Jan. 26, 1971 M. MARTINEZ 3,557,540

STRANDING MACHINE

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FIG. 1.

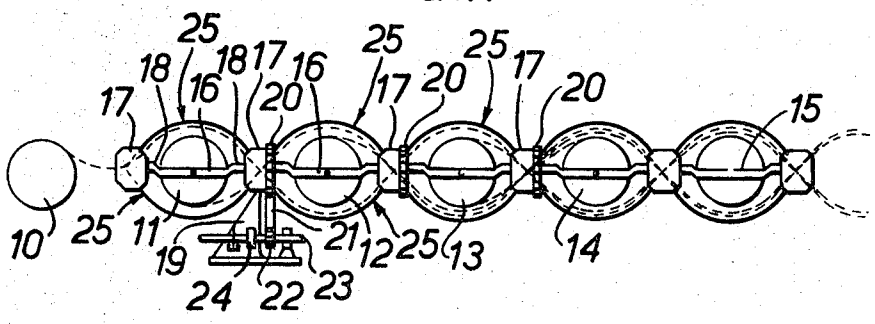


FIG. 2.

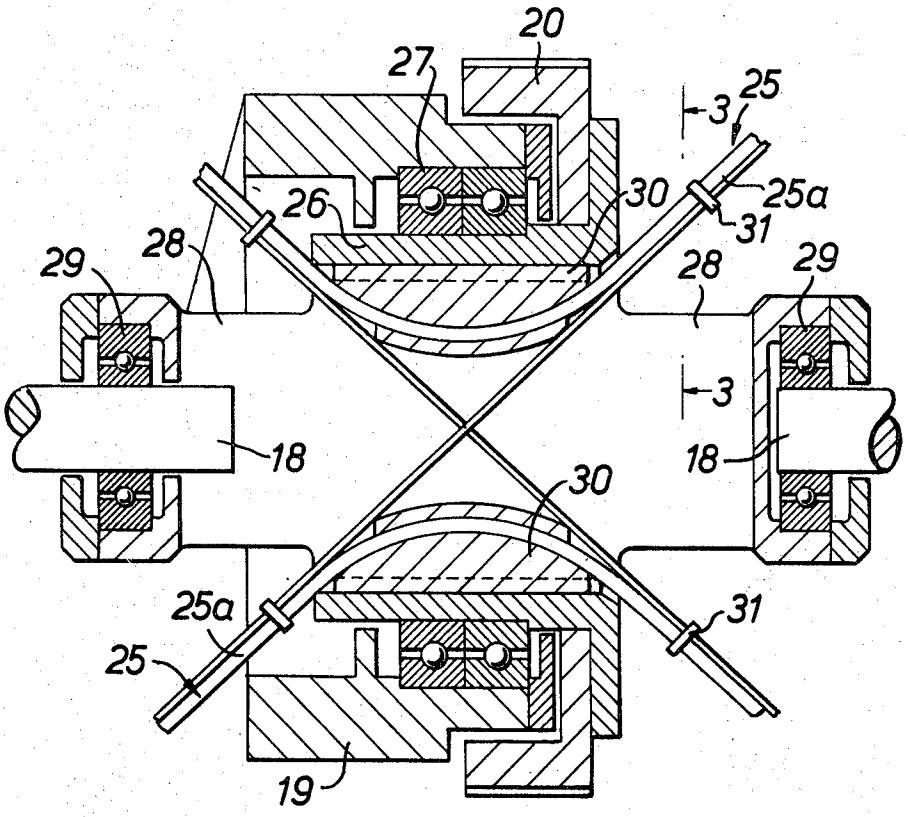


FIG. 3.

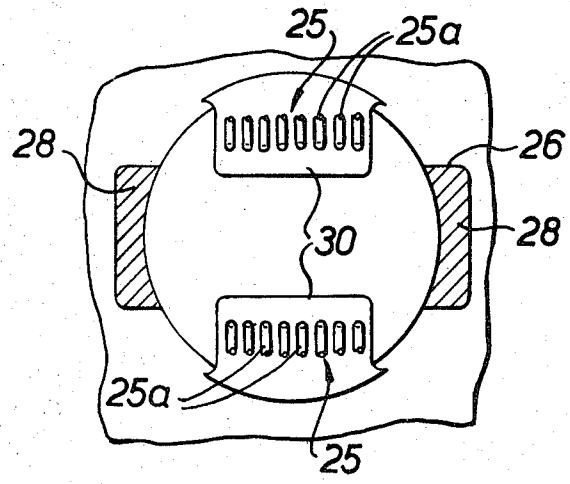


FIG. 4.

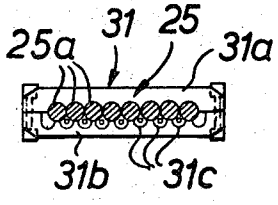


FIG. 5.

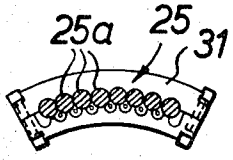
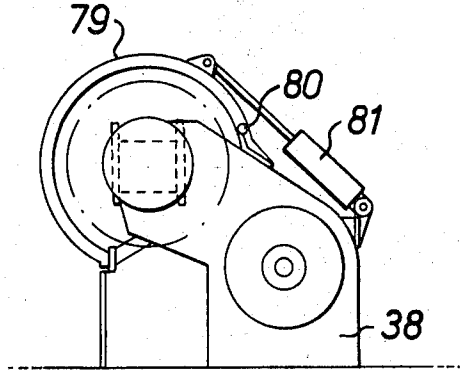


FIG. 7.



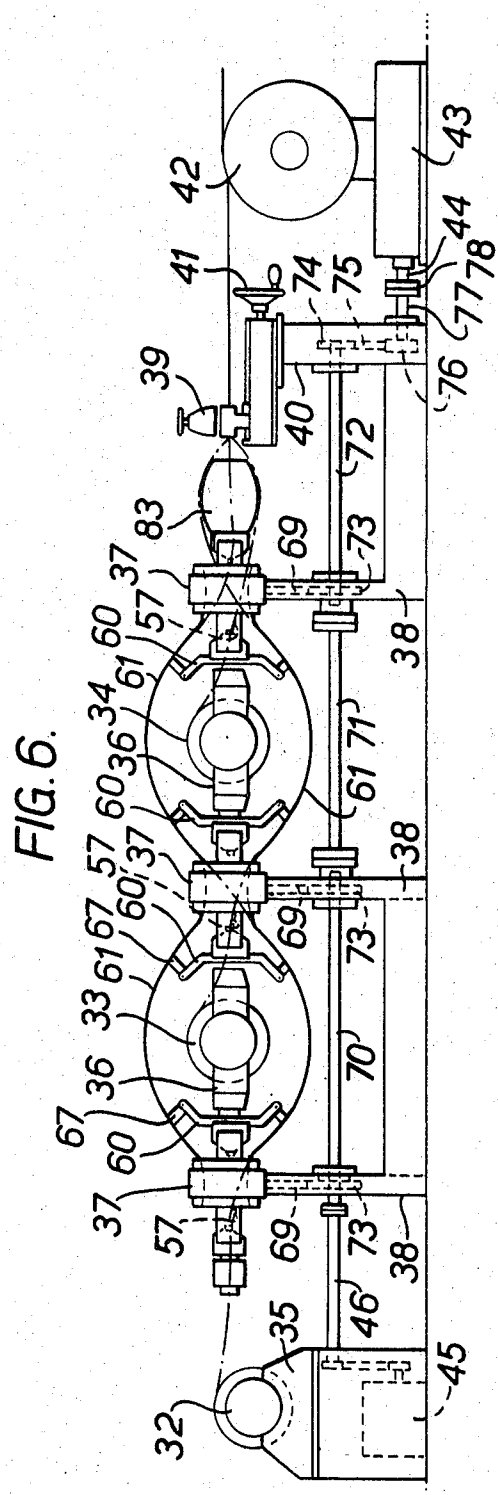

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FIG. 6.

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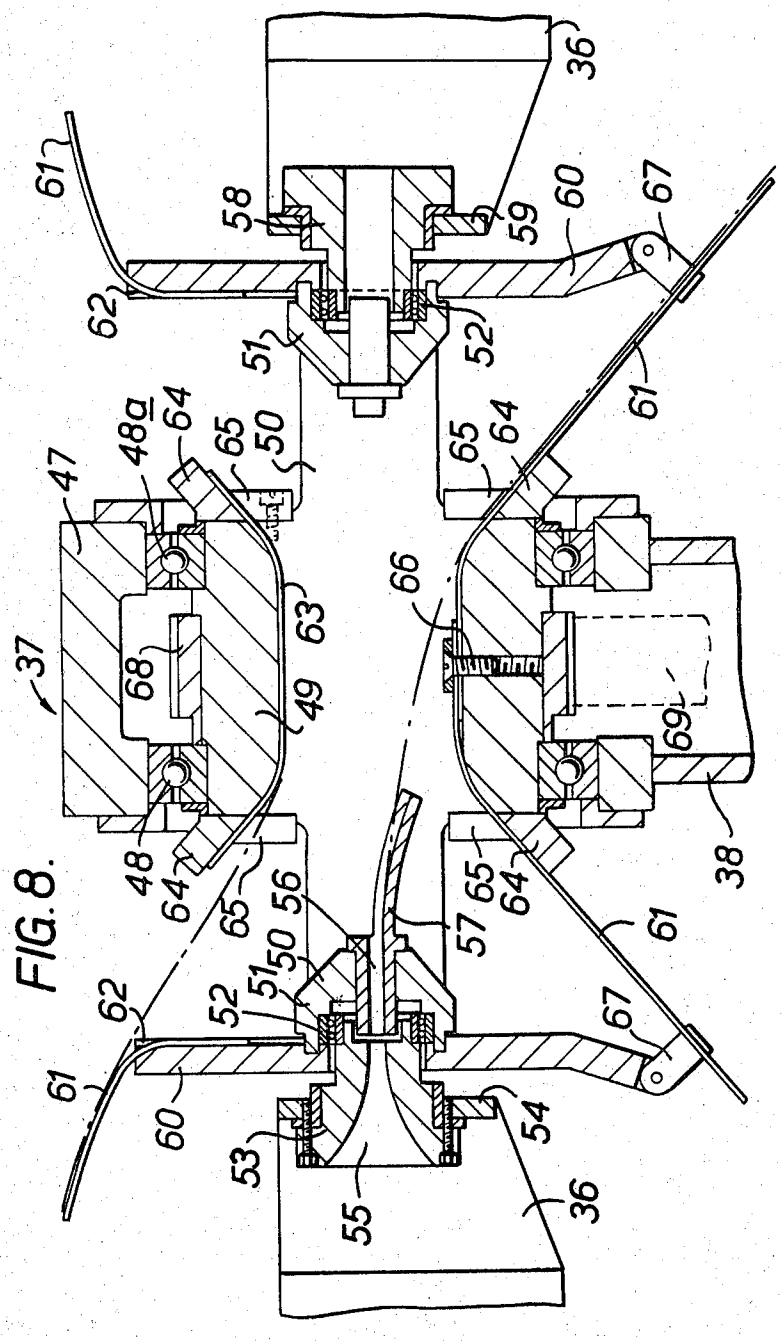

FIG. 8.

FIG. 9.

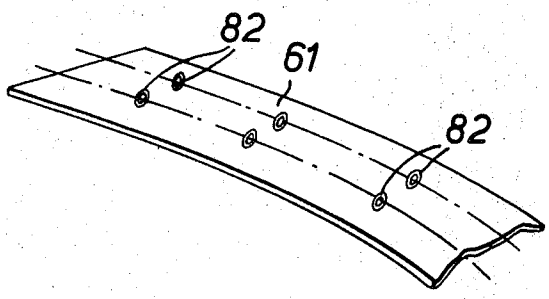

FIG. 10.

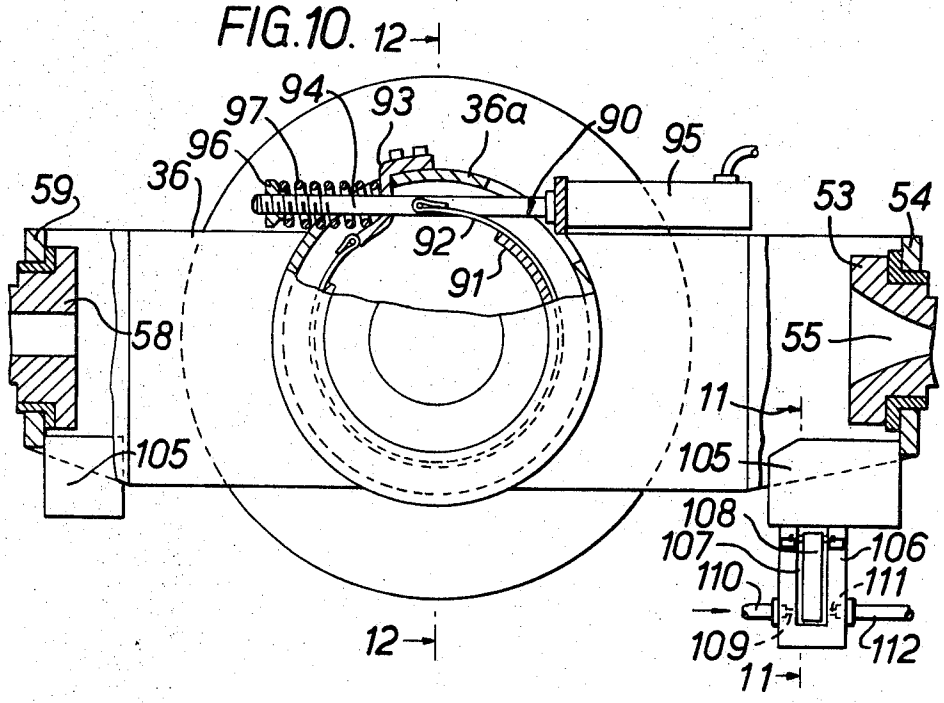

FIG. 11.

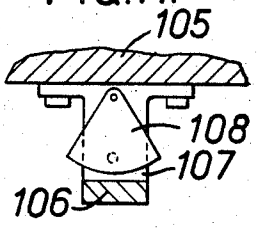

FIG.12.

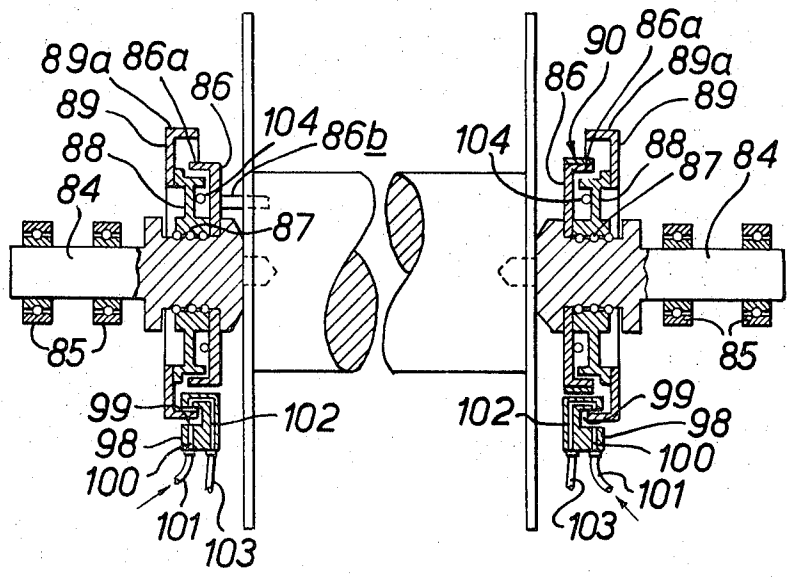
89a
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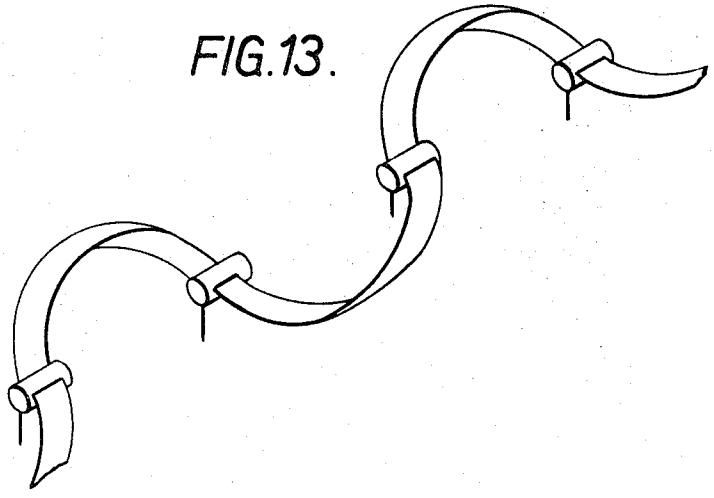
FIG.13.



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3,557,540

STRANDING MACHINE

Mario Martinez, Dibden Manor, Dibden Hythe, Southampton, England

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Claims priority, application Great Britain, Aug. 3, 1967, 35,677/67
Int. Cl. D07b 3/04
U.S. Cl. 57—58.34 20 Claims

ABSTRACT OF THE DISCLOSURE

A stranding machine in which the spools of wire are spaced-apart and supported in cradles themselves non-rotatably supported in spaced apart bearing structures each of which include a driven member to which are secured curved support members which rotate therewith, the strand of wire from each spool passing around the adjacent spool and supported on the support members and passing through the bearing structures so as to follow a sinusoidal path about the longitudinal axis of the machine.

This invention relates to a stranding machine for stranding wire or the like into cable or rope and in particular to a high speed stranding machine.

In such stranding machines the spools of wire are normally supported within a drum structure which is supported for rotation in large diameter bearings, the wire from the spools passing through the drum at its periphery.

When these machines rotate at high speeds the bearings usually exceed the recommended speeds, the drum structure is subject to very high bursting stresses and the wires are subject to high centrifugal forces causing them to bear against guide dies with consequent considerable wear of the guides. Furthermore considerable tension has to be applied to the wires to prevent them from looping out between the guides and breaking.

An object of the present invention is to provide a stranding machine, especially a high speed stranding machine, in which the centrifugal forces acting on the wires are balanced and drums and large bearings are not required, thereby avoiding the disadvantages of known machines and probably producing a saving in the cost of manufacture of the machine.

According to the present invention there is provided a stranding machine comprising a plurality of spaced apart spools mounted for rotation in cradles non-rotatably supported in spaced apart bearing structures, the wire from each or some of the spools passing therefrom in a curved path partly around the adjacent spool and through one or more of the spaced apart bearing structures and following a sinusoidal path about the longitudinal axis of the machine, the wires between the bearing structures being supported by a rotatable curved support member.

Preferably there are provided two sinusoidal paths which across on the longitudinal axis, each wire along at least part of its path passing through a bearing structure and crossing another strand of wire within said structure following the other path.

In one arrangement each wire where it passes through a bearing structure crosses the strand of wire from the adjacent spool, the arrangement being such that towards the outlet end of the machine the strands of wire alternate spools lie side-by-side in one group and the strands of wire from the intervening spools lie side-by-side in a second group.

The wires between the bearing structures may be supported by a rotatable curved support member comprising a sheet or strip or a group or groups of juxtaposed ropes or wires supported within each bearing and being outwardly curved between the spaced apart bearings.

The sheet or strip or wires or ropes may consist of a continuous length of sheet or strip material or rope or wire extending from the first bearing structure and terminating in the last bearing structure. The length of the sheet or strip or rope or wire may be spirally wound about the axis of the machine.

There may be a plurality of sheets or strips or groups of ropes or wires equi-angularly disposed around the axis of the machine.

The support member may be curved transversely of the machine. The support member may be coated with a wear resistant material such as ceramics applied by plating or spraying.

The support members may be supported within each bearing structure by a block engaged with a rotatable part of the bearing.

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 annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a diagrammatic side elevation of a first embodiment of a stranding machine according to the present invention,

FIG. 2 is a section through one of the spaced-apart bearing structures,

FIG. 3 is a section taken along the line **3—3** indicated on FIG. 2,

FIG. 4 is an end view of a tie member of the rotatable support member for supporting the strands of wire,

FIG. 5 shows an alternative form of tie member,

FIG. 6 is a side elevation of a second embodiment of a stranding machine according to the present invention,

FIG. 7 is an end view of the machine shown in FIG. 6,

FIG. 8 is a section through the upper part of one of the bearing structures of FIG. 6,

FIG. 9 is a diagrammatic perspective view of part of a rotatable support member of FIG. 6,

FIG. 10 is a side view of a spool and cradle, partly broken away to reveal details,

FIG. 11 is a section taken on the line **11—11** indicated on FIG. 10,

FIG. 12 is a section taken on the line **12—12** indicated on FIG. 10, and

FIG. 13 is a diagrammatic representation of a support member wound about the axis of the machine.

The high speed stranding machine shown in FIGS. 1 to 3 comprises a plurality of spaced apart spools **10**, **11**, **12**, **13**, **14** and **15**, each of the spools **11–15** being supported in a cradle **16** which is supported in bearing structures **17**, the centre of gravity of each spool **10–15** and supporting cradle **16** lying below the longitudinal axis of shaft portions **18** of each cradle **16**.

Each bearing structure **17** is supported on a pedestal **19**, only one of which is shown in FIG. 1, and includes a toothed pulley **20** driven by a belt or chain **21** from a toothed pulley **22** mounted on a drive shaft **23** which may be common to all pedestals **19**. Mounted on the drive shaft **23** is a brake **24** operated by a control system, not shown.

Extending from each bearing structure **17** are opposed rotatable support members **25** each comprising a group of wires or ropes **25***a* which are curved away from the longitudinal axis of the machine so as to form a smooth curved support path for wires from the spools **10–15**. The support path is sinusoidal about the longitudinal axis of the machine.

One of the bearing structures **17** is shown more clearly in FIG. 2 and comprises a sleeve **26** to which the toothed pulley **20** is secured, the sleeve **26** being carried in bearings **27** secured to the pedestal structure **19**. The sleeve **26** is provided with axially extending extensions **28** each of which supports a bearing **29** in which the ends of the shaft portions **18** of adjacent cradles **16** are mounted.

Located within the bore of the sleeve **26** are two opposed blocks **30** which are dovetailed into the sleeve **26**. Each block **30** may comprise a nylon reinforced block of plastics material and receives the wires **25***a* of each support member **25** which may be continuous from one end of the machine to the other, or may comprise lengths of wire secured at each end to a block **30**. The blocks **30** may be formed of metal with an insert of plastics material through which the wires **25** pass. Each of the groups of wires **25***a* are held together by clamp members **31** as shown more clearly in FIG. 4. Each clamp member **31** comprises an outer portion **31***a* provided with recesses for locating the wires **25***a* and an inner portion **31***b* having recesses **31***c* forming guides for the wires from the spools **10–15**. The clamp members **31** prevent the wires from the spools **10–15** from falling downwardly when the machine is stationary.

The group of wires **25***a* may be curved transversely of the machine as shown in FIG. 5 and the wires **25** may be coated with a wear resistant material, such as a ceramic material, which may be applied by plating or spraying. The wires **25***a* may comprise high tensile steel wires or comprise ropes formed from nylon or any other suitable material.

The stranding machine described with reference to FIGS. 1 to 5 operates as follows; wire from the spool **10** passes through the first bearing structure **17** and is guided by one of the support members **25** extending partly around the bobbin **11** and then through the second bearing structure **17** and guided by one of the support members **25** extending partly around the bobbin **12** and so on. The wire from the spool **11** passes through the second bearing structure **17** and is supported by the other support member **25** extending partly around the bobbin **12** and so on. The wires from the spools cross each other within the sleeves **26** of the bearing structures **17**. It will be appreciated that the groups of wires or ropes **25***a* provide smoothly curved paths for the wires from the spools preventing the wires from being kinked. The wires follow the sinusoidal path and centrifugal forces acting on each wire are balanced.

The support members **25** may not all be in a common plane, for example the two support members **25** extending between the second and third bearing structures **17** may be disposed in a plane at right angles to the plane of the two support members **25** extending between the first and second bearings **17**.

The support members **25** may be wound about the axis of the machine as shown in FIG. 13.

The support member **25** need not be supported in large diameter bearings and the centrifugal forces imposed on the wires in the region of a support member **25** are balanced by the centrifugal forces acting on the wire in the region of the adjacent support members **25**. The strands of wires from the bobbins **10–15** are drawn off through a closing die by any suitable hauling apparatus located at the delivery end of the machine.

The wires from each bobbin **11–15** may be drawn off through a curved guide tube and the wires may be maintained under tension by applying a retarding force to each spool.

The embodiment shown in FIGS. 6 to 12 comprises three spools **32, 33** and **34**. The spool **32** is supported in a bearing structure **35** located at one end of the machine. Each spool **33** and **34** is supported in a cradle **36** which are themselves supported in spaced apart bearing structures **37** described in greater detail hereafter. The bearing structures **37** are mounted on spaced apart stands **38**.

At the end of the machine remote from the bearing structure **35** there is provided an axially movable closing die **39** supported on a stand **40** and moved by operating a hand wheel **41**. Adjacent the stand **40** is a haul-off capstan **42** driven from a variable ratio gear box **43** having an input shaft **44**.

As will be seen more clearly from FIG. 8 each spaced apart bearing structure **37** comprises a rigid casing **47** secured to the upper end of the associated stand **38**. Mounted in bearings **48** and **48***a* within the casing **47** is a rotatable member **49** having axially extending extensions **50** each provided at its outer end with a frusto-conical bearing support **51** housing a bearing **52**. Supported in the left hand bearing **52**, as viewed in FIG. 8, is a stub axle **53** which is secured to an end wall **54** of a cradle **36**. The stub axle **53** is provided with a flared opening **55** having one end aligned with a channel **56** provided in a guide member **57** mounted in the bearing support **51**.

Supported in the right hand bearing **52**, as viewed in FIG. 8, is a stub axle **58** secured to an end wall **59** of the adjacent cradle **36**. Mounted on each bearing support **51** for rotation therewith is a disc **60** having radially extending arms for supporting outwardly curved support members **61** which extend between the bearing structures **37**. The upper half of FIG. 8 illustrates one method of securing the support members **61**, where the wires from the spools pass externally over the support members **61**, and the lower half of FIG. 8 illustrates a method of securing the support members **61** where the wires from the spools pass inwardly of the support members **61**.

Referring firstly to the construction shown in the upper half of FIG. 8 each arm of each support disc **60** is provided with a channel **62** which is curved at its outer end and in which is received and secured the end of a support member **61** formed by a sheet or strip of metal as shown in FIG. 9. The bore of the member **49** is curved and provided with a similarly curved wear resistant strip of metal **63** over which passes the wires from the spools. Each side of the member **49** is provided with a ring **64** having slots **65** in which the ends of the strip **63** are received and which serve to locate the strip **63** circumferentially of the member **49**.

In the embodiment shown in the lower half of FIG. 8 the end of each support member **61** is received in the curved bore of the support member **49** and they are overlapped and secured thereto by fixing screws **66**. The support members **61** are again received in slots **65** of the rings **64**. The arms of each disc **60** are bent towards the adjacent spool and each arm is provided at its outer end with a hinged clip **67** which engages the support members **61**.

The member **49** of each bearing structure **37** has mounted thereon a geared sprocket **68** engaged by a chain or toothed belt **69**. Supported in the spaced apart stands **38** and **40** are interconnected shafts **70, 71** and **72** on which are mounted sprockets **73** each engaged by the chain or belt **69**. The shaft **72** is provided with a sprocket **74** engaged by a chain or belt **75** which is also engaged with a sprocket **76** mounted on a shaft **77** connected to the input shaft **44** by a coupling **78**. The shaft **70** is connected to a shaft **46** which is driven from a motor **45**.

As shown in FIG. 7, the bearing structures **37** and the support members **61** are enclosed by a curved guard **79** hinged at **80** to the stands **38**. The guard **79** is moved about the hinge **80** by means of a hydraulic or pneumatic actuator **81**. As shown in FIG. 9 each support member **61** may be provided with guide rings **82** secured to one side or the other of the support member **61** depending whether the wires are to pass beneath or over the exterior thereof. Located at the outlet end of the machine is a guide **83**.

Referring now more particularly to FIGS. 10 to 12 the spools **33, 34** are mounted in their respective cradle **36** by means of pintles **84** which as shown in FIG. 12 are mounted for axial movement in bearings **85**. Each pintle **84** has secured to it a disc **86** having an axially directed

flange 86*a* at its outer periphery and carries a spring loaded driving pin 86*b* which engages in a hole in the side of the spool. Mounted on each pintle 84 through a ball and helical groove connection 87 is a fly-wheel 88 to which is secured a ring 89 having an axially directed flange 89*a*.

In contact with the flange 86*a* of one of the pintles 84 of each spool is a band brake 90 comprising a pad 91 of friction material secured to a band 92 having one end fixed to a member 93 secured to cradle structure 36*a* and having its other end fixed to a rod 94 of a pneumatic actuator 95 mounted on the cradle 36. The free end of the rod 94 is screw-threaded and has mounted thereon an adjustable abutment 96 for a spring 97. The spring 97 urges the brake 90 towards the "on" position and the brake 90 is released by releaving the air pressure in the actuator 95.

The brake 90 is adjusted by controlling the air pressure of the actuator 95 to give the required degree of friction to the spool, thereby maintaining the wire fed from the spool at a predetermined tension. The brake 90 is applied to prevent rotation of the spool when the machine is stopped for any reason and prevents the spool overrunning due to inertia.

The machine is provided with means to stop the machine should a wire break during operation and such means comprises a block 98 which is secured to the cradle 36, the block 98 having a recess 99 in which is normally received the flange 89*a* of the ring 89. Provided in the block 98 is a duct 100 which communicates with the recess 99 and which is supplied with air under pressure through a conduit 101. Also provided in the block 98 is a duct 102 which communicates with the recess 99 on the side opposite to that of duct 100. The duct 102 has its inlet aligned with the outlet of duct 100 and is connected to a conduit 103 connected to a control circuit which includes the actuator 95.

Under normal operating conditions the flange 89*a* acts as an obturating valve and prevents air issuing from the duct 100 entering the duct 102. It will be appreciated that during rotation of the spool the pintles 84 will rotate with it and the fly-wheels 88 will be urged towards the discs 86. If the wire from a spool breaks then due to the friction applied to the spool it will slow down. The inertia of the fly-wheels 88 causes them to rotate relative to the pintles 84 and due to the ball and helical groove connection 87 they will move axially along the pintles 84 in a direction away from the spool and thus move the flange 89*a* away from the recess 99 thus allowing air from duct 100 to enter duct 102. The increase of pressure in the duct 102 is used as a signal to operate brake means to stop the machine and to effect venting of the actuator 95, the spring 97 then urging the band brake 90 to the fully-on position. The brake means of the machine may comprise a brake or brakes associated with the main drive shafts 46, 70, 71, 72.

The blocks 98 and associated parts also prevent the machine from being started if one of the pintles 84 is not properly or fully engaged with its spool. The air flow from duct 100 is not prevented from entering the duct 102 until the pintle 84 is fully engaged. Spring means 104 are provided for returning the fly-wheels 88 to their inoperative position. Each cradle 36 is provided with weights 105 to prevent rotation thereof about the longitudinal axis of the machine.

Mounted on one of the weights 105 of each cradle 36 is a block 106 having a central opening 107 in which is pivotally mounted a member 108. The block 106 is provided with a duct 109 connected to a conduit 110 and a duct 111 connected to a conduit 112. The ducts 109 and 111 are aligned with each other and communicate with the opening 107. Under normal operating conditions the member 108 hangs vertically downwards and prevents air from duct 109 entering the duct 111. If for any reason, such as a failure of one of the bearings 52, the cradle 36 is subject to excessive rocking motion about the longitudinal axis of the machine the member will continue to hang vertically downwards and the block will move, thus allowing the ducts 109, 111 to communicate with each other and the increase in pressure in the conduit 112 is used to actuate means for stopping the machine which will include the brakes 90.

In operation of the machine the motor 45 drives the shafts 46, 70, 71, 72 and rotation of the shafts 46, 70, 71, 72 effects rotation of the members 49 via the sprockets 73, chains or belts 69 and sprockets 68, and this results in rotation of the support members 61 about the longitudinal axis of the machine. The haul-off capstan 42 is driven from the gear box 43 and pulls the wires through the closing die 39. The wire from each spool 32, 33, 34 passes through the associated guide member 57 and is guided onto the inside or the exterior of the support member 61, as the case may be, the wires from adjacent spools crossing within the members 49. The wires follow a sinusoidal path along the machine.

It will be appreciated that the machine described with reference to FIGS. 6 to 12 can comprise more than three spools, the number of spools depending on the number of wires to be stranded into the rope or cable.

The brakes 90 apply a retarding force to the spools thus producing the necessary tension to the strands of wire and serve to brake the spools should a strand of wire fracture, thereby preventing the spool overrunning due to inertia and spilling off its wire. The brakes 90 instead of being actuated by a pneumatic system may be operated remotely by a hydraulic or electric control system can also include wire breakage sensing means to effect shut down of the machine if a wire breakage occurs.

The wires from the spools run in parallel paths as far as the guide 83 which brings them together before entering the closing die 39. Centrifugal forces acting on the wires are balanced due to the fact that the wires follow the sinusoidal path and therefore the wires are not urged into wearing contact with the guides 82 by any considerable force and also the tension applied to the wires need only be sufficient to keep them in tension and does not have to prevent the wires from looping out between the guides 82.

Other modes of applying the principles 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.

I therefore particularly point out and distinctly claim as my invention:

1. A stranding machine comprising a plurality of spaced-apart spools, means mounting said spools, in cradles, spaced-apart bearing structures, means non-rotatably mounting said cradles in said structures, rotatable curved support members mounted for rotation in said structure, the strand from each spool passing therefrom in a curved path partly around the adjacent spool and being supported on said rotatable curved support members and passing through at least one of said spaced-apart bearing structures so as to follow a sinusoidal path symmetrical about the longitudinal axis of the machine.

2. A stranding machine comprising a plurality of spaced-apart spools, means mounting said spools in cradles, spaced-apart bearing structures, means non-rotatably mounting said cradles in said structures, two rotatable curved support members mounted for rotation in said structures, the curved support members forming two sinusoidal paths disposed symmetrical about the axis of the machine, the strand from each spool passing therefrom in a curved path partly around the adjacent spool and being supported on said rotatable curved support members and passing through said spaced-apart bearing structures, each wire strand along at least part of its path crossing another strand of wire from the other sinusoidal path within one of said bearing structures.

3. A stranding machine as claimed in claim 2 wherein

each wire strand crosses the wire strand from the adjacent spool, the arrangement being such that towards the outlet end of the machine the strands of wire from alternate spools lie side-by-side in one group and the strands of wire from the intervening spools lie side-by-side in a second group.

4. A stranding machine as claimed in claim **1** in which the strands of wires from the spools pass over the outer surface of the rotatable curved support members.

5. A stranding machine as claimed in claim **1** in which the strands of wires from the spools pass over the internal surface of the rotatable curved support members.

6. A stranding machine as claimed in claim **2** in which the strands of wires from the spools pass over the outer surface of the rotatable curved support members.

7. A stranding machine as claimed in claim **2** in which the strands of wires from the spools pass over the internal surface of the rotatable curved support members.

8. A stranding machine as claimed in claim **1** in which the support member is wound about the longitudinal axis of the machine.

9. A stranding machine as claimed in claim **2** in which the support member is wound about the longitudinal axis of the machine.

10. A stranding machine as claimed in claim **1** in which each bearing support structure includes a rotatably mounted member, means mounting said member in fixed structure, axially extending portions on said member, bearings supported in said axially extending portions, said cradles being supported in said bearings, means supporting said curved support members from said rotatably mounted member.

11. A stranding machine as claimed in claim **2** in which each bearing support structure includes a rotatably mounted member, means mounting said member in fixed structure, axially extending portions on said member, bearing supported in said axially extending portions, said cradles being supported in said bearings, means supporting said curved support members from said rotatably mounted member.

12. A stranding machine as claimed in claim **2** in which each bearing support structure includes a rotatably mounted member, means mounting said member in fixed structure, axially extending portions on said member, bearings supported in said axially extending portions, said cradles being supported in said bearings, means supporting said curved support members from said rotatably mounted member, said means comprising support members mounted on said rotatably mounted member.

13. A stranding machine comprising a plurality of spaced-apart spools, means mounting said spools, in cradles, spaced-apart bearing structures, means non-rotatably mounting said cradles in said structures, rotatably curved support members mounted for rotation in said structures, the strand from each spool passing therefrom in a curved path partly around the adjacent spool and being supported on said rotatable curved support members and passing through said spaced-apart bearing structures so as to follow a sinusoidal path symmetrical about the longitudinal axis of the machine, means for braking said machine and each cradle being provided with brake means and means for sensing breakage of said strand connected to said brake means.

14. A stranding machine as claimed in claim **13** in which said brake means comprises a brake, spring means for urging said brake to the fully on position and actuator means for urging said brake to the off position.

15. A stranding machine as claimed in claim **13** in which said means for sensing breakage of said strand comprises a pintle for mounting said spool in said cradle, a fly-wheel mounted on said pintle and adapted to overrun said pintle upon breakage of said strand, means for moving said fly-wheel axially of said pintle upon the fly-wheel overrunning said pintle upon breakage of said strand, an obturating member on said fly-wheel, opposed conduits on each side of said obturating member, means supplying fluid under pressure to one conduit, means connecting the other conduit to means for actuating said brake means, said obturating member being moved by said fly-wheel from its obturating position upon said axial movement of said fly-wheel.

16. A stranding machine as claimed in claim **13** in which said means for sensing breakage of said strand comprises a pintle for mounting said spool in said cradle, a fly-wheel mounted on the pintle, a ball and helical groove connection between said fly-wheel and pintle to cause axial movement of said pintle upon the fly-wheel overrunning said pintle upon breakage of said strand, an obturating member on said fly-wheel, opposed conduits on each side of said obturating member, means supplying fluid under pressure to one conduit, means connecting the other conduit to means for actuating said brake means, said obturating member being moved by said fly-wheel from its obturating position upon axial movement of said fly-wheel.

17. A stranding machine as claimed in claim **13** in which means are provided for sensing excessive rocking movement of each cradle about the longitudinal axis of the machine, said means comprising a block secured to the lower side of said cradle, an opening in said block, an obturating member in said opening, means pivotally mounting the upper part of said obturating member in said opening, a first passage in said block, means connecting said first passage to a source of pressure fluid, a second passage in said block, means connecting said second passage to control means for operating said brake means for the machine, said first and second passages having openings aligned on opposite sides of the obturating member, excessive rocking movement of said cradle causing said block to move and said obturating member to remain substantially fixed so that said passages communicate with each other to cause operation of said brake means.

18. Apparatus for sensing breakage of wire from a spool and for applying a braking force to said spool comprising rotatable pintles for supporting said spool, at least one pintle having a drum, a friction band contacting said drum, a fly-wheel mounted on a pintle and adapted to overrun said pintle upon breakage of said wire, means for moving said fly-wheel axially of said pintle upon overrun of said fly-wheel, an obturating member on said fly-wheel, opposed conduits on each side of said obturating member, means supplying fluid under pressure to one conduit, means connecting the other conduit to means for actuating said friction band, said obturating member being moved by said fly-wheel from its obturating position upon said axial movement of said fly-wheel.

19. Apparatus as claimed in claim **18** in which said means for moving said fly-wheel comprises a ball and helical groove connection between the fly-wheel and pintle.

20. Apparatus for sensing excessive rocking movement of a non-rotatably mounted cradle for a spool comprising a block secured to the lower side of said cradle, an opening in said block, and obturating member in said opening, means pivotally mounting the upper part of said obturating member in said opening, a first passage in said block, means connecting said first passage to a source of pressure fluid, a second passage in said block, means connecting said second passage to control means for operating said brake means for the machine, said first and second passages having openings aligned on opposite sides of the obturating member, excessive rocking movement of said cradle causing said block to move and said obturating member to remain substantially fixed so that said passages communicate with each other to cause operation of said brake means.

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