of which are coincident and at right angles to the box faces, which turn in bearings 47 and 53 respectively, these latter being respectively supported on a pedestal 54 and on a bracket secured thereto. The stub shaft 48 is not integral with the box wall but is constructed with a flange 49 carrying six studs 50; three of these studs 50 pass through holes in the wall 51 of the lower half of the box which is then bolted to the flange 49 as shown in Figure 6, the other three studs passing through slots in the corresponding wall of the upper box half 44, slots replacing the holes in order that the upper half of the box may be easily assembled on the lower half after the latter has been bolted to the flange 49. This stub shaft has an axial bore and the wall of the box is provided with a correspondingly positioned hole 52 in order to provide for the egress of the completed strand 27. The stub shaft 55 is integral with the wall of the box and is formed by an annular projection which is necessarily of considerable internal diameter to permit the entry of the wires converging from the die plates 18 and 25 towards the die 56 in the wall of the box.

The two rolls 40 and 41 are fixed to or integral with their roll shafts 42 and 43 respectively, the axes of the rolls are at right angles to the axes of the stub shafts 48 and 55 and the rolls are maintained in contact with each other and in axial alignment by brasses 62, 63, 64 and 65 which are respectively housed in slots 66, 67, 68 and 69 in the other two walls of the box. The brasses 62 and 63 are maintained in position by the cap 70 and the brasses 64 and 65 by the cap 71, each of the caps being secured by four stud bolts 72. The rolls 40 and 41 have peripheral grooves 59 and 60, the shape of these being such as to provide between them at the plane passing through their axes an aperture 61 forming a die of the required size and shape and through which the axis of rotation of the die box passes. It is evident that by some adjustment of the nuts on the studs 72 the position of the die 61 may be adjusted in one direction with respect to the axis of rotation of the die box—and/or if desired the distance between the axes of the rolls may be slightly varied in order to slightly vary the size of the die 61. The stub shaft 48 has keyed thereon a spur gear wheel 57 which may engage with other gearing in order that the die box may be rotated by the driving shaft 31, alterna-

tively this stub shaft 48 may have keyed thereon a chain wheel 58 which is driven by the shaft 31 through the worm gear 32, spur and pinion gear 33 and the chain 34 as shown in Figures 1 and 2.

The arrangements for positively driving each of the two rolls will now be described. Upon the flange 49 of the stub shaft 48 and concentric therewith is fitted an externally toothed gear wheel 73 which is locked against rotation by set screws 74 which screw into the pedestal or carriage of the bearing 47 and by a bolt 75 which passes through the wheel and a bracket 76 projecting from the cap of the bearing 47. The flange 49 is free to turn within the bore of the wheel 73. The cap 70 of the die box is fitted with a bearing 77 supporting a shaft 79 the axis of which is parallel with the axis of rotation of the head. On an enlarged end of this shaft is cut a pinion 81 which engages with the spur wheel 73. A bevel wheel 83, fitted on this shaft and secured thereto, engages a bevel pinion 85 cut on the end of a shaft 87 carried in a bearing 89 on a bracket 91 on the cap 70, the axis of this shaft 87 being parallel with the axis of the rolls 40 and 41. The other end of the spindle 87 carries a pinion 93 which engages a spur wheel 95 running loosely on the roll shaft 42. Between the brass 63 and the wheel 95, two levers 97 and 99 are each threaded on the roll shaft but not keyed thereon and between these two levers is a pulley 101 which is keyed on to the roll shaft; a strap 103 provided with a friction lining encompasses the pulley and is provided with a lug 105. A counter sunk headed set pin 107 passes in turn through the outer end of the lever 97, the lug 105 and the lever 99 and is screwed in the wheel 95, ensuring that the wheel, the two levers and the strap all have the same angular movement about the axis of the roll shaft 42. As the die box is rotated, say in an anticlockwise direction when viewed in the direction of the arrows in Figure 3, the pinion 81 will roll upon the wheel 73 and will therefore be rotated about its own axis, the bevel wheel 83 rotating at a similar speed will drive through the bevel pinion 85 the shaft 87 which in turn will drive through its pinion 93 the spur wheel 95 which imparts rotation to the "upper" roll 40 through the slipping clutch 103. The oppositely disposed cap 71 of the die box is exactly similar to the cap 70 and similarly carries a pinion 82 which gears with the fixed wheel 73 at a point diametrically opposite that at which the pinion 81 engages. Any rotation of this pinion 82 is transmitted to the roller 41 in a precisely similar manner to the way in which rotation is transmitted to roller 40, that is, from the pinion 82 through the bevel wheels 84 and 86 to the pinion 94 driving the spur wheel 96 and thence through the slipping clutch 104 to the roll 41.

The preliminary shaping die 56 in which the wires are assembled is illustrated in Figures 7 and 8. This die is constructed in two halves 109 and 110 which are secured to the plate 111 by set screws, each one of which passes through an arcuate slot in the die in order to provide for the angular adjustment of the die about the axis of rotation of the die box. The plate 111 fits in a recess in the end wall and is secured thereto by set screws. It will be seen in Figure 8 that the forward end of this preliminary shaping die approaches very near to the rolls—this has been found to be advisable to prevent some or all of the wires in that part of the strand between this die and the roll die 61 from spreading apart due to the squeezing action of the rolls tending to push backwards any slack in individual wires.

In practice the back plate 1 is caused to rotate at the same speed as the die box 26, the former being driven by the main driving shaft 31 via the reduction gearing 32 and 33, chain drive 35, shaft 36 and chain drive 37; this speed will depend upon the pitch length of the helical formation it is desired to impart to the strand, assuming that the speed of the draw-off capstan 28, which is also driven by the shaft 31 through appropriate gearing, remains constant. If the back plate and the die box revolve at the same speed then the position of the inner group of seven wires will always be the same relative to the die 61. The speed of the cage, which is also driven through reduction gearing by the driving shaft 31, will always be in excess of that of the die box and back plate since the outer wires must be stranded around the inner wires in addition to being merely grouped together and the group receiving a helical formation.

The gearing driving the two rolls 40 and 41 is arranged so as to tend to impart to them a peripheral speed at the grooves thereof slightly in excess of the take-up speed at the capstan surface, but the slip between the friction lined straps and respective pulleys about which they turn is carefully adjusted by means of the bolts 112 and 113 to limit the amount of work put into the rolls in order that there will still be a certain amount of tension in the strand between the die and the capstan—the amount being as low as possible without danger of slip at the capstan, in order to avoid stretching the individual wires by excessive tension therein.

Although, in the foregoing description of an example of a stranding machine incorporating a driven roller closing die in accordance with our invention, it has been stated that the speed of the rotation of the back plate carrying the bobbins containing inner wires of the stand is equal to that of the die box, it should be understood that the invention is not limited in this respect, and that the back plate or its equivalent may rotate at a speed other than that of the die box.

I have described in some detail the application of my invention to a machine which includes only one cage and a back place and in which only one closing die arrangement is provided. It will be appreciated, however, that the invention may be applied to larger machines. Machines which includes two or more cages and in which a closing die arrangement is provided in front of each cage may have each set of roll dies driven in accordance with my invention, the advantages reaped by doing this often being greater than in the more simple case.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a machine for the manufacture of prespiralled non-circular strand, a rotating stranding die formed of a plurality of rolls, means located beyond the said die, for drawing off the completed strand, means for rotatably driving at least one of the said rolls, means for driving the drawing-off means, and a slipping coupling, inserted in the first said driving means, appropriately proportioning the torque applied to the said driven roll relative to the torque applied to the drawing-off means.

2. In a machine for the manufacture of prespiralled non-circular strand, a stranding die formed of a plurality of rolls, supporting means

for said rolls, means for rotating said supporting means and rolls round the strand, means driven from said rotating means for imparting rotary motion to at least one of the rolls, means located beyond the said closing die for drawing off the completed strand, means for driving said drawing-off means, and a slipping coupling inserted in the means imparting rotation to the roll, proportioning the tractive force applied by the said rolls to the strand relative to that applied by the drawing-off means.

3. In a machine for the manufacture of pre-spiralled non-circular strand, a rotating stranding die formed of a plurality of rolls, means located beyond the said die, for drawing off the completed strand, driving means for rotating at least one of the said rolls to assist the forward motion of the strand, a common driving means for said drawing-off means and said rotating means, and a slipping coupling inserted between said common driving means and one of said driven means, proportioning the tractive force applied by the said roll to the strand relative to that applied by the drawing-off means.

4. In a stranding machine for the manufacture of pre-spiralled non-circular strand, a stranding die formed of a plurality of rolls, supporting means for said rolls, means for rotating said supporting means and rolls round the strand, means for driving at least one of said rolls in rotation about its axis, a preliminary assembly die immediately preceding said stranding die, and means securing said assembly die to said supporting means in an angularly adjustable manner relative to the said stranding die and in close proximity thereto.

5. In a machine for the manufacture of pre-spiralled non-circular strand, a rotating stranding die formed of a plurality of rolls, means located beyond the said die, for drawing off the completed strand, means for rotatably driving at least one of said rolls, means for driving the drawing off means, and adjusting means included in the first said driving means to limit the torque applied by the first said driving means to the driven roll to a desired proportion of the torque applied to the drawing off means.

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