Feb. 21, 1967 H. H. KEUSEMANN ETAL 3,304,960

WIRE-TYING APPARATUS

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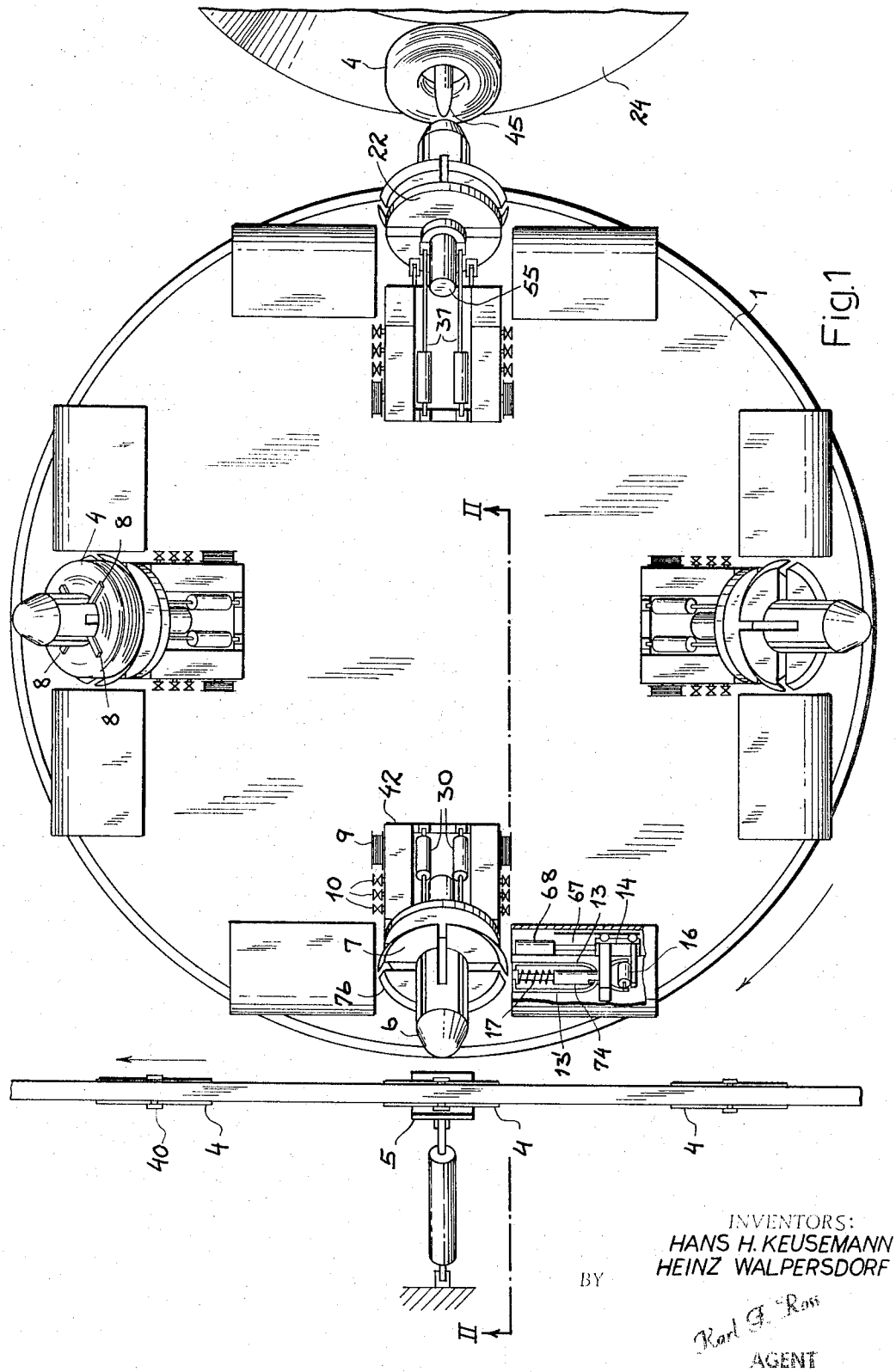


Fig. 1

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WIRE-TYING APPARATUS

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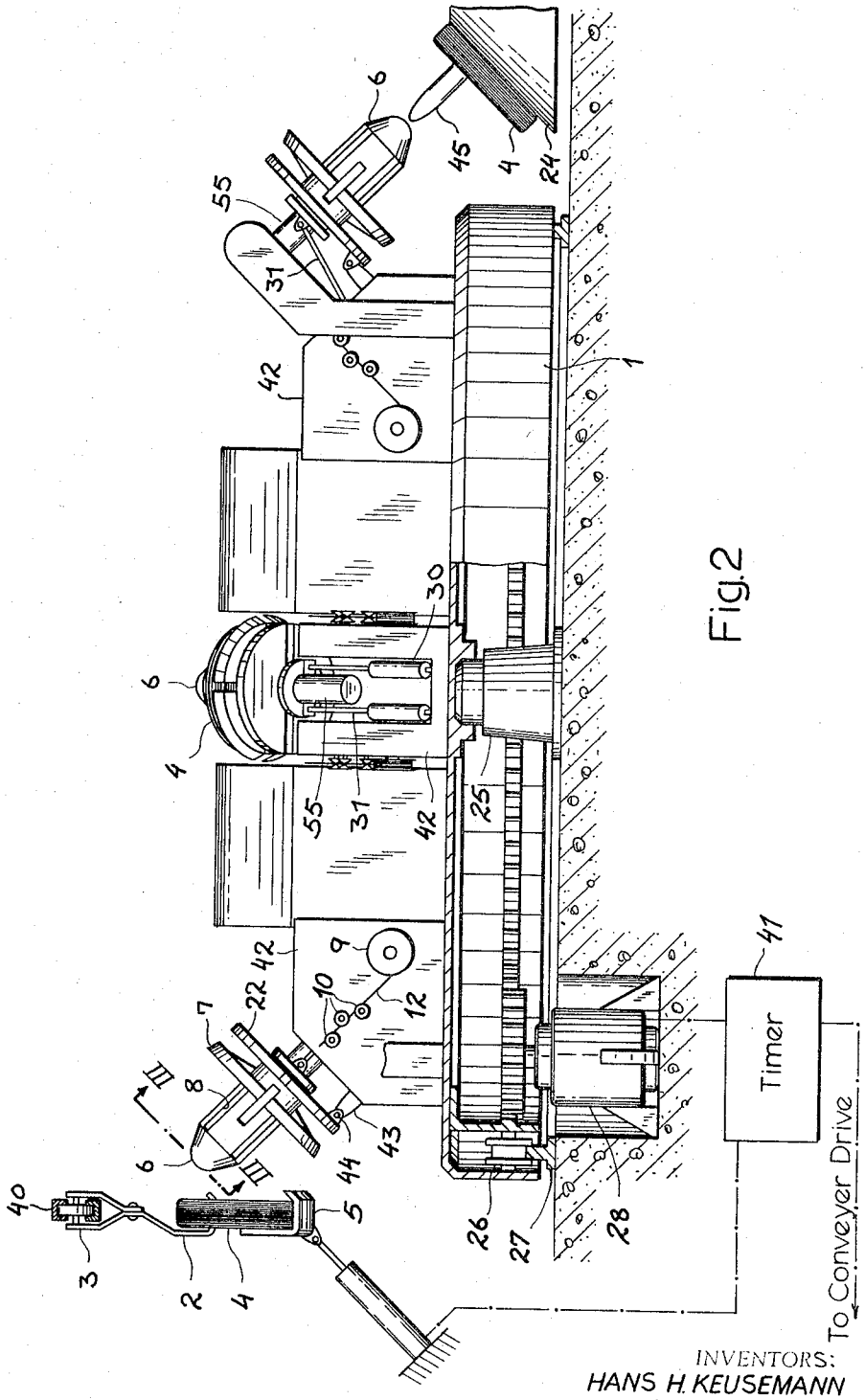


Fig.2

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WIRE-TYING APPARATUS

Filed June 1, 1964

5 Sheets-Sheet 3

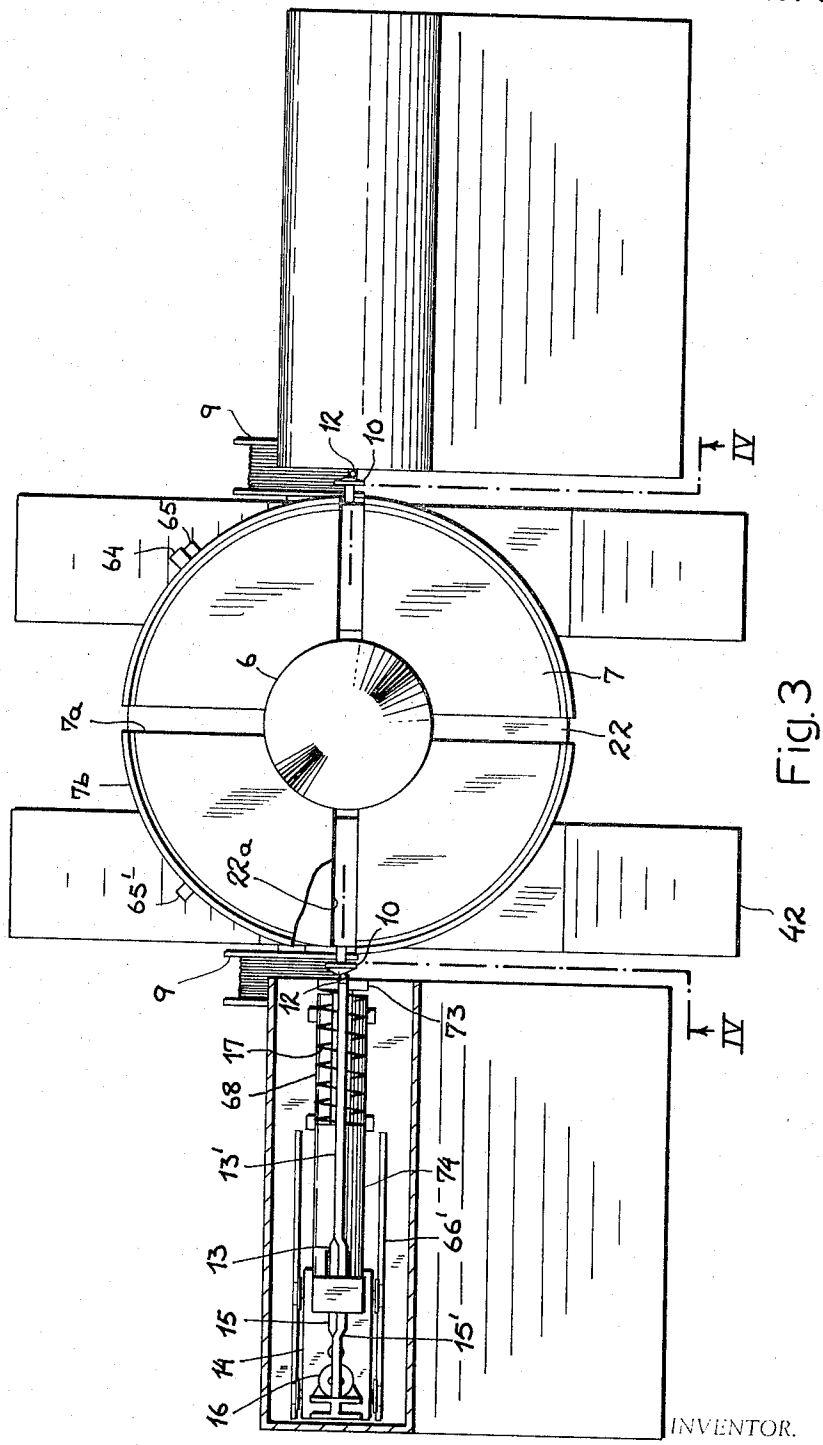


Fig. 3

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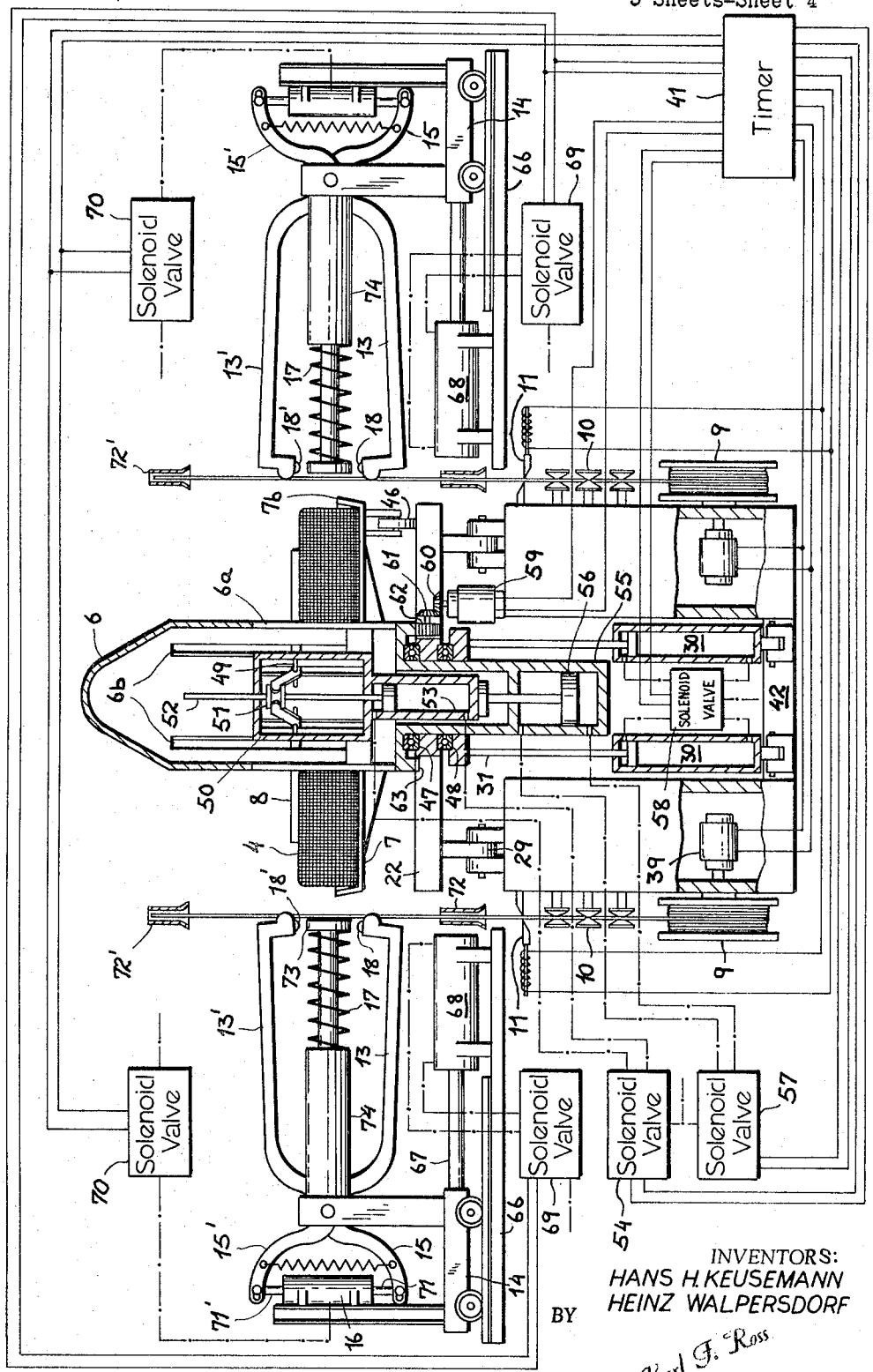
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WIRE-TYING APPARATUS

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Fig.4



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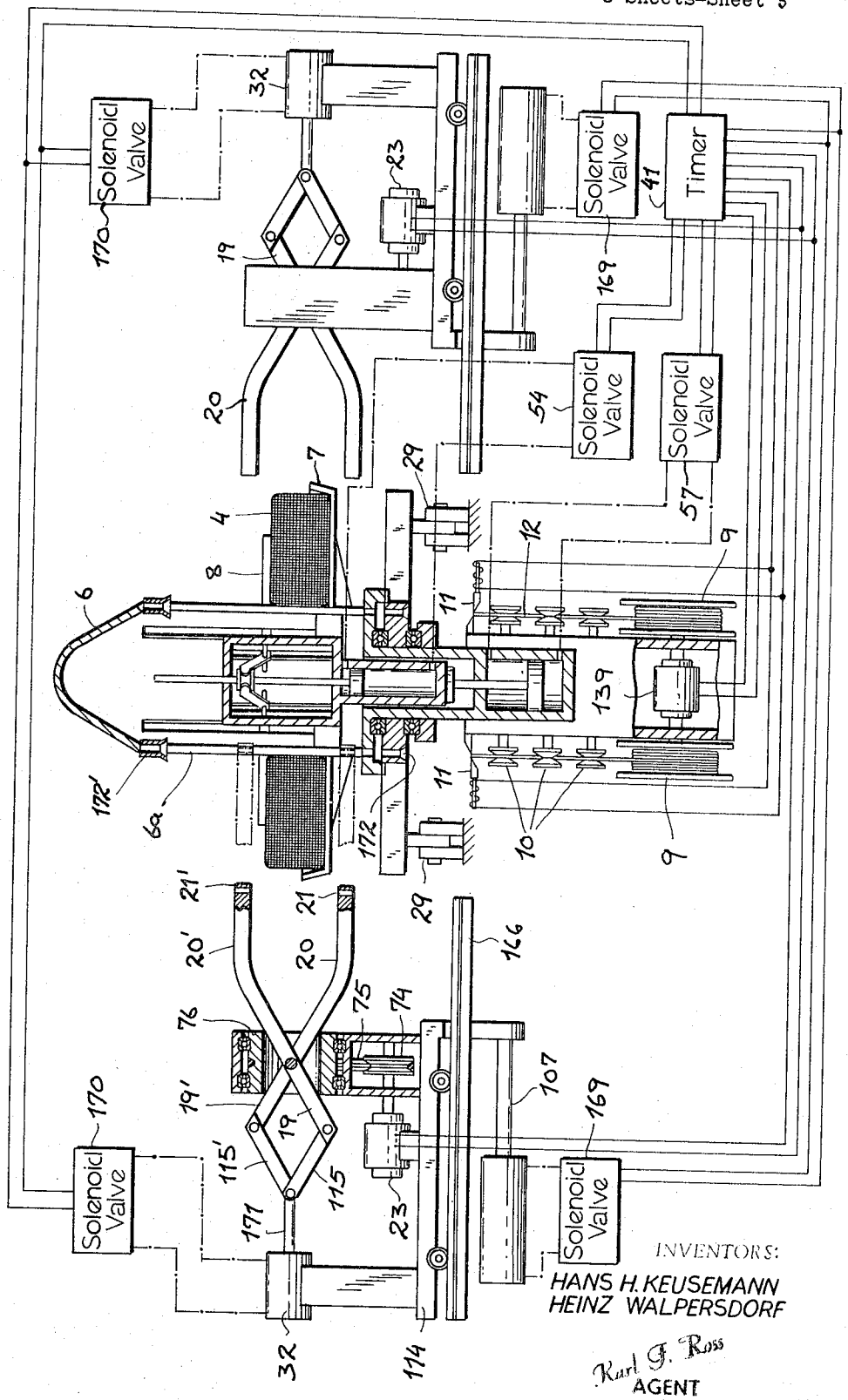
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WIRE-TYING APPARATUS

Filed June 1, 1964 5 Sheets-Sheet 5

Fig. 5



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3,304,960

WIRE-TYING APPARATUS

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15 Claims. (Cl. 140—93.6)

Our present invention relates to apparatus for tying coiled wire, e.g. as obtained from a wire-drawing plant in which the freshly produced wire, while still hot, is reeled up in the form of coils that are suspended in air for cooling prior to storage. Frequently, the coils to be cooled are transported along a conveyor track to their further destination, such as a storeroom or a vehicle, where they are to be received in tied condition to prevent unreeling and entanglement during subsequent handling. The general object of our present invention, accordingly, is to provide automatic means for efficiently tying a succession of wire coils during their passage from a supply station to a receiving station.

A more particular object of this invention is to provide apparatus for tying wire coils while they are moving along a predetremined path and in such manner as to facilitate air cooling during such movement.

Still more specifically, it is an object of our invention to provide wire-tying means adapted to co-operate with a conveyor for suspended coils so as to receive these coils successively from the conveyor and to deposit them, after tying, at the point of reception.

A feature of our invention resides in the provision of a turntable, generally one with a substantially vertical axis, which carries one or more supports for wire coils to be deposited thereon at the supply station, rotation of the turntable thus transporting the coils to the receiving station where they are unloaded after being operated on by a tying mechanism associated with each support. Thus, the turntable may be tangent, at the loading point, to the conveyor track previously referred to and may rotate beyond that point through an arc of about 180°, or even more, before reaching the point of unloading, the rotation of the turntable being so synchronized with the conveyor motion that a fresh coil arrives at the loading point concurrently with a coil support of the turntable to facilitate transfer by manual or automatic means. The tying mechanism, operating also in synchronism with the continuously or intermittently rotating turntable, includes means for looping a length of tie wire from a dispenser about a coil carried on the associated support, and advantageously, for fastening the ends of the looped tie wire together in suitable manner; this may be done by fusion, e.g. electrically, or by mechanical knotting or twisting.

The invention will be described hereafter in greater detail, reference being made to the accompanying drawing in which:

FIG. 1 is a top plan view of a coil-transporting system provided with wire-tying apparatus according to the invention;

FIG. 2 is an elevational view of the apparatus of FIG. 1, shown partly in section on the line II—II thereof;

FIG. 3 is a view from above, on the line III—III of FIG. 2, of one of the supports forming part of the apparatus of FIGS. 1 and 2;

FIG. 4 is an enlarged sectional elevation taken on the line IV—IV of FIG. 3; and

FIG. 5 is a view similar to FIG. 4, illustrating a modification.

In FIGS. 1 and 2 we show a turntable **1** disposed adjacent a conveyor track **40** along which a succession of carriages **3** are movable generally tangentially past the

turntable. The carriages **3** are provided with depending hooks **2** carrying wire coils **4** which were deposited thereon, by manual or automatic means, at an associated wire-drawing plant not shown. Turntable **1** is journaled in a hub **25** and is driven by one or more motors **28** having rollers **26** in frictional engagement with a circular reel **27**, proper synchronism between the motions of the turntable **1** and the carriages **3** being maintained by a servo-system known per se and illustrated only diagrammatically as a timer **41** coupled to motor **28** and to the conveyor drive (not shown). Timer **41** also controls all the other operations described hereinafter, including that of a transfer mechanism here shown as a hydraulically operated arm **5** which lifts each coil **4** from its hook **2** and deposits it on a nearby coil support rising from turntable **1**. This support, several of which are peripherally spaced on turntable **1**, comprises a base **42** rigid with the turntable and a disk **7** with a central boss **6** inclinedly mounted on that base so that the common axis of disk **7** and boss **6** diverges upwardly at an acute angle from the vertical axis of the turntable. Boss **42** also carries a plurality of supply reels **9** (two in the embodiment illustrated) for tie wire **12** which moves between pairs of feed and guide rollers **10** past a cutting device **11** upwardly across the plane of disk **7**.

The disk **7** with its boss **6** rests on a plate **22** hinged at **29** to an extension **43** of boss **42** so as to be tiltable about a horizontal axis **44**, as shown in the right-hand portion of FIG. 2, under the control of timer **41** through the intermediary of a pair of hydraulic pistons **31** (see also FIG. 4) in cylinders **30**. Disk **7**, in thus swinging through an angle of about 90°, dumps the coil **4** onto a receiver **24** therefor which may be another turntable having a series of rods projecting inclinedly upwardly from its frustoconical periphery for coaxial alignment with the downwardly tilted boss **6**. Receiver **24** should, of course, also be synchronized through the intermediary of timer **41** or by other means.

FIGS. 3 and 4 show details of a support such as the one seen at left in FIG. 2. Disk **7** is provided with four radial slots **7***a* at locations 90° apart and has an upstanding rim **7***b* for accurate centering of a coil **4** deposited thereon. Two of the slots **7***a* are aligned with a pair of diametrically opposite slots **22***a* in plate **22** on which the disk **7** rotatably bears through rollers **46** (only one shown). Boss **6**, rigid with disk **7**, engages the plate **22** at its upper and lower surface through the intermediary of ball bearings **47**, **48**. This boss is of tubular structure and has two sets of axially extending peripheral slots **6***a* and **6***b*, the slots **6***a* being aligned with the slots **7***a* of disk **7** whereas the slots **6***b* are interleaved with the slots **6***a* at locations offset therefrom by 45°. Slots **6***b* serve to accommodate an array of four outrigger arms **8** which are hinged to brackets **49** on a cage **50** slidably mounted within boss **6**. The inner ends of the lever-like arms **8** are engaged by a grooved collar **51** on a piston **52** projecting from a hydraulic cylinder **53** which is rigid with cage **50**, a solenoid valve **54** controlled by timer **41** regulating the admission of hydraulic fluid to cylinder **53** for raising or lowering the piston **52** with its collar **51**, thereby alternately swinging the arms **8** into an outwardly extending horizontal position (shown in FIG. 4) or retracting them through slots **6***b* into the boss **6** to facilitate the deposition of a coil **4** on the disk **7** and its subsequent removal therefrom. A further hydraulic cylinder **55**, integral with boss **6**, receives a piston **56** rigidly joined to the assembly **50**, **53** for lowering and raising the outstretched arms **8**, thereby compacting the wire coil **42** against the disk **7**; cylinder **55** is controlled by a solenoid valve **57** which is also responsive to timer **41**. A further solenoid valve **58** actuates the pistons **31** of cylinders **30** under the control of the timer.

Disk 7 and boss 6 are rotatable, relatively to their carrier plate 22, with the aid of a motor 59 likewise controlled by the timer 41. The shaft of motor 59 has a bevel gar 60 meshing with another bevel gear 61 on a horizontal shaft carrying a pinion 62, the latter engaging the teeth of a ring gear 63 on the underside of boss 6. Motor 59 is reversible and alternately switched by the timer 41 for rotation in opposite directions, thereby turning the disk 7 through 90° during each operating cycle. Disk 7 is indexed in either of its two limiting positions by the co-operation of a lug 64 thereon (FIG. 3) with a respective abutment 65, 65' on plate 22. It will be understood that the hydraulic connections from solenoid valves 54 and 57 to cylinders 53 and 55 should be sufficiently flexible to allow for such rotation. If it were desired to turn the disk unidirectionally instead of oscillating it, the hydraulic controls for the arms 8 could be replaced for greater convenience by electromagnetic activators.

The system so far described, in which the slots 6*a* and 7*a* of the boss 6 and disk 7 are alternately alignable with the slots 22*a* of carrier plate 22, is the same for the two embodiments shown in FIGS. 4 and 5, respectively. Reference, however, will now be made specifically to the system of FIG. 4 for a description of a first embodiment of the wire-tying mechanism associated with the support 6, 7, 22, 42. This mechanism is symmetrically duplicated on diametrically opposite sides of plate 22 and comprises on each side a carriage 14 which is radially movable on a track 66, with reference to the support axis, by means of a hydraulic piston 67 whose cylinder 68 obtains its fluid supply through a solenoid valve 69 controlled by the timer 41. Carriage 14 supports another hydraulic cylinder 16, controlled by a timer-operated solenoid valve 70 whose two vertical pistons 71, 71' are articulated to rearward extensions 15, 15' of prongs 13, 13' forming part of a pair of tongs engageable with the tie wire 12 from the associated reel 9. The latter is intermittently driven, in response to the operation of timer 41, by a motor 39 designed to advance a length of that tie wire through a pair of aligned guide sleeves 72, 72' above and below prongs 13 and 13', respectively. A pusher rod 73, slidable in a sleeve 74 on carriage 14 and urged toward the disk 7 by a sourrounding coil spring 17, is disposed between the prongs 13, 13' whose extremities carry a pair of confronting electrodes 18, 18'; these extremities are slitted, as seen in FIG. 3, in a plane including the axes of plate 22 and of sleeves 72, 72' for positive engagement with the length of tie wire 12 extending beyond these sleeves. It will also be noted that the prongs 13, 13' are aligned with the slots 6*a*, 7*a* and 22*a* so as to be able to reach around the proximal portion of the flattened coil 4 for the purpose of bringing the ends of the suitably dimensioned length of tie wire 12 together within the boss 6, the electrodes 18, 18' serving to fuse these ends whereby a tie loop is closed around the coil wire.

The operation of cutter 11, under the control of timer 41, precedes that of piston 67 and occurs at a time when the prongs 13, 13' and the pusher 73 are spaced from the axis of sleeves 72, 72'; thereafter, the aligned extremities of these three elements engage the severed length of tie wire, the pusher 73 clamping the wire against the outer peripheries of disk 7 and coil 4 while the prongs 13, 13' move inwardly to complete the looping process. Cylinder 16 operates thereafter to spread the prong extensions 15, 15' with concurrent energization of electrodes 18, 18' via circuits not shown. The operation of cylinders 16 and 68 is now reversed to let the carriage 14 return to its normal withdrawn position. Motor 39 then threads another length of tie wire 12 through the cylinders 72 and 72'.

The two tying mechanisms shown in FIGS. 3 and 4 operate concurrently, in the manner just described, to place a pair of loops around diametrically opposite portions of wire coil 4. Next, motor 59 swings the disk 7 into its alternate position to align the remaining slots 6*a*, 7*a* with the slots 22*a* and thereby with the tongs 13, 13', 15, 15'. The procedure is then repeated so that the coil now carries four tie loops spaced 90° apart. In the interim, turntable 1 has rotated to bring the support under consideration from the vicinity of conveyor track 40 to a point adjacent receiver 24, the piston 31 then tilting the disk 7 to discharge the tied coil onto the confronting receiving rod 45. It will be apparent that the number of coils tied simultaneously equals half the number of supports on turntable 1 if the loading and unloading stations are disposed at diametrically opposite locations as shown in FIG. 1.

The modified system of FIG. 5 comprises a pair of carriages 114 which are displaceable on tracks 116 by hydraulic pistons 167 under the control of timer-actuated solenoid valves 169, each carriage 114 having disposed thereon a hydraulic cylinder 32 which is controlled by a timer-actuated solenoid valve 170 and whose piston 171 is articulated to a pair of arms 115, 115' linked in turn to extensions 19, 19' or prongs 20, 20'. The scissor linkage 19, 19', 20, 20' again constitutes a pair of tongs adapted to reach around an adjacent section of coil 4. The extremities of prongs 20, 20' are, however, now provided with orifices 21, 21' alignable with a pair of sleeves 172, 172' which, in contradistinction to the sleeves 72, 72' of the preceding embodiment, are disposed along a line just within the inner periphery of the annular body of coil 4. Piston 171 and the associated linkage 115, 19, 20, 119 and 115', 19', 20', 119' are bodily rotatable about the piston axis with the aid of a motor 23 having a pulley 74 which is coupled via a belt 75 with another pulley 76 traversed by the scissor arms. Motor 23 is also controlled by the timer 41.

The operation of the system of FIG. 5 differs from that of the arrangement of FIG. 4 in that at the beginning of a cycle, i.e. at the time of operation of reel motor 139, carriage 114 is in its position of closest approach to the support axis so that the orifices 21, 21' at the extremities of prongs 20, 20' are aligned with the sleeves 172, 172'. Upon the subsequent operation of cutter 11, carriage 114 is retracted so that the length of tie wire 12 engaged by the orifices 21, 21' is drawn outwardly to loop about the coil wire. Next, piston 171 moves into its cylinder 32 to stretch the linkage 115, 115' etc., thereby bringing the free ends of the tie wire close together; finally, motor 23 is energized to spin the stretched linkage about its axis for a limited period, thereby twisting the ends of the tie wire in a predetermined number of turns about each other.

As in the preceding embodiment, tie loops are formed concurrently at diametrically opposite points of coil 4 and the process is repeated upon 90° rotation of disk 7 to form another pair of ties at intermediate locations.

It will be evident that the number of coil supports on the turntable, the number of tying mechanisms associated with each coil support, and other details may be modified to suit various requirements, our invention being therefore not limited to the specific embodiments described and illustrated but being susceptible of various modifications without departing from the spirit and scope of the appended claims.

What is claimed is:

1. An apparatus for the tying of wire coils, comprising a turntable provided with a wire-coil support adjacent its periphery, a dispenser for tie wire on said turntable adjacent said support, and mechanism on said turntable for looping a length of tie wire from said dispenser about a coil carried by said support and severing said length from the remainder of the wire, said turntable being rotatable for transporting said coil from a supply station to a removal station during operation of said mechanism, said support including a disk having a boss rising centrally therefrom, a plurality of outrigger arms extending radially from said boss, said arms being retractable for facilitating the deposition of a coil on said disk and its subsequent removal therefrom, and means for axially dis-

placing said arms toward said disk for compressing the deposited coil.

2. An apparatus as defined in claim 1 wherein said disk is provided with an upstanding rim for retaining a coil deposited thereon.

3. An apparatus as defined in claim 1 wherein said mechanism comprises a carriage disposed beyond the periphery of said disk and radially movable relatively to the latter and tong means on said carriage with a pair of prongs disposed in an axial plane of said disk for reaching around the wire strands of a coil deposited thereon, said disk being provided with at least one radial slot forming a clearance for the passage of one of said prongs.

4. An apparatus for the tying of wire coils, comprising a turntable provided with a wire-coil support adjacent its periphery, a dispenser for the tie wire on said turntable adjacent said support, and mechanism on said turntable for looping a length of tie wire from said dispenser about a coil carried by said support and severing said length from the remainder of the wire, said turntable being rotatable for transporting said coil from a supply station to a removal station during operation of said mechanism, said support including a disk having a boss rising centrally therefrom, said disk being rotatable about its axis and provided with means for indexing it in a plurality of predetermined angular positions.

5. An apparatus as defined in claim 4 wherein said support further comprises a carrier plate for said disk secured to said turntable, said disk being provided with roller means rotatably supporting it on said plate.

6. An apparatus as defined in claim 5 wherein said mechanism comprises tong means engageable with said tie wire, said plate and said disk being provided with radial slots forming clearances for said tong means aligned therewith in each of said angular positions of said disk.

7. An apparatus for the tying of wire coils, comprising a turntable provided with a wire-coil support adjacent its periphery, a dispenser for tie wire on said turntable adjacent said support, and mechanism on said turntable for looping a length of tie wire from said dispenser about a coil carried by said support and severing said length from the remainder of the wire, said turntable being rotatable for transporting said coil from a supply station to a removal station during operation of said mechanism, said support including a disk having a boss rising centrally therefrom, said turntable being substantially horizontal, said disk and said boss having an axis diverging upwardly at an acute angle from the axis of said turntable, said disk being provided with mounting means pivotally securing it to said turntable for swinging said disk together with said boss into an outwardly and downwardly inclined discharge position.

8. An apparatus as defined in claim 3 wherein said dispenser comprises a supply reel and guide means for directing a length of tie wire from said supply reel along a line substantially transverse to said disk within said axial plane.

9. An apparatus as defined in claim 8 wherein the line defined by said guide means lies just beyond the periphery of said disk, said prongs being provided with extremities engageable with opposite ends of said length of tie wire for bending said ends toward each other inside the center hole of the deposited coil.

10. An apparatus as defined in claim 9 wherein said prongs are provided with electrodes at said extremities for fusing the bent ends of said tie wire together.

11. An apparatus as defined in claim 8 wherein the line defined by said guide means lies within the confines of said disk at a location registering with the center hole of the deposited coil, said prongs being provided with extremities having bores alignable with said guide means for traversal by a length of tie wire from said supply reel.

12. An apparatus for the tying of wire coils, comprising a turntable provided with a wire-coil support adjacent its periphery, a dispenser for the tie wire on said turntable adjacent said support, and mechanism on said turntable for looping a length of tie wire from said dispenser about a coil carried by said support and severing said length from the remainder of the wire, said turntable being rotatable for transporting said coil from a supply station to a removal station during operation of said mechanism, said mechanism comprising a carriage disposed beyond the periphery of said disk and radially movable relatively to the latter, and tong means on said carriage with a pair of prongs disposed in an axial plane of said disk for reaching around the wire strands of a coil deposited thereon, said disk being provided with at least one radial slot forming a clearance for the passage of one of said prongs, said dispenser comprising a supply reel and guide means for directing a length of tie wire from said supply reel along a line substantially transverse to said disk within said axial plane, the line defined by said guide means lying just beyond the periphery of said disk, said prongs being provided with extremities engageable with opposite ends of said length of tie wire for bending said ends toward each other inside the center hole of the deposited coil, said mechanism further comprising a spring-loaded pusher member carried by said tong means between said prongs for exerting radially inward pressure upon the length of tie wire looped around the coil.

13. An apparatus as defined in claim 11 wherein said mechanism further comprises drive means for rotating said prongs about each other upon outward withdrawal of the ends of an engaged tie wire, thereby twisting said ends together.

14. In a wire-drawing plant having suspension means for carrying successive coils of freshly drawn wire along a substantially linear track, the combination therewith of a turntable substantially tangent to said track and provided with a plurality of peripherally spaced-apart supports for wire coils removed from said suspension means, propulsion means for advancing said suspension means along said track and concurrently rotating said turntable in synchronism therewith, means controlled by said propulsion means for transferring a coil from said suspension means to one of said supports at a location of closest approach of said turntable to said track, a dispenser for tie wire on said turntable adjacent each of said supports mechanism on said turntable individual to each of said supports for looping a length of tie wire from the respective dispenser about a coil carried by the support and severing said length from the remainder of the tie wire, said mechanism being operable during rotation of said turntable from said location of closest approach to a remote location, and receiving means for tied coils at said remote location, said turntable having a substantially vertical axis and each support is tiltable into a dumping position about a substantially horizontal axis close to the periphery of said turntable, further comprising coil-discharging means for so tilting each support upon its rotation past said receiving means.

15. The combination defined in claim 14 wherein each support comprises a coil-carrying disk having an axis normally diverging upwardly at an acute angle from the axis of said turntable.

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