Sept. 29, 1953 B. H. DAVIS 2,653,773

WIRE-SPOOLING APPARATUS

Filed July 13, 1951 4 Sheets-Sheet 1

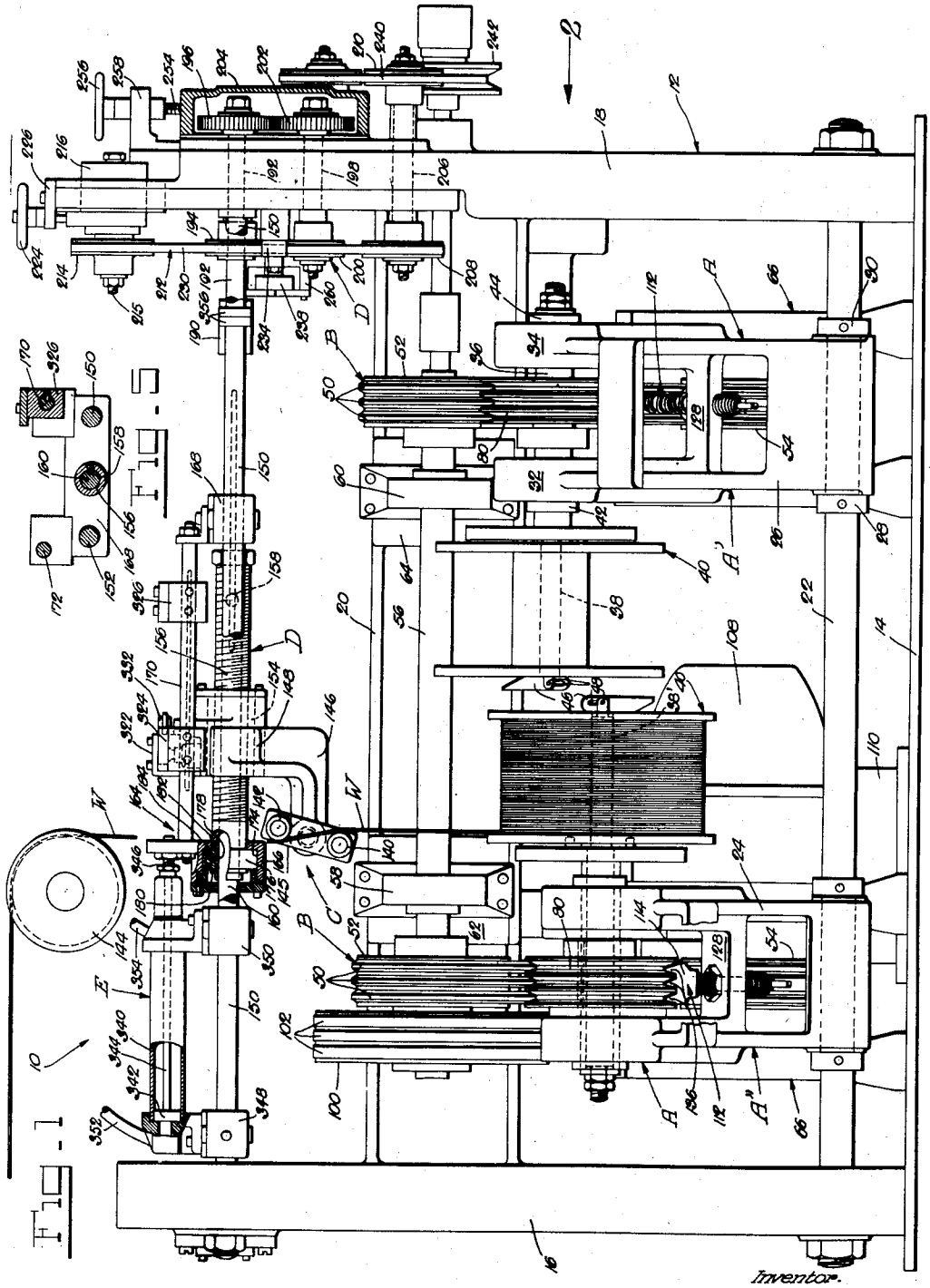

Fig. 1

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WIRE-SPOOLING APPARATUS

Filed July 13, 1951 4 Sheets-Sheet 2

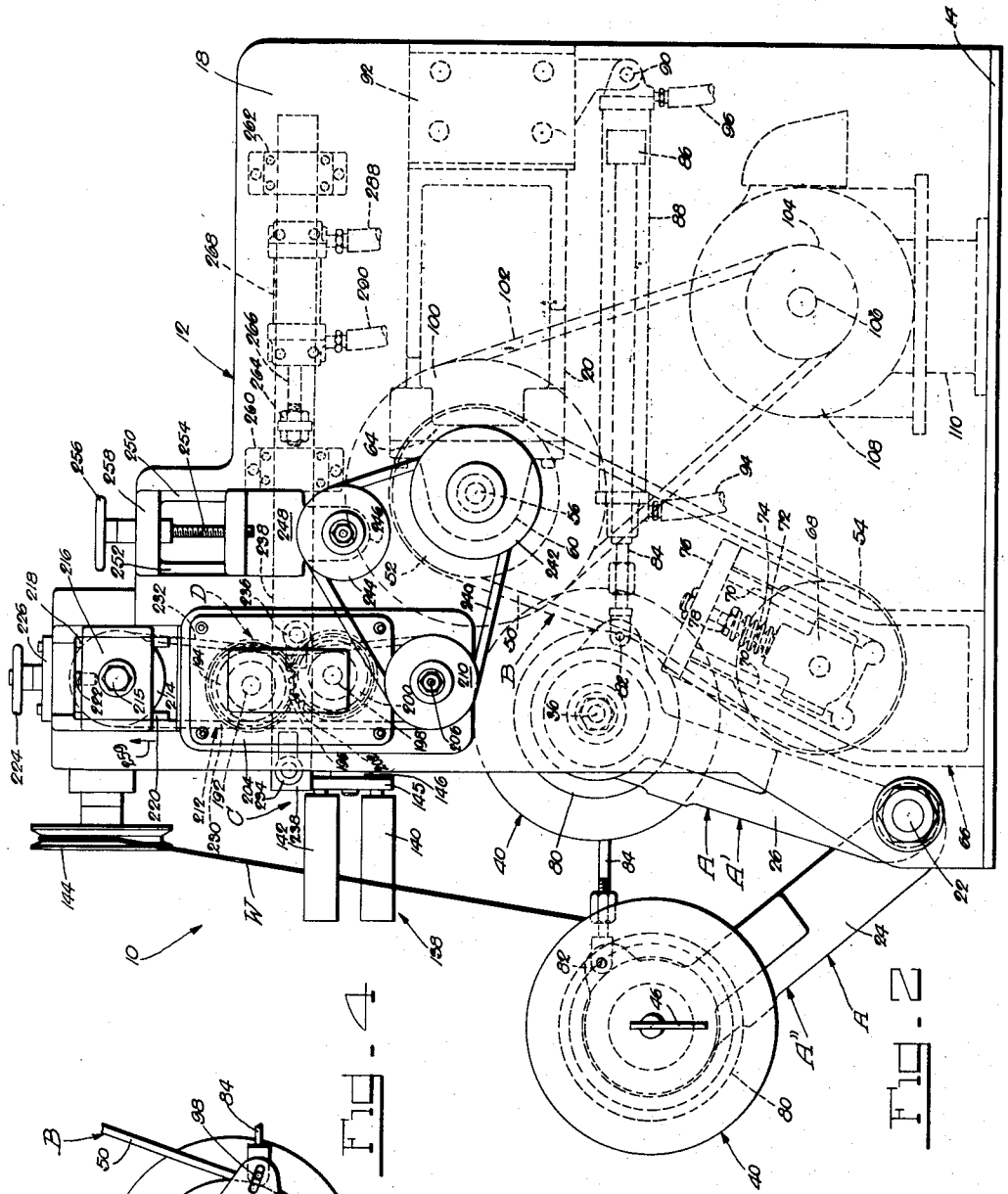

Fig. 4

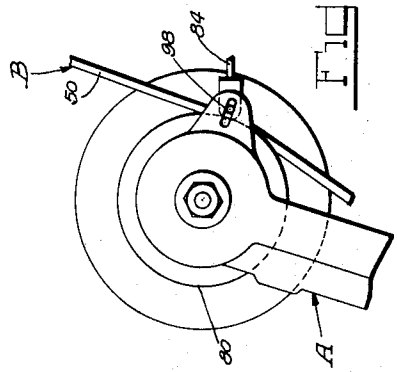

Fig. 5

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WIRE-SPOOLING APPARATUS

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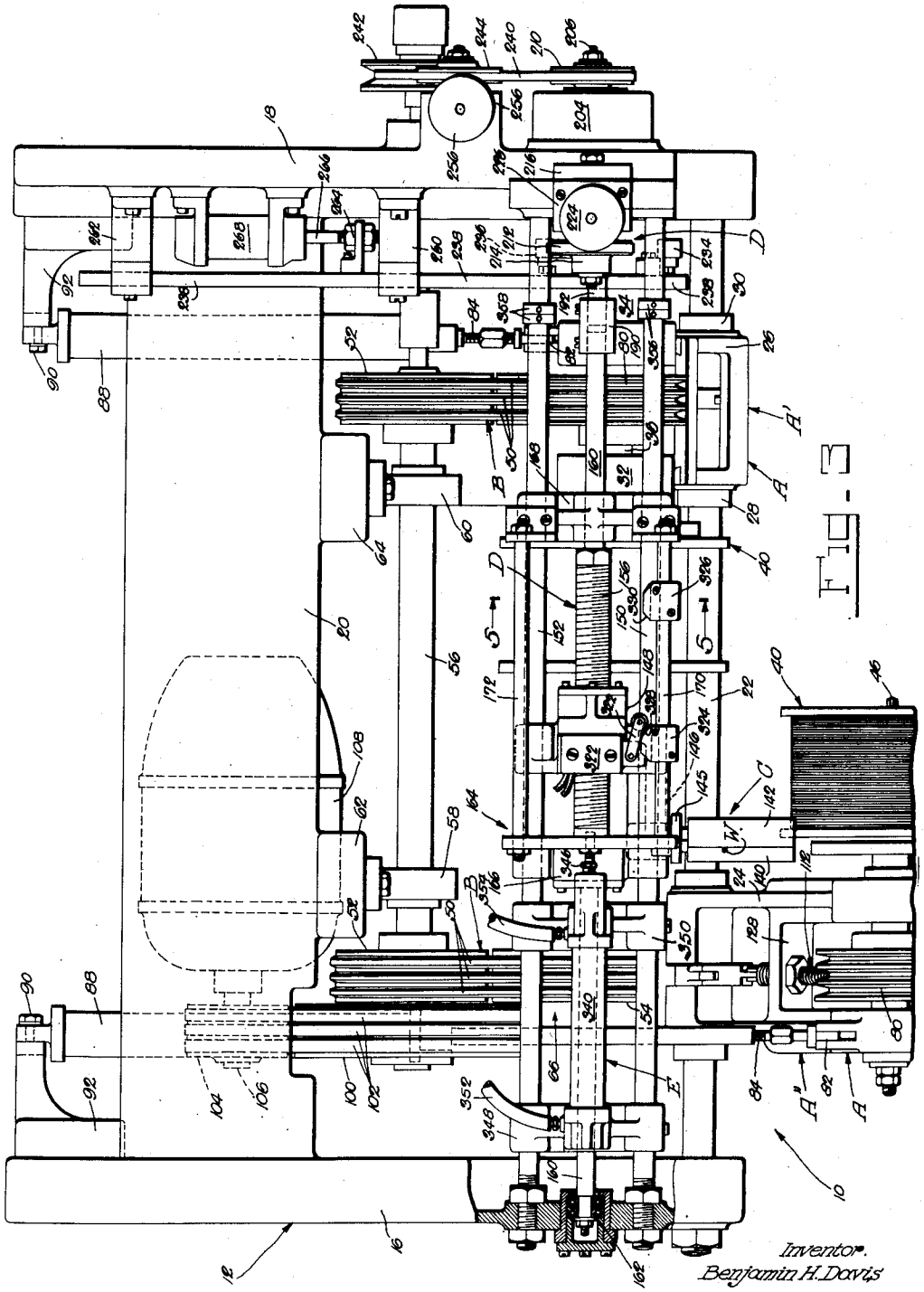

Fig. 3

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WIRE-SPOOLING APPARATUS

Filed July 13, 1951 4 Sheets-Sheet 4

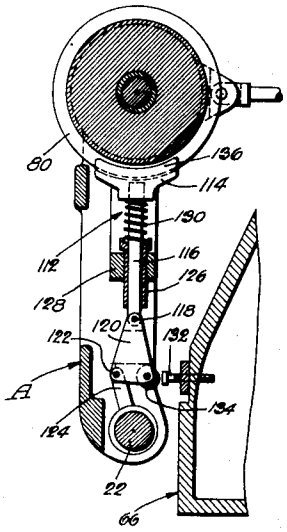

Fig. 6

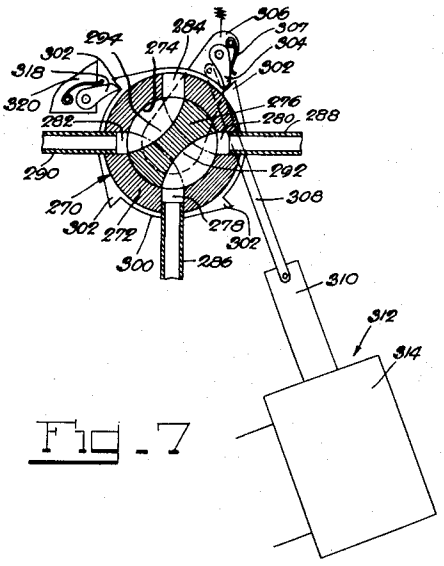

Fig. 7

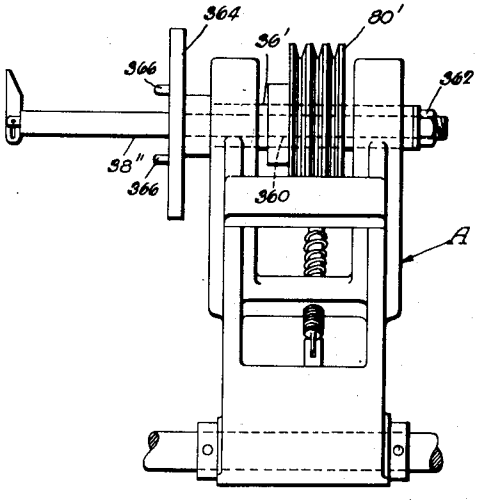

Fig. 8

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UNITED STATES PATENT OFFICE

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WIRE-SPOOLING APPARATUS

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Application July 13, 1951, Serial No. 236,638

9 Claims. (Cl. 242—25)

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This invention relates generally to wire-spooling apparatus, and more particularly to apparatus for power-winding a continuous supply-wire in orderly-arranged superposed layers on a spool.

It is an object of the present invention to provide apparatus of this type with a spool-carrier which is movable into a winding position in which the spool is in driving relation with a continuous power-drive, and also into an idle position in which the spool is disconnected from the power-drive and the carrier is readily and safely accessible for the replacement of a full spool with an empty spool.

It is another object of the present invention to provide apparatus of this type with alternately operative twin spool-carriers which are individually movable into winding and idle positions and in driving relation with the same power-drive in their respective winding positions, so that a single wire-guide may be used for both spools by simply shifting the wire-guide into wire-guiding relation with the spool on either carrier in its winding position, and a full spool may readily be replaced with an empty spool on either carrier in its idle position at a safe distance from the other carrier in its winding position.

A further object of the present invention is to provide a spool-carrier of the aforementioned type with a shaft which serves as a mandrel for replaceable spools and carries a driven element that is moved by the carrier into and from frictional driving engagement with a continuous driver, so that the mandrel is automatically connected with and disconnected from the driver without any special clutch provisions and on mere movement of the carrier into and from its winding position.

Another object of the present invention is to provide the aforementioned continuous driver in the form of a V-type belt, or preferably several of these belts which pass over grooved pulleys that are normally yieldingly urged apart and of which at least one pulley is power-driven, and the driven element on the spool-carrying mandrel of the carrier is a grooved pulley which on movement of the carrier into its winding position will engage the adjacent runs of the belts to establish therewith a positive driving connection which will assuredly overcome even exceptional drag on the drum being wound with wire.

It is a further object of the present invention to provide apparatus of this type with a wire-guide which repeatedly traverses a drum on the carrier widthwise to deposit wire thereon in

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orderly arranged superposed layers, and which is impelled by a periodically reversing rotary feed-spindle that is driven in synchronism with the aforementioned driving belts so that, by virtue of the direct driving connection of these belts with the pulley on the carrier rather than with the spool thereon, and despite any possible variation in the drive of the spool by virtue of the increasing diameter of the wound wire thereon, the wire turns are deposited in each layer on the spool in uniform engagement with each other throughout the winding of the spool with wire.

It is another object of the present invention to provide in apparatus of the aforementioned twin-carrier type a single wire-guide which is carried by, and guided for reciprocable spool-traversing movement on, a transfer unit that is, in turn, guided for movement into wire-guiding relation with the spool on either carrier on a shaft which is driven in synchronism with the aforementioned driver, while the aforementioned feed-spindle is a part of the transfer unit moving therewith and is splined to said shaft whereby the transfer-unit and wire guide may be shifted together into operative alignment with the spool on either carrier without interrupting the driving connection between the feed-spindle and shaft at any time.

A further object of the present invention is to provide in the drive of the aforementioned feed-spindle for the wire-guide a reversing mechanism in the structurally simple form of a driven belt, a pair of gear-connected driving pulleys of which one pulley is directly coupled with the feed-spindle, and belt-deflectors which are automatically shifted in unison at the ends of successive spool-traverses of the wire-guide for deflecting the opposite runs of the driven belt into alternate driving engagement with the driving pulleys, respectively, thereby to drive the feed spindle in opposite directions, respectively.

Another object of the present invention is to provide apparatus of the aforementioned movable spool-carrier type with a brake which will automatically stop free-wheeling of the drum-carrying mandrel on the carrier on movement of the latter from its winding position, and which will automatically release the mandrel for rotation on movement of the carrier into its winding position.

It is a further object of the present invention to form the pulley-carrying shaft on the aforementioned movable carrier and the spool-carrying mandrel as separate parts of which the shaft with its pulley is permanently mounted in

the carrier and the mandrel is removably carried by the shaft for ready replacement with another mandrel that will accommodate a spool of a different size.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a front-elevational view of wire-spooling apparatus embodying the present invention;

Fig. 2 is a side elevation of the same apparatus as viewed in the direction of the arrow 2 in Fig. 1;

Fig. 3 is a top plan view of the apparatus;

Fig. 4 is a fragmentary view of a modified connection between a spool-carrier and its shifter element;

Fig. 5 is a section on the line 5—5 of Fig. 3;

Fig. 6 is a section through one of the spool-carriers of the apparatus, showing automatic brake-mechanism for the spool on the carrier;

Fig. 7 is a diagrammatic illustration of certain control mechanism of the instant apparatus; and

Fig. 8 shows a modified mounting for replaceable mandrels on either spool-carrier of the instant apparatus.

Referring to the drawings, and more particularly to Figs. 1 to 3 thereof, the reference numeral 10 generally designates a wire-spooling apparatus which comprises a main frame 12 on which are mounted the various operating devices and mechanisms of the apparatus. The main frame 12 which may be in the form of a casting, provides in this instance a base 14, opposite upright side walls 16 and 18 and a preferably integral brace 20 which extends between the side walls 16 and 18 and may be generally U-shaped in cross-section (Figs. 1 and 2). The various operating devices and mechanisms on the main-frame 12 are: "spool-carriers" A (Figs. 1, 2 and 3); "drives" B for the spool-carriers A (Figs. 1, 2 and 3); "wire-guiding mechanism" C (Figs. 1 and 3); "operating and control means" D for wire-guiding mechanism C (Figs. 1, 2 and 3); and "shifting device" E for wire-guiding mechanism C.

Spool-carriers A

Referring particularly to Figs. 1 and 3, there is shown a shaft 22 which is firmly mounted with its ends in the opposite side walls 16 and 18, respectively, of the main frame 12. Mounted for free turning movement on the shaft 22 are spaced rockers 24 and 26 which constitute the swinging frames of the respective spool carriers A so that the latter are, in the present instance, swingable to and from their respective winding positions to be described. Since the spool-carriers A are identical in most essential respects, a detailed description of one of these spool carriers, namely carrier A', is sufficient. Thus, the rocker 26 of the spool-carrier A', which is held against axial movement on the shaft 22 between pinned collars 28 and 30 thereon, is provided in its upper spaced ends 32 and 34 with suitable journal bearings for a shaft 36 of which an extension 38 projects beyond the rocker end 32 to serve as a mandrel for a replaceable spool 40. The mandrel shaft 36 may in any suitable manner be held against axial movement relative to the rocker 26, as by an integral intermediate collar 42 and a fixed end collar 44, for instance. The mandrel 38 carries at its outer end a spool-retainer 46 which may be of the conventional type having a floating pivot connection 48 with the adjacent end of the mandrel 38 so as to be shiftable from the spool-locking position shown in Fig. 1 into a spool-releasing position in which it extends axially of the mandrel 38 and permits the replacement of a spool 40 on the mandrel. The other spool-carrier differs from the carrier A' only by having its mandrel 38' extend from the opposite side thereof so that both mandrels 38 and 38' extend between the spool-carriers.

Drives B for the spool-carriers A

Referring now to Figs. 1 to 3, the drives B are, in the present instance, belt-type drives each of which comprises preferably several belts 50, passing over spaced upper and lower pulleys 52 and 54, respectively. The upper pulleys 52 are mounted in spaced relation on a main-drive shaft 56 which is journalled in spaced bearing brackets 58 and 60 on preferably integral web-portions 62 and 64, respectively, on the brace 20 of the main frame 12 of the apparatus. The lower pulleys 54 are carried by spaced upright standards 66, respectively, on the base 14 of the main frame 12. More particularly, each lower pulley 54 is journalled in a bearing block 68 (Fig. 2) which is guided for movement toward and away from the adjacent upper pulley 52 in ways 70 in the respective standard 66. Each bearing block 68 is urged away from the adjacent upper pulley 52 by a compression-type spring 72 which surrounds an adjustable threaded pin 74 on a cross-member 76 on top of the respective standard 66, and backs against an adjustment nut 78 on the pin 74. The belts 50 of the drives B are thus tensioned by the springs 72, while the pins 74 serve as adjustable stops to limit the retraction of the bearing blocks 68.

Mounted on the mandrel-shaft 36 of each spool-carrier A is a pulley 80 which is in driving engagement with the belts 50 of the adjacent drive B when the spool-carrier is in its winding position in which the same leans toward the adjacent belt-drive B in the fashion indicated by the spool-carrier A' in Fig. 2. Conversely, the pulley 80 on each spool-carrier A is out of driving engagement with the adjacent belt-drive B when said carrier is in its idle position in which the same leans away from the adjacent belt drive in the fashion indicated by the spool-carrier A'' in Fig. 2.

The belts 50 of each drive B are, in the present instance, of the double-V type so as to have maximum traction not only on the respective pulleys 52 and 54 over which they pass, but also on the pulley 80 on the adjacent spool-carrier A when the latter is in its winding position.

Each of the spool-carriers A is, for swinging movement into its winding and idle positions, pivotally connected at 82 with the rod 84 of a plunger 86 in a cylinder 88 (Figs. 2 and 3) which is itself pivotally mounted at 90 on a bracket 92 on the adjacent side wall of the main frame 12. The opposite ends of each cylinder 88 are connected by suitable conduits or hose connections 94 and 96 with any conventional two-way valve (not shown) operable, preferably manually, to admit fluid under pressure to one end of the cylinder and vent the other end thereof, and vice versa, for swinging the corresponding spool-carrier A into its winding and idle positions.

The pivot-connection between each spool-carrier A and the adjacent plunger-rod 84 may,

if desired, be of the floating type indicated at 98 in Fig. 4, in which case the stroke of the corresponding plunger 86 in its cylinder 88 is so selected that the plunger will, on swinging the spool-carrier into its winding position, arrive in its inner end position in the cylinder just before the pulley 80 on the carrier drivingly engages the belts 50 of the corresponding drive B, with the result that the spool-carrier will, under its own gravity and that of the spool thereon, complete its swinging movement into winding position. Accordingly, the pulley 80 on each spool-carrier A will rest against the adjacent belt-drive B only with the gravitational force of said spool-carrier and the parts carried thereby, with the result that the traction between the pulley 80 and the adjacent belt-drive B is, despite the increasing weight of the spool as the same is being wound with wire, never such as to occasion breakage of the wire being led to the spool.

As shown in Figs. 2 and 3, the main-drive shaft 56 carries also a pulley 100, peferably of the multi-groove type, which through V-type belts 102 is drivingly connected with a pulley 104 on the shaft 106 of an electric motor or other suitable prime mover 108 on a pedestal 110 on the base 14 of the frame 12.

Each spool-carrier A is also provided with automatic brake-mechanism 112. Since these brake-mechanisms may be identical, only one of them will be described with reference to Fig. 6. The brake-mechanism 112 there shown comprises a brake-shoe 114 on the upper end of a shank 116 of which the lower end is pivotally connected at 118 with a link 120 which is, in turn, pivotally connected at 122 with another link 124 that is freely turnable on the carrier shaft 22. The shank 116 of the brake-shoe 114 is guided for axial movement in a bushing 126 in a cross-web 128 of the spool-carrier, and a compression-type spring 130 surrounds the shank 116 and normally urges the shoe 114 into braking engagement with the pulley 80 on the spool-carrier. When the shoe 114 is in normal braking engagement with the pulley 80, the links 120 and 124 form a slightly bent knee as shown in Fig. 6. Threaded into the adjacent standard 66 is an adjustable stop 132 which, on the inward swing of the spool-carrier toward its winding position, will be engaged by an antifriction-roller 134 on the link 120, with the result that the links 120 and 124 will be further bent and the shoe 114 retracted from braking engagement with the pulley 80 as the spool-carrier swings into its winding position. Conversely, on swinging the spool-carrier away from its winding position, the roller 134 will soon move away from the stop 132, thereby permitting the spring 130 to reengage the brake-shoe 114 with the pulley 80. For maximum braking effect, the shoe is preferably provided with V-shaped ribs 136 which fit in the correspondingly-shaped grooves in the pulley 80 (see also Fig. 1).

Wire-guiding mechanism C

This mechanism, which is hereinafter referred to as "wire-guide" and designated by the reference numeral 138, comprises wire-guiding pins 140 and 142 which straddle the wire W as the same is led from a supply (not shown) over a guide roll 144 onto the spool 40 on one of the spool-carriers A. The pins 140 and 142 are carried by a plate 145 on an extension 146 of a bracket 148 which is slidable on spaced parallel rods 150 and 152, the ends of which are suitably mounted in the end walls 16 and 18, respectively, of the main-frame 12. The wire-guide 138 is, in a manner to be described, transferred on the rods 150 and 152 into operative alignment with the spool on either carrier A. Further, the wire-guide 138 is, while in operative alignment with the spool on either carrier A, reciprocated on the rods 150 and 152 in a manner to be described, so that the guided wire W will repeatedly traverse the spool widthwise and become wound thereon in uniform superposed layers.

Operating and control means D for wire-guiding mechanism C

For the widthwise spool traverse of the wire-guide 138, the bracket 148 carries a bushing 154 (Fig. 1) which threadedly receives a feed spindle 156 that is splined at 158 to a shaft 160 so as to be slidable thereon as well as drivingly connected therewith. The shaft 160 extends between and parallel to the rods 150 and 152 and is journalled with one end in the sidewall 16 of the main frame 12 as indicated at 162 in Fig. 3. The other end of the shaft 160 is drivingly coupled with a journalled shaft described hereinafter. The feed spindle 156 is part of a transfer-unit 164 which further includes opposite end brackets 166 and 168 slidable on the rods 150 and 152, and spaced parallel tie rods 170 and 172 which connect these end brackets and extend parallel to the rods 150 and 152. The end bracket 166 has a recess 174 for the reception of an antifriction bearing 176 (Fig. 1) in which a diametrically reduced end 178 of the feed spindle 156 is journalled. A clamping ring 180 may be used to hold the annular shoulder 182 on the feed spindle 156 in permanent engagement with the inner race 184 of the bearing 176, thereby connecting the spindle 156 with the bracket 166 for movement of the former with the transfer-unit 164 on the rods 150 and 152, yet permitting independent rotation of the spindle 156. Thus, since the wire-guide 138 will, by virtue of its threaded connection with the feed spindle 156, move with the transfer-unit 164, it is the latter which is shifted on the rods 150 and 152, in a manner hereinafter described, in order to bring the wire-guide 138 into operative alignment with the spool on either carrier A. The wire guide 138 is, for its repeated widthwise traverse of the spool on either carrier A, repeatedly reciprocated, by the feed spindle 156 which is driven and periodically reversed in a manner to be described presently.

The shaft 160, which is drivingly connected at 158 with the spindle 156, is coupled at 190 to a stub shaft 192 which is suitably journalled in the frame wall 18 and carries on opposite sides thereof a pulley 194 and a gear 196, respectively. Journalled in the same frame wall 18 is another stub shaft 198 which carries on opposite sides thereof a pulley 200 and a gear 202, respectively. As shown in Figs. 1 and 2, the gears 196 and 202 are in permanent mesh with each other and enclosed in a cover 204 on the frame wall 18. Suitably journalled in the frame wall 18 is still another stub shaft 206 which carries at its opposite ends pulleys 208 and 210, respectively, of which the pulley 208 is drivingly connected by a belt 212 with a pulley 214 on a stub-shaft 215 which is journalled in a bearing block 216. As best shown in Fig. 2, the bearing block 216 is guided for vertical movement in ways

218 and 220 in the frame wall 18, and receives a threaded shank 222 which is mounted for rotational but non-axial movement in a top plate 226 on the frame wall 18 and carries a hand-wheel 224. The hand-wheel 224 may be turned to shift the bearing block 216 for the purpose of tensioning the belt 212 to the desired degree.

It appears from Fig. 2 that the stub shafts 192 and 198 are laterally offset from a line passing through the stub shafts 206 and 215 and are located on opposite sides, respectively, of this line, so that the pulleys 194 and 200, which are of identical dimensions, are equally spaced from, and out of driving engagement with, the adjacent runs 230 and 232, respectively, of the belt 212 when these runs normally extend rectilinearly between the pulleys 208 and 214 and are not inwardly flexed into driving engagement with the respective pulleys 194 and 200 by belt deflectors 234 and 236, respective 17, which are in the form of rollers on a reciprocable shifter bar 238.

For driving the pulley 208 and, hence, the belt 212, the pulley 210, which turns in unison with the pulley 208, is drivingly connected by a belt 240 with a pulley 242 on the main drive shaft 56 (Figs. 1 and 2). In order to hold the belt 240 under proper tension, the same is also passed over another pulley 244 which is journalled in an extension 246 on a bearing block 248 that is guided for vertical movement in suitable ways 250 and 252 in the frame wall 18, and threadedly connected with a spindle 254 which is mounted for rotational but non-axial movement in the laterally projecting lug 258 on the frame wall 18 and carries a hand wheel 256. Thus, on turning the hand wheel 256, the belt 240 may be tensioned to any desired degree.

It follows from the preceding description that the belt-drives B for the spool-carriers A and the belt-drive 212 for the wire-guide 138 are operative when the motor 108 is running. The belt 212 moves in the direction of the arrow 259 (Fig. 2) and the feed-spindle may have a right-hand thread, so that the wire-guide 138 will be moved to the left as viewed in Fig. 1, on flexing the run 232 of the belt 212 inwardly into driving engagement with the pulley 200 as shown in Fig. 2. In thus inwardly flexing the belt run 232 into driving engagement with the pulley 200, the gear 202 turning therewith will drive the companion gear 196 and thus rotate the stub-shaft 192 and the shaft 160 which, by virtue of its splined connection 158 with the feed spindle 156, will drive the latter. Conversely, the feed spindle 156 will be driven in the opposite direction and the wire-guide 138 shifted in the reverse direction on the feed spindle, on inwardly flexing the run 230 of the belt 212 into driving engagement with the pulley 194 on the stub-shaft 192 which is directly connected with the shaft 160.

The inward flexing of the belt-runs 230 and 232 is, as previously mentioned, accomplished by the belt deflectors 234 and 236, respectively, on the shifter bar 238. The shifter bar 238 is, as shown in Figs. 1 and 3, guided for reciprocation in spaced brackets 260 and 262 on frame wall 18 and is drivingly connected at 264 with the rod 266 of a double-acting piston (not shown) in a cylinder 268 on the frame wall 18. The stroke of the piston in the cylinder 268 is such that the belt deflectors 234 and 236 flex the adjacent belt-runs 230 and 232 inwardly into driving engagement with the pulleys 194 and 200, respectively, when said piston is in its opposite end positions, respectively, in the cylinder 268.

For shifting the piston in the cylinder 268 into its opposite end positions for the purpose of causing reversals in the drive of the wire-guide 138, there is provided for the cylinder 268 a suitable valve mechanism 270 which may be of the type illustrated diagrammatically in Fig. 7. The valve mechanism 270 comprises a casing 272 with a cylindrical chamber 274 in which a valve 276 is turnable. The casing 272 is provided with ducts 278, 280, 282 and 284 of which the ducts 78, 280 and 282 are connected through suitable conduits 286, 288 and 290, respectively, with a source of fluid under pressure and the opposite ends of the cylinder 268, respectively, while the duct 284 serves as a vent. The rotary valve 276 is provided with passages 292 and 294 which, in the angular position of the valve 276 shown in Fig. 7, provide communication between the conduits 286 and 288 and between the conduit 290 and the duct 284, respectively, thereby admitting fluid under pressure to the right-hand end of the cylinder 268 as viewed in Fig. 2, and venting the opposite side of the cylinder. Accordingly, the shifter bar 238 is, in the aforementioned angular position of the valve 276 (Fig. 7), in its leftmost position shown in Fig. 2 in which the belt deflector 236 flexes the adjacent belt-run 232 inwardly into driving engagement with the pulley 200 for causing spool-traversing movement of the wire guide 138, as hereinbefore mentioned, to the left as viewed in Fig. 1. On turning the valve 276 through 90° into the dot-and-dash line position shown in Fig. 7, fluid under pressure is admitted to the left-hand end of the cylinder 268 (Fig. 2) and the opposite end of the cylinder is vented, with the result that the piston therein and the shifter bar 238 connected therewith are shifted into their opposite end positions in which the belt deflector 234 flexes the adjacent belt run 230 inwardly into driving engagement with the pulley 194 to cause, as hereinbefore mentioned, spool-traversing movement of the wire-guide 138 to the right as viewed in Fig. 1.

To index the valve 276 through 90° for the periodic reversal of the spool-traversing movement of the wire-guide 138, the valve 276 is outside the casing 272 provided with a ratchet disc 300 having in this instance four equi-angularly spaced peripheral teeth 302 with which cooperates a pivoted indexing pawl 304 on a carrier 306 that is suitably mounted for independent rotation coaxially of the valve 276. The indexing pawl 304 is normally urged against the ratchet-disc 300 by a spring 307. The pawl carrier 306 is connected by a link 308 with the core 310 of a solenoid 312 having the usual winding 314. On energization of the solenoid winding 314 the core 310 will be retracted, with the result that the pawl 304 will index the ratchet disc 300 through 90° and turn the valve 276 to the same extent. To prevent backing-up of the ratchet disc 300, and hence of the valve 276, during the idle return of the indexing pawl 304 into operative engagement with the next succeeding tooth 302 on the ratchet disc, there is provided a pivoted and spring-urged backing pawl 318 on a fixed support 320. The circuit of the solenoid winding 314 includes any suitable source of electric power (not shown) and a normally open switch 322 (Figs. 1 and 3) which, on being closed in a manner to be described, will close the circuit of the solenoid winding 314.

Carried by one of the tie-rods of the transfer-unit **164**, in this instance the tie-rod **170**, are blocks **324** and **326** which have adjacent cam-edges **328** and **330**, respectively, adapted to actuate an arm **332** of the switch **322** and close the latter at the end of each spool-traversing movement of the wire-guide **138**. To this end, the blocks **324** and **326** are longitudinally adjustable on the tie-rod **170**, and are so spaced from each other that the switch **322** will be closed and the direction of travel of the wire-guide **138** reversed, every time the wire guided onto the spool **40** on the adjacent carrier A reaches either end of the spool. In view of the foregoing, it is evident that the length of the spool-traverse movement of the wire guide **138** may be adjusted to accommodate spools of varying widths by simply adjusting the blocks **324** and **325** on the tie-rod **170**.

Shifting device E for wire-guiding mechanism C

Referring now to Figs. 1 and 3, there is shown a cylinder **340** receiving a double-acting piston **342** the rod **344** of which is connected at **346** with the transfer unit **164**. The cylinder **340** is provided with saddle-like brackets **348** and **350** which are fixedly mounted on the rods **150** and **152**. The opposite ends of the cylinder **340** are, through hose connections **352** and **354**, connected with a valve (not shown) which is in communication with a source of fluid under pressure. The valve is preferably manually operable to admit fluid under pressure into one end of the cylinder **340** and vent the opposite end thereof, and vice versa, thereby to shift the transfer unit **164** into two end positions in which the wire-guide **138** is in operative alignment with the spools **40** on the carriers A, respectively. The left end position of the transfer unit **164**, as viewed in Fig. 1, is determined by the left end of the cylinder **340** and is, hence, invariable. The maximum stroke of the piston **342** in the cylinder **340** exceeds the maximum distance through which the transfer unit **164** has to travel in order to be in operative alignment with spools of minimum widths on the carriers A, respectively. In order to stop the transfer unit **164** in various right end positions as viewed in Figs. 1 and 3, so that the wire guide **138** may be in correct operative alignment with spools of varying widths on the carrier A', the transfer unit **164** will move against longitudinally adjustable stop collars **356** and **358** on the rods **150** and **152**, respectively.

In order to adapt the instant apparatus for winding wire on spools of different arbor diameters, recourse may be had to replaceable mandrels **38''** in a hollow shaft **36'** in either of the carriers A (Fig. 8). The hollow shaft **36'** carries the pulley **80'** which is adapted for driving engagement with the adjacent belt drive B in the winding position of the carrier. The replaceable mandrels **38''**, of which one is shown in Fig. 8, have different diameters for the reception of spools of different arbor diameters, respectively, but have identical shanks **360** for removable fitted reception in the same hollow shaft **36'** in the carrier. The end of the shank **360** of each mandrel **38''** is threaded for the reception of a nut **362** by means of which to hold the shank **360** securely in the hollow shaft **36'** in the carrier. More particularly, the shank **360** of each replaceable mandrel **38'** is provided with a plate or disc **364** having lugs **366** for driving engagement with the adjacent end disc of a spool on the mandrel, and the plate or disc **364** is drawn into firm engagement with the adjacent end of the hollow shaft **36'** on tightening the nut **362** against the opposite end of the hollow shaft **36'**.

Mode of operation

Assuming that the spool **40** on the carrier A'' is fully wound with wire and that the apparatus has been stopped after a prolonged run, the carrier A'' is shifted into its idle position by appropriate action of the piston in the coordinated cylinder **88**, while the carrier A' is shifted into its winding position as shown in Figs. 1 to 3, by appropriate action of the piston in the coordinated cylinder **88**, in order that the empty spool on the latter carrier may not interfere with the removal of the full spool from the carrier A''. Prior to the removal of the full spool from the carrier A'', the wire leading to the latter spool is severed.

For resuming an operating run of the apparatus, the transfer unit **164** may, by appropriate manually controlled action of the piston **342** in the cylinder **340**, be shifted into operative alignment with the empty spool on the carrier A', and the latter may be returned to its idle position for suitable anchorage of the supply wire W on the empty spool. The motor **108** of the apparatus may now be started in order to render the belt drives B and the belt drive **212** operative. On subsequently shifting the carrier A' into its winding position, the empty spool **40** thereon will be driven from the adjacent belt drive B so that the wire W will be wound thereon. Since the wire guide **138** will continuously reciprocate on the feed spindle **156** of the transfer unit **164** while the motor **108** is running, the wire guide may be in any momentary position intermediate the width of the spool on the carrier A' when the latter is shifted into its winding position, with the result that the turns of the first wire layer on the spool may be evenly deposited over a part only of the width of the spool. However, the turns of all subsequent layers of wire on the spool will be evenly distributed throughout the width of the latter, as will be readily understood.

While the carrier A' is in its winding position, the travel of the wire-guide **138** on the feed-spindle **156** will periodically be reversed by the hereinbefore described operating and control means D on successive closures of the switch **322** by the cam edges **328** and **330** of the blocks **324** and **326**, respectively, on the transfer unit **164**, so that the wire will, except perhaps in the first layer thereof on the spool, be evenly distributed in the remaining layers throughout the width of the spool.

The even distribution of the wire in the successive layers on the spool is assured by virtue of the driving connection of the adjacent belts **50** with the pulley **80** on the carrier, rather than with the spool thereon, so that any possible variation in the drive due to the increasing diameter of the wound wire thereon will not in the least interfere with the even distribution of the wire in the successive layers on the spool.

While the spool on the carrier A' is being wound with wire, the carrier A'' remains in its idle position. After completion of the wire-winding operation on the spool of the carrier A', the latter is shifted into its idle position, whereby its brake mechanism **112** will act immediately to stop the full spool to permit the severance of the wire leading thereto. Immediately thereafter, and while the apparatus remains in operating condition, the transfer-unit **164** is, by appropriate manually controlled action of the

piston 342 in the cylinder 340, shifted into operative alignment with the empty spool on the carrier A'', whereupon the severed end of the supply wire is suitably anchored to the latter spool. The carrier A'' is next shifted into its winding position to be wound with wire. While the carrier A'' is in its winding position and the spool thereon is being wound with wire, the full spool on the other carrier A' in its idle position may be removed and replaced with an empty spool to be wound with wire on the following spool winding cycle of the apparatus. The spools on the carriers A' and A'' may thus alternately be wound with wire and replaced by empty spools. More particularly, the spool on one carrier may be wound with wire, while a full spool on the other carrier may be removed and replaced with an empty spool, and vice-versa.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. In wire-spooling apparatus, the combination of two spaced belt-drives having adjacent belt-runs in substantially the same plane; two spaced carriers, each carrier having a rotary mandrel carrying a pulley and being adapted for removably carrying a spool, said carriers being movable to and from winding positions in which their mandrels are in substantial axial alignment and their pulleys are in driving engagement with said belt-runs, respectively; a rotary shaft extending substantially parallel to the mandrels on said carriers; a guide-unit comprising an externally-threaded sleeve splined to and axially slidable on said shaft and a wire-guide threadedly received by said sleeve and held against rotation therewith so as to be moved axially thereon on rotation of said sleeve and shaft; first means for shifting said sleeve on said shaft into two positions in which said wire-guide is in operative alignment with drums on said carriers, respectively; and other means for driving said shaft in opposite directions to cause reciprocation of said wire-guide for its widthwise traverse of the drum on either carrier.

2. The combination in wire-spooling apparatus as set forth in claim 1, in which said other means comprise another belt-drive having other opposite runs, two other pulleys located adjacent but out of driving engagement with said other belt-runs, respectively, and carrying gears, respectively, in permanent mesh with each other, one of said other pulleys being drivingly connected with said shaft; a belt-run shifter having two idler pulleys and being movable in opposite directions to cause the latter to deflect said other belt runs into driving engagement with said other pulleys, respectively, a fluid-cylinder and a double-acting piston therein connected with said shifter, a valve-means for admitting fluid under pressure into either end of said cylinder and venting the opposite end thereof, and means actuating said valve-means at the end of each spool-traverse of said wire-guide.

3. In wire-spooling apparatus, the combination of two carriers having rotary mandrels, respectively, each for removably carrying a spool, said carriers being individually movable to and from winding positions in which their respective mandrels are driven and extend in substantial axial alignment with each other; a rotary shaft extending substantially parallel to the mandrels on said carriers; a guide-unit comprising an externally-threaded sleeve splined to and axially slidable on said shaft and being of a length in excess of the width of a drum on either carrier, and a wire-guide threadedly received by said sleeve and held against rotation therewith so as to be moved axially thereon on rotation of said sleeve and shaft; first means for shifting said sleeve on said shaft into two positions in which said wire-guide is in operative alignment with drums on said carriers, respectively; and other means for driving said shaft in opposite directions, while said sleeve is in either of said two positions, to cause reciprocation of said wire-guide for its widthwise traverse of a drum on either carrier.

4. The combination in wire-spooling apparatus as set forth in claim 3, in which said other means comprise a reversible drive for said shaft, a device operative to reverse said drive, an electric switch carried by said wire-guide and adapted on each actuation thereof to render said device operative, and two switch-actuators carried by said sleeve in spaced relation longitudinally of the latter and adapted to actuate said switch at the ends of successive spool-traversing movements, respectively, of said wire-guide.

5. The combination in wire-spooling apparatus as set forth in claim 3, in which said other means comprise a reversible drive for said shaft, a device operative to reverse said drive, an electric switch carried by said wire-guide and adapted on each actuation thereof to render said device operative, and two switch-actuators carried by said sleeve in adjustable spaced relation longitudinally of the latter and adapted to actuate said switch at the ends of successive spool traversing movements, respectively, of variable lengths.

6. The combination in wire-spooling apparatus as set forth in claim 3, in which said other means comprise a belt-drive having opposite runs, two first pulleys located adjacent but out of driving engagement with said belt-runs, respectively, and carrying gears, respectively, in permanent mesh with each other, one of said pulleys being drivingly connected with said shaft, a belt-run shifter having two idler pulleys and being movable in opposite directions into opposite end positions in which said idler pulleys deflect said belt-runs into driving engagement with said first pulleys, respectively, a device operative to move said shifter alternately into said end positions, an electric switch carried by said wire guide and adapted on each actuation thereof to render said device operative, and two switch-actuators carried by said sleeve in spaced relation longitudinally of the latter and adapted to actuate said switch at the ends of successive spool-traversing movements, respectively, of said wire-guide.

7. In wire-spooling apparatus, the combination of a drive comprising spaced V-type pulleys, of which one is driven, and a double V-type belt passing over said pulleys; a carrier having at one side of said belt a rotary mandrel carrying another pulley having a V-groove and being adapted for removably carrying a spool, said carrier being movable to and from a winding position in which the V-groove of said other pulley is in driving engagement with the adjacent run of said belt; a wedge-shaped brake-shoe having a shank guided on said carrier for movement

of said brake-shoe into and from braking engagement with the V-groove in said other pulley; a spring for normally urging said brake-shoe into braking engagement with said other pulley; a toggle-joint connected at its ends with said carrier and brake-shoe shank, respectively; and a fixed stop engaged by and actuating said toggle-joint to retract said brake-shoe from braking engagement with said other pulley on movement of said carrier into said winding position.

8. In wire-spooling apparatus, the combination of an uprising frame pivoted at its bottom about a substantially horizontal axis; a belt drive having an ascending belt run; a mandrel journalled in the top of said frame and extending substantially parallel to the pivot axis of said frame; a pulley on said mandrel, the latter being adapted for removably carrying a spool at one side of said pulley, and said frame being swingable to and from a winding position in which said pulley is in driving engagement with said belt run and said frame leans toward the latter at such an inclination that the gravity of said frame and the parts carried thereby solely retain said pulley in driving engagement with said belt run; and power means operative to swing said frame from winding position and toward winding position and release said frame for gravity return into winding position on its swing toward winding position by said power means.

9. In wire-spooling apparatus, the combination of an uprising frame pivoted at its bottom about a substantially horizontal axis; a belt-drive having an ascending belt-run; a mandrel journalled in the top of said frame and extending substantially parallel to the pivot axis of said frame; a pulley on said mandrel, the latter being adapted for removably carrying a spool at one side of said pulley, and said frame being turnable to and from a winding position in which said pulley is in driving engagement with said belt-run and said frame leans toward the latter at such an inclination that the gravity of said frame and the parts carried thereby solely retain said pulley in driving engagement with said belt-run; a cylinder; a double-acting piston therein having a floating pivot connection with said frame; and means operable to control the ingress of fluid under pressure into, and its egress from, the ends of said cylinder for turning said frame to and from its winding position, the stroke of said piston being such that the latter will turn said frame toward its winding position, but will reach its corresponding end position before said frame reaches said winding position whereupon said frame is permitted to gravitate into its winding position by said floating pivot connection between piston and frame.

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