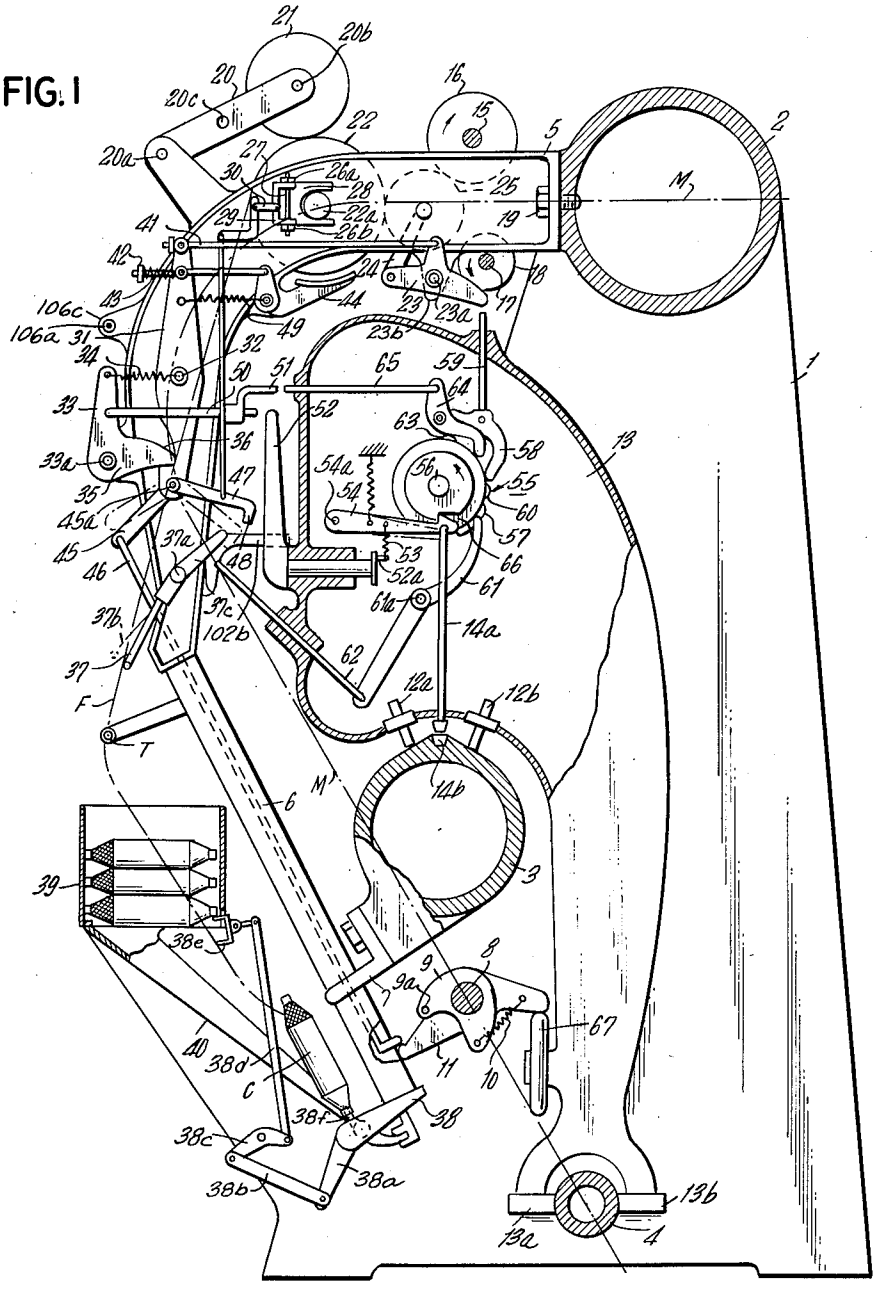
May 8, 1962 S. FÜRST 3,033,478

AUTOMATIC YARN-PACKAGE WINDING MACHINE

Filed March 10, 1959 3 Sheets-Sheet 1

FIG. 1

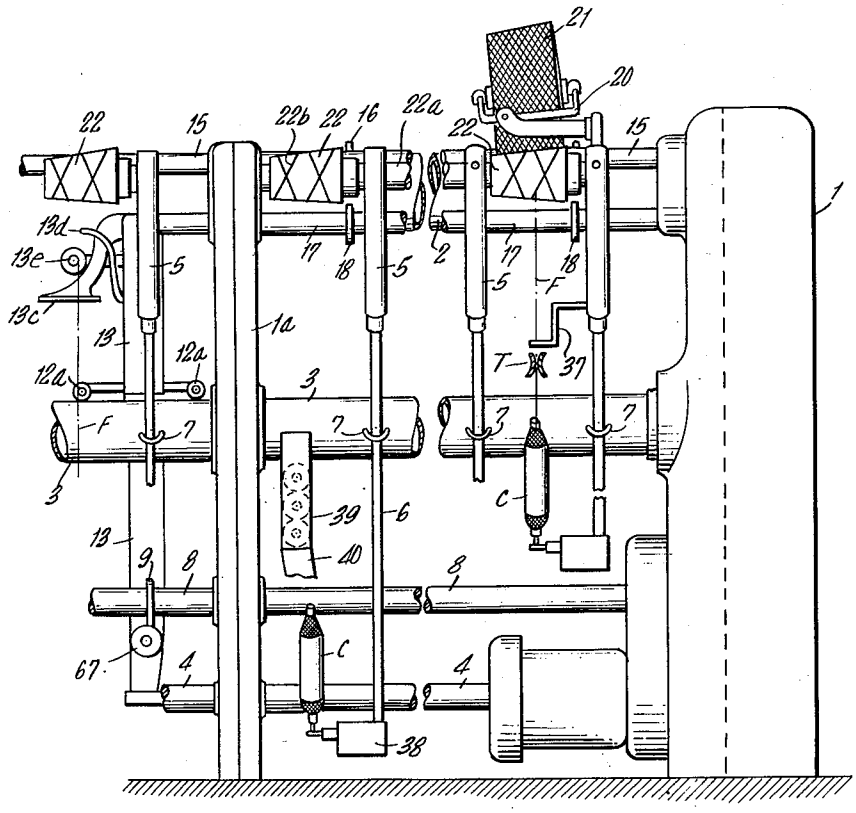


May 8, 1962 S. FÜRST 3,033,478

AUTOMATIC YARN-PACKAGE WINDING MACHINE

Filed March 10, 1959 3 Sheets-Sheet 2

FIG. 2

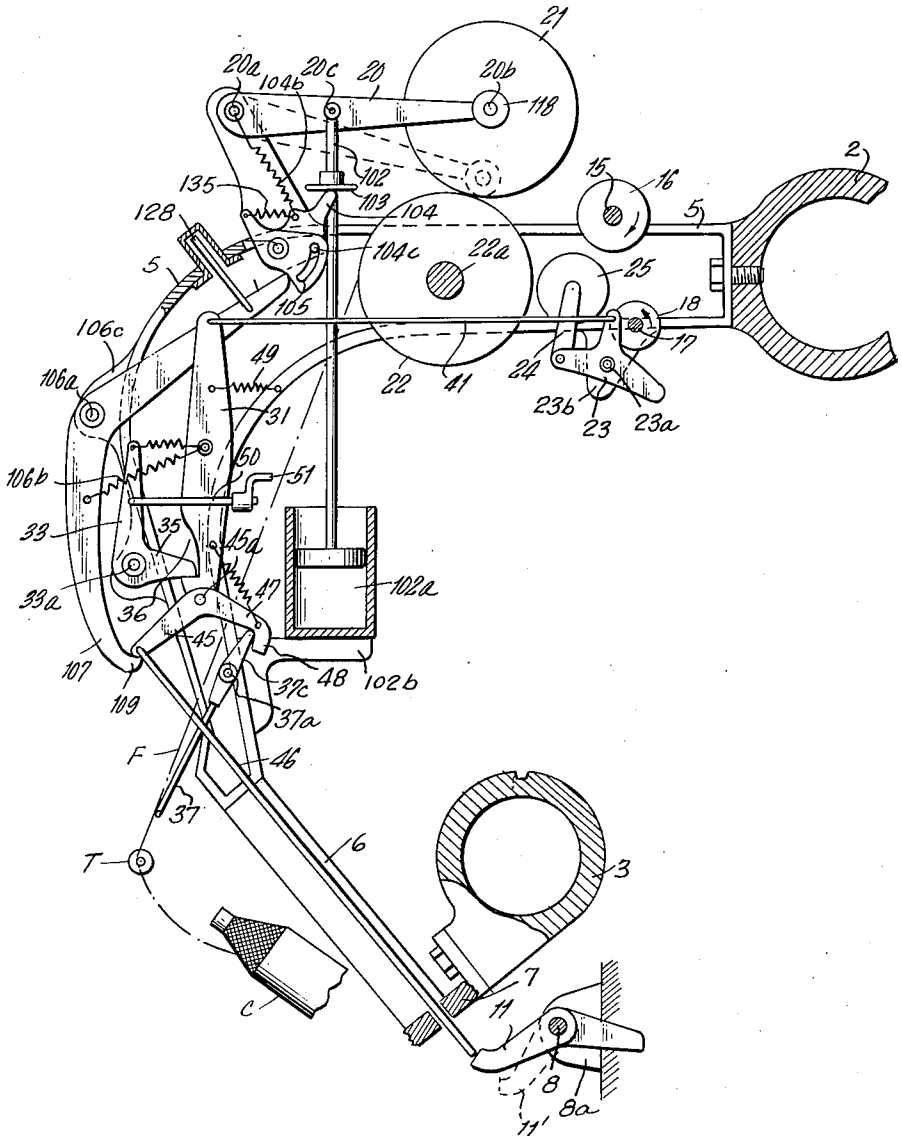


May 8, 1962 S. FÜRST 3,033,478

AUTOMATIC YARN-PACKAGE WINDING MACHINE

Filed March 10, 1959 3 Sheets-Sheet 3

FIG. 3



United States Patent Office 3,033,478 Patented May 8, 1962

3,033,478

AUTOMATIC YARN-PACKAGE WINDING MACHINE

Stefan Fürst, Monchen-Gladbach, Germany, assignor to Walter Reiners, Monchen-Gladbach, Germany

Filed Mar. 10, 1959, Ser. No. 798,406
Claims priority, application Germany Mar. 10, 1958
22 Claims. (Cl. 242—35.6)

My invention relates to winding machines for rewinding relatively small packages of yarn, such as spinning cops, into larger packages of a desired type and size, such as cross-wound coils also called "cheeses." In a more particular aspect, my invention concerns yarn-winding machines that comprise a multiplicity of individually operable winding stations which are provided with feeder means for dispensing yarn-supply coils to the stations, and with a mobile servicing unit or "tender" that periodically travels along a group of stations and automatically performs such servicing operations as may be needed in any individual station for returning it to operative condition after occurrence of fault or stoppage.

Such fault or stoppage in an individual winding station, to be eliminated by automatic operation of the servicing unit, may come about because of yarn breakage or because the spinning cop or other supply coil becomes depleted and must be exchanged for a new yarn supplying coil. In any such case, a yarn guard, consisting of a sensitive feeler biased into engagement with the normally taut yarn, will deflect in response to absence of the yarn; and the deflecting motion is utilized for controlling the mobile servicing unit, when it next approaches the disturbed winding station, to automatically eliminate the stoppage either by tying the broken yarn ends together, or by effecting an exchange of the depleted supply coil before joining its yarn with that of the take-up spool.

In known multi-station machines of the above-mentioned type, the new supply coils are conveyed to the individual winding stations on the same side of the machine where the travelling servicing unit acts upon the winding stations and where the machine must be supervised or serviced by the attending personnel. This is an impediment to the activities to be manually performed by the personnel who from time to time may have to remove the finished yarn packages and insert new spool cores for the new packages to be wound. Furthermore, the device for feeding new supply coils to the winding stations, regardless of whether the feeder device is a chute, coil magazine or endless belt, occupies space at the same location where the mobile servicing unit must be able to travel in order to eliminate any disturbances in the above-described manner. This results in an intricate construction and makes access to the interior components of such a machine rather difficult.

It is an object of my invention to minimize or virtually eliminate these difficulties.

Another object of my invention is to improve the design and economy of the automatic control devices that come into play whenever an individual winding station requires one or more servicing operations to eliminate a yarn fault or other cause of stoppage. The latter object will be further explained presently.

There are known winding machines in which a central control device, in response to the action of sensing or checking members, performs a number of servicing activities in a predetermined sequence, whenever called upon to operate. The entire servicing program, comprising several different servicing activities, will always run off regardless of whether each particular servicing activity has become necessary and is being utilized at a time. However, some of the servicing activities available in the

machine are needed more often than others. For example, the yarn-end knotting device must operate more often in response to yarn breakage than the device for replenishing a depleted yarn supply coil is called upon to act. Thus, when using good quality yarns, it may be necessary to eliminate yarn breakage by a knotting operation about once for each third supply coil, in addition to the normal tying operations resulting from a supply-coil exchange. But this ratio is more unfavorable with low-quality yarns which may involve many more breakages. The frequency at which the take-up spool is completely filled and must be exchanged for an empty spool core is still smaller than that of the supply-coil exchanging operations. For example, when large yarn packages such as "cheeses" are being wound, approximately ten spinning cops may be consumed before it becomes necessary to remove the completed yarn package. It is apparent therefore, that automatic control means which, each time they are called upon to operate, go through a complete cycle of all available servicing actions, although only one of them may be utilized at a time, involve undesirable waste of time. In multi-station winding machines with a traveling servicing unit, such limited efficiency is tantamount to placing an appreciable limitation upon the number of individual winding stations that can be economically serviced by a single servicing unit.

It is, therefore, a more specific object of my invention to provide service-operation control means that secure a more economical performance by permitting only those servicing actions to be performed as are necessary at a time.

Another more specific object is to have the individual service-operations performed independently of one another but in such a manner that they cannot take place simultaneously and hence cannot interfere with each other.

Relating to the above-mentioned objects of improved accessibility and reduced space requirements, it is a feature of my invention to mount the mobile tender and the feeder device for the yarn supply coils on opposite sides respectively of the yarn path extending in each winding station between the supply coil and the take-up spool. In such a machine the yarn remains freely accessible, the mobile tender and the feeder device do not interfere with each other, and the winding machine can be given a more compact design. This is of particular advantage in cases where new supply coils are furnished to the winding station from a magazine that accommodates a number of reserve coils, or where the supply coils are fed to the stations by means of an endless belt. The mobile tender is preferably located on the rear side of the yarn path, whereas the coil feeder means are located in front where the yarn is accessible to the attendant personnel.

According to another feature of my invention, the space requirements of the machine are minimized by mounting the components of each individual winding station on a supporting frame or arm structure whose transverse cross section has a center line of folded or curved shape, similar to the shape of a 7, S or Z. With such a design, the magazine or other feeder means for the supply coils can be located, at least partially, in the area near the lower portion of the curved shape, whereas the mobile tender is made to travel in the upper angle or bight space, and the components for winding the take-up spools, such as the take-up spool holder, yarn guide and winder drive, are mounted on the upper curved portion of the structure. With such a design, the space directly beneath the forwardly protruding yarn guiding drum remains vacant so that the yarn seeking or gripping device of the mobile tender can swing beneath the yarn-guiding drum up to the take-up spool in order to entrain the yarn end therefrom. Another gripper, turning in a different direction, then seeks and entrains the yarn end

of the supply coil, whereafter both yarn ends are tied together in the knotter of the tender.

According to another feature of my invention the above-mentioned supporting arm structure of each individual winding station with all station components mounted thereon, is removable from the main frame structure of the multi-station machine without requiring removal or change of any parts needed for continued winding operation of the other winding stations. The individually removable arm structure may form a box for protection of the components mounted within it, and is preferably narrow in comparison with its horizontal depth, occupying not more than one-half of the width or mutual center spacing of an individual winding station measured in the longitudinal direction of the multi-station machine.

The individual supporting arm structures of the respective winding stations are preferably fastened to a top carrier which extends above the track for the mobile tender and from which the arm structures protrude toward the front of the machine and then downwardly so as to form approximately a one-quarter circle with a downwardly extended outrigger portion. The components accessible from the front, including the yarn-guiding drum, the drive shaft for the drum, and the journalling frame for the take-up spool, are preferably mounted in or on the upper portion of the supporting arm structure, whereas the control components to be acted upon by the mobile tender are disposed in the lower portion of the arm structure. If desired, a manually actuable control member may also be mounted on the outer side of the lower arm portion.

According to still another feature of my invention, the machine is provided with two parallel drive shafts common to all winding stations and running continuously in mutually opposed directions, and each winding station has a coupling roller normally driven from one shaft for rotating the take-up spool in the winding sense but temporarily engageable with the other shaft for reversing the take-up spool whenever its yarn end is to be unwound for tying it together with the yarn coming from the supply coil. More specifically, the coupling roller is mounted on the above-mentioned arm structure of each winding station so that removal of the structure has the effect of uncoupling the station from the common winder drive without affecting the other winding stations.

According to a further feature of my invention, the winding operation in each winding station is continually checked by a reciprocating checking motion which controls a movable member to periodically enter into the deflecting path of the yarn-absence responsive yarn guard in order to sense whether or not the guard has responded, and which, when thus encountering the responded yarn guard in deflected in position, acts as a force relay to displace a control member which stops the winding operation in the affected station and prepares it for servicing by the mobile tender. According to another feature, more specific than the one last mentioned, the periodic checking motion is produced in each station by an oscillating control shaft which is common to a group or all of the stations and serves also to provide the motive power for the fault-responsive displacement of the above-mentioned service control member. Preferably the same oscillating control shaft is also used for driving a normally active device for periodically reciprocating the yarn guiding drum in its axial direction a slight amount relative to the take-up spool to thereby obtain a desired irregularity in the distribution of the yarn turns.

In order to prevent the periodic checking operation from interfering with any servicing operation of the tender, and according to another feature of the invention, the tender is provided with means that temporarily put the normally oscillating devices of an individual winding station out of operation as long as the tender is in the vicinity of that station, without disturbing the action of the oscillating control shaft upon the other stations.

The mentioned movable control member for controlling the winder drive and preparing a stopped winding station for servicing by the tender is preferably also feed-back controllable by the tender itself and, if desired, is also controllable manually. According to another, more specific feature this control member, hereinafter referred to as "main" control member, is pivotally mounted and capable of different amounts of pivotal deflection under control by respectively different sensing or checking means, and thus acts to release respectively different control or servicing operations in the winding station and/or in the mobile tender, depending upon the amount of pivotal deflection. Due to such discriminating control performance of the main control member it selects the servicing operation first to be performed or selects only one of the various operations of which the winding station and tender are capable.

As explained, the main control member is controlled by the yarn guard which engages the yarn during winding operation and responds to absence of yarn due to yarn breakage or depletion of the supply coil. However, according to another feature of my invention, the same main control member is also connected with, and controlled by, a sensing means which responds to the change in diameter of the yarn package being built up on the take-up spool, and which, when the package is filled, deflects the main control member for causing it to stop the winding operation. The spool-diameter responsive means may further act to shift the main control member to a position in which the yarn-engaging guard is locked in position of normal winding operation.

It is further preferable to provide the spool-diameter responsive sensing means with a signal which indicates that the take-up spool is completed and that the attendant is to manually exchange the take-up spool for an empty core. After exchange, the locking of the yarn guard must be eliminated which can be done manually, for example by actuating a pushbutton, or by automatic means. The invention, of course, is also applicable to machines in which the exchange of the take-up spool is effected automatically under control by the above-mentioned diameter-responsive sensing means.

It is another feature of the invention to provide the machine with periodic control means which, during winding operation, intermittently disengage the winder drive from the take-up spool to permit stopping the spool or manually modifying its operation in the short idle intervals by means of only slight controlling force. Preferably the above-mentioned reciprocating checking motion is additionally used for oscillating the main control member an amount too slight for stopping or reversing the winder drive or initiating any servicing operation of the tender but sufficient to intermittently disengage the intermediate coupling roller from the common winder drive of the machine.

The foregoing and other objects, advantages and features of my invention will be apparent from, and will be described in, the following with reference to the embodiment illustrated by way of example on the accompanying drawings in which:

FIG. 1 shows a cross-sectional side view of a multi-station winding machine according to the invention, some of the components being omitted for the purpose of a more lucid illustration.

FIG. 2 is a schematic and fragmentary front view of the same winding machine.

FIG. 3 illustrates schematically the relationship between some of the components shown in FIGS. 1 and 2, together with further components omitted in the preceding figures.

The illustrated machine comprises lateral frame structures 1 (FIGS. 1, 2) which are rigidly joined with a tubular carrier beam 2 extending along the top of the machine,

another tubular beam 3 which forms a runway for the mobile servicing unit described below, and a likewise tubular rail 4. The tubular structures 2, 3 and 4 extend horizontally parallel to each other along all individual coil winding stations of the machine. Fastened to the tubular top beam 2 at each individual winding station is a rigid arm 5 of arcuate shape which is preferably designed as a box structure and extends from beam 2 forward and downward. The lower end of arm structure 5 carries a tubular sleeve 6 which is joined with beam 3 by a bracket 7.

A control shaft 8, which during operation of the machine continuously turns a given angle forward and back, extends parallel to the top beam 2 between the lateral frame structures of the machine. Aside from being journalled at its ends, the oscillating shaft may also be supported in bearings between the individual winding stations, such as at 1*a* (FIG. 2), depending upon the length of the shaft. Firmly mounted on shaft 8 at each winding station is an entrainer 9 which is joined by a spring 10 with a swing arm 11 rotatably seated on shaft 8 and normally held by a spring 10 against a stop 9*a* of the entrainer 9. During the oscillatory movement of shaft 8 and entrainer 9, the arm 11 is normally free to be carried along for the actuation of testing means described below.

The machine is provided with a mobile tender 13 which has two pairs of running wheels 12*a*, 12*b* seated upon the track formed by the tubular beam 5. If desired, one of the running wheels of each pair may be made removable by giving it a stuck-in axle, thus facilitating the removal or insertion of the tender. Journalled on the lower bifurcated end of the tender 13 are guide rollers 13*a* and 13*b* which rest against opposite sides of the guide rail 4 thus maintaining the tender in proper position during its travel. During operation of the machine, the tender 13 travels along the individual winding stations from a starting position to an end position and then returns to the starting position, and so forth; and is temporarily arrested in front of any one winding station that may require servicing at the time. The means for driving the tender 13 along the track beam are not illustrated and described herein because they are not essential to the present invention proper and may be identical with those illustrated and described in the copending application of S. Fürst and M. Rühl, Serial No. 796,049, filed February 27, 1959.

The travel of the tender 13 is automatically stopped in the proper servicing position relative to a winding station by means of a latch rod 14*a* (FIG. 1) whose latch end enters into a recess 14*b* of the track beam 3. In this position, the yarn-end seizing devices of the tender 13, preferably consisting of air suction nozzles as shown at 13*c* and 13*d* in FIG. 2, can operate under control by a start-stop cam mechanism 55 to suctionally entrain the yarn end of the take-up spool and the yarn end of the supply coil and to place both into the action range of a knotting device 13*e* which ties both ends together similarly to the device of application Serial No. 796,049, referred to above.

A winder drive shaft 15, continuously rotating during operation of the machine, extends above arm structure 5 in parallel relation to the axis of the top beam 2 and carries at each individual winding station a friction roller 16. Located beneath arm 5 is another drive shaft 17 which likewise rotates continuously during operation of the machine, but in a direction opposed to that of the shaft 15. Shaft 17 carries at each individual winding station a friction roller 18. The two shafts 15 and 17 are journalled in the lateral frame structures of the machine independently of the carrier arms 5. If necessary, the shafts 15 and 17 may also be supported by bearings on other locations, for example at 1*a*, between two winding stations. Each carrier arm 5, after loosening a pair of screw bolts of which one is shown at 19 (FIG. 1) can be removed from the top beam 2 without loosening or changing any part required for the continued operation of the other winding stations.

A frame 20 is pivotally mounted at 20*a* on arm 5 and forms a journal at 20*b* for the take-up spool 21 of the winding station. Also journalled on arm 5 is a yarn guiding drum 22 with a drum shaft 22*a*. A three-armed lever 23 is pivoted at 23*a* to the carrier arm 5 and is connected by a link 24 with an intermediate friction roller 25. When lever 23 is in the position shown in FIG. 1, the intermediate roller 25 couples the friction roller 16 on shaft 15 with the guiding drum 22. The take-up spool 21, gravity biased against the periphery of drum 22, is then entrained in the winding-up direction, and the guiding groove 22*b* (FIG. 2) extending about the periphery of the guiding drum and forming a loop closed upon itself, reciprocates the incoming yarn back and forth along the take-up spool, thus producing the desired cross-wound yarn package.

When the lever 23 is turned counterclockwise about its pivot 23*a* (FIG. 1), the intermediate roller 25 is removed from roller 16 and instead placed in coupling engagement with the reversely driven roller 18 so that now the guiding drum 22 and the entrained take-up spool 21 rotate in the unwinding direction. This is done only temporarily whenever it is necessary to unwind a certain length of yarn from the take-up spool for the purpose of tying the yarn together with that coming from the supply coil, as will be more fully explained hereinafter.

The carrier arm 5 is further provided with fixed bearings 26*a*, 26*b* in which a vertical pivot shaft 27 is mounted. A fork member 28 of angular shape is pivoted on shaft 27 and straddles the drum shaft 22*a*. The lever arm 23 (FIG. 1) has its shaft 23*a* fastened to the outrigger carrier arm 5. A nose 23*b* (FIG. 3) on the carrier arm 5 supports the pivot shaft 23*a*. A portion 29 of member 28, extending at a right angle to the bifurcated portion, is connected by a link 30 with a mechanism, described below, which causes the member 28 to reciprocate parallel to the axis of the drum shaft 22*a*. During such reciprocation, the bifurcated portion of member 28 displaces the drum shaft 22*a* with drum 22 in the axial direction slightly toward the right or left (relative to FIG. 2) thus periodically displacing the reversing points of the guiding groove 22*b* for better distributing the winding turns on the yarn package being produced and avoiding pattern wind.

The arm structure 5 further carries a main control lever 31 which is biased by a spring 49 for clockwise motion about a pivot 32. Also mounted on arm structure 5 is a latch member 33 pivoted at 33*a* and biased by a spring 34 for engagement of its latch arm 35 with a catch recess 36 of control lever 31.

Pivoted at 37*a* to the lower end of arm structure 5 is a yarn guard 37 which is normally biased into feeling engagement with the yarn F coming from the supply coil C and passing over the guiding drum 22 onto the take-up spool 21. In the event of yarn breakage or when the supply coil C is exhausted, the guard 37 responds to the absence of yarn by turning clockwise into the position schematically shown at 37*b* (FIG. 1). As will be further explained below, such deflection of the yarn guard has the effect of stopping the winding operation of the winding station and causing the tender 13, upon its next passage, to become arrested at the winding station and to reestablish proper winding conditions.

The tube 6 attached to the lower end of arm structure 5, carries at its bottom a holder 38 for accommodating the above-mentioned yarn-supply coil C, such as a spinning cop. As shown in FIG. 1, holder 38 has a bobbin peg 38*f* on which coil C is supported. An arm 38*a* of holder 38 is linked through elements 38*b*, 38*c*, 38*d* to escapement lock 38*e*, so that actuation of holder 38 to rotate bobbin peg 38*f* causes escapement lock 38*e* to release a full coil 3C from the magazine 39. The cop is

supplied to the holder 38 from the magazine 39 through a chute 40 which forms a slideway for an individual coil issued at a time from the magazine. Magazine 39 and chute 40 are attached to the frame structure 1, in the position shown in FIG. 1. The removal of a depleted coil C is effected, for example by control devices as described and illustrated in my co-pending application Serial No. 704,983, filed December 24, 1957, and Serial No. 728,139, filed April 4, 1958, both assigned to the assignee of the present invention.

A horizontal pusher rod 41 links one arm of drive control member 23 with the main control lever 31. The main control lever 31 is further connected by an intermediate spring 43 and another pusher rod 42 with a brake shoe 44. When control lever 31 is turned a sufficient amount counterclockwise, the brake shoe 44 places itself against the yarn-guiding drum 22 for stopping its rotation.

The brake 44 (FIG. 1) remains applied when the intermediate roller 25 engages the rollers 18 and 22. With this engagement of roller 25 with rollers 18 and 22, the spool 21 is turned in the reverse direction to some extent, so that the end of the wound-up yarn can be seized and conveyed to the knotting device. This reverse rotation is effected in opposition to the braking action of the brake 44. However, the braking action of brake 44 is not so strongly effective as to prevent a rotation of the roller 22, but is only called upon to shorten the coasting time of this roller when the machine is brought to a standstill. When this roller 22 is turned in the reverse direction by roller 18 acting through the roller 25, this reverse rotation can, therefore, take place in opposition to the braking effect of the brake 44. This has the advantage that the roller will stop immediately as soon as the reverse rotation is terminated. Such immediate stopping of roller 22 is necessary because the knotting operation is already commenced by the end of the reverse rotation. If the roller 22 were not stopped by the brake 44 but, during reverse rotation would continue to run an additional extent, then the yarn pulled from the take-up spool would not remain taut but would become slack.

Pivoted to the lower end of main control lever 31 is a bell crank lever 45 to which a reciprocating movement is imparted by a linking rod 46 that passes through the tube 6. This reciprocating motion is transmitted from the oscillating control shaft 8 and the sensing arm 11 onto a lug at the lower end of rod 46 and takes place whenever, and as long as, the swing arm 11 is free to participate in the oscillation of the entrainer 9, this being the case when the tender 13 is not located at the winding station. The oscillatory motion of swing arm 11, rod 46 and bell-crank lever 45 ceases when a wheel 67 on the approaching tender forces the swing lever 11 counterclockwise out of engagement with the entrainer stop 9*a*, this condition being shown in FIG. 1.

The linking rod 46 is acted upon by the dog member or swing arm 11 which, during operation of the machine is kept reciprocating on its shaft 8 for the purpose of imparting to the lever 45 an oscillating motion serving to test the operating condition of the winding station and, as the case may be, to effect the stoppage of the winding operation in the station upon occurrence of yarn breakage or supply-coil depletion or completion of a yarn package on the take-up spool.

During operation of the machine, the shaft 8 (FIGS. 1, 2) is continuously reciprocated, as previously mentioned, through a given angle, by means of a crank at the end of shaft 8, which crank is eccentrically connected to a motor driven gear in a known manner. As shaft 8 rocks back and forth, the swing arm or dog 11 rocks with it. Rod 46, which normally rests on dog 11, is thus longitudinally oscillated by dog 11 and transmits this oscillating motion to the lever 45 (FIG. 1).

The right arm 47 of bell-crank lever 45 forms at its end a lug 48 which, when the yarn guard 37 is in position of normal operation, can catch behind the arm 37*c* of the yarn-guard whenever, during the above-mentioned oscillating movement of lever 45 about its pivot 45*a*, the arm 47 is in lowermost position. However, when the yarn guard 37 is deflected to the position 37*b* due to breakage or absence of yarn, the lug 48, during its clockwise stroke will place itself upon the tip of the arm 37*c*. This has the result that during the oscillating motion imparted to lever 45 by rod 46, a pushing force is exerted by lever arm 47 upon the lower end of the main control lever 31 with the effect of turning the control lever 31 counterclockwise in opposition to the biasing spring 49. This releases the pawl arm 35 of latch member 33 from the catch recess 36 of control lever 31. Consequently, the control lever 31 remains deflected in the counterclockwise direction until, at a later time, the control lever 31 is pushed back to the original position.

The just-mentioned counterclockwise motion of the main control lever 31 from the illustrated to the relieved position is, in turn, imparted through the linking rod 41 to the drive control lever 23 which now moves the intermediate friction roller 25 away from the forward driving roller 16. The drum 22 now runs idle and is stopped by the brakeshoe. Only little braking force is required because the brake is never called upon to be active when the drum is coupled with the winder drive. During subsequent counterclockwise motion of drive control lever 23, the coupling roller 25 is placed into engagement with the reversing roller 18. This causes the guiding drum 22 to rotate in the unwinding direction in order to expose a sufficient length of yarn from the take-up spool as required for the seizing and knotting of the yarn ends. The just-mentioned further motion of lever 23, however, comes about by operation of the tender 13, as will be explained.

While in the above-described event of breakage or absence of yarn the bell-crank lever 45 entrains the main control lever 31 for a relatively large amount of pivotal motion about pivot 32, the continuous reciprocation imparted to the bell-crank lever 45 by rod 46 operates during normal winding operation to impart a much smaller amount of pivotal motion to the same lever 31. This continuous reciprocation of lever 31 is too short for releasing the latch member 33 but suffices for temporarily moving the coupling roller 25 a slight distance away from the forward driving roller 15 and the yarn guiding drum 22. Such intermittent and short-lasting disconnection of the yarn guiding drum 22 from the drive permits imposing upon this drum or upon the take-up spool or other components of the winding station a modifying control manual or adjustment with the aid of only slight controlling force.

The tender 13, when passing by an individual winding station, must check whether the winding operation in that station is still in good order. For the purpose of such checking, a horizontal tappet 50 is linked to the latch member 33 and carries an extension 51. If, due to breakage or absence of yarn in the winding station, the latch member 33 is turned clockwise about its pivot 33*a* in the manner described above, the tappet 50 moves toward the right and enters into the travelling range of a switch arm 52 which is pivotally mounted on the housing structure of the tender 13 and is normally in the illustrated upright position. When the tender 13 approaches a winding station in which the tappet 50 has previously shifted to the right, the switch arm 52 is engaged by the protruding end of the tappet and is turned in one or the other direction depending upon whether the tender 13 arrives from the left or right (relating to FIG. 2). The deflecting motion of switch arm 52 is transmitted by a crank 52*a* and a spring 53 to a latch pawl 54 which then moves clockwise about its pivot 54*a* into the dot-and-dash position. This lowers the rod 14*a* so that its stop end will engage the recess 14*b* of the track structure 3

at the moment when the tender 13 is properly positioned in front of the winding station.

The downward motion of pawl 54 due to the deflection of switch arm 52 from its normal position has the further effect of releasing the servicing mechanisms 55 of the tender 13 for a single cycle of operation. The servicing mechanisms comprise a control shaft 56 which carries a number of coaxial cam discs located one behind the other in the axial direction and cooperating with respective cam followers, such as those denoted by 58, 61 and 64. The cam shaft 56 is connected with a separate drive (further described in application Serial No. 728,139) which tends to rotate the cam shaft counterclockwise, but such rotation is possible only after the pawl 54 has moved to releasing position. One of the cam discs is provided with a peripherally elongated cam projection 57 acting upon the follower lever 58. The follower motion of lever 58 is transmitted by a tappet 59 to the drive control lever 23. This has the effect of engaging the coupling roller 25 with the reverse driving roller 18. As explained, this causes the yarn guiding drum 22 to turn in the unwinding direction for a limited interval of time depending upon the length of the traveling cam projection 57 in the servicing mechanism 55 of the tender. As a result, a certain length of yarn, previously wound upon the take-up spool 21, is unwound and laid bare so that it can be seized by the yarn seeking and knotting devices 13*c*, 13*d*, 13*e* (FIG. 2) which form part of the servicing mechanism and are controlled by other cams of cam shaft 56. The control means for these servicing devices may correspond to those illustrated and described in my co-pending applications Serial No. 704,983, filed December 24, 1957, and Serial No. 728,139, filed April 14, 1958.

At the end of the servicing operations, a cam projection 60 acts upon the cam follower 61 pivoted at 61*a* and causes lifting of a tappet 62. The tappet acts upon the arm 37*c* of the yarn guard 37 and returns to its position for normal winding operation. Shortly thereafter, another cam projection 63 acts upon the follower 64 which moves a tappet 65 to the left and thus pushes the projection 51 of tappet 50 toward the left, for returning the latch member 53 to its illustrated latching position. This permits the main control lever 31 to follow the force of its biasing spring 49 and to turn to the normal operating position in which the control lever 31 remains latched by latch member 33. The winding station, free of any yarn fault, is now capable of continuing the normal winding operation. In the meantime, the servicing mechanisms have terminated a single cycle of operation, and the cam shaft 56 is again arrested in the illustrated position by pawl 54 catching into recess 66. This has the effect of lifting the stop rod 14*a* out of the recess 14*b* in track beam 3, and the tender 13 can continue its travel toward the next following winding station.

As the tender 13 travels past an individual winding station, the roller 67 journalled on the housing structure of the tender engages the swing lever 11 in that particular station and turns it counterclockwise, thus disengaging it from the stop 9*a* of entrainer 9. Thus, the swing arm 11 and the connecting rod 46 remain at rest while the tender is traveling by a winding station or is stopped in front of the station. Consequently, during the above-mentioned servicing operations of the tender, initiated by fault-responsive deflection of the yarn guard 37, the bell-crank lever 45 is at rest, and any undesired control action that may otherwise be caused by the oscillations of swing arm 11 is prevented. The oscillating movement of swing arm 11 ceases some time before the tender reaches the winding station and is resumed only after the tender has left that station. Thereafter, the oscillating shaft 8 is again capable of producing the desired checking operation so that, if the winding operation in the station becomes faulty or interrupted, the take-up spool automatically arrested and the station is prepared for servicing by the tender 13 upon its next arrival.

When during winding operation, the yarn package on take-up spool 21 has reached a predetermined diameter, and the journalling frame 20 is lifted away from guide drum 22 a corresponding distance, a damper rod 102 cooperating with an hydraulic damping cylinder 102*a* (FIG. 3) is likewise lifted. The cylinder 20*x* is carried on a support 102*b* of the arm structure 5. A shoulder disc 103 firmly secured to rod 102 then permits a lever 104, pivoted at 104*a*, to move counterclockwise under the biasing force of a spring 104*b* to a position in which a segment 105, likewise pivoted at 104*a*, is entrained to follow the pivotal movement in the clockwise direction. The segment 105 is connected with the lever 104 by a biasing spring 135 and has a slot traversed by a stop pin 104*c* of lever 104. A lever 106 pivoted at 106*a* to a nose 106*c* of the arm structure 5 and biased by a spring 106*b* for counterclockwise motion, normally rests against the circular periphery of the segment 105. However, when segment 105, entrained by the stop 104*c* of lever 104, reaches the position illustrated in FIG. 3, the lever 106 is released and snaps counterclockwise to the illustrated position. This causes a pushbutton 128 to protrude out of the surface of the arm structure 5 thus signalling to the attendant that the yarn package on take-up spool 21 is completed.

When due to lifting of the journalling frame 20 the lever snaps to the illustrated position as described above, a lug 109 formed by an extension 107 of lever 106 catches beneath the bell-crank lever 45 and locks it in position. Now the lug 48 of lever arm 47 is held arrested so that the connecting rod 46 (FIGS. 3, 1) is kept in lifted position and no longer continues to follow the reciprocating motion of the swing lever 11. This stops the reciprocating motion of the horizontal connecting rod 41 and of the drive control lever 23. The intermediate coupling roller 25, therefore, is kept in the inactive position shown in FIG. 3. The yarn guard 37 is kept arrested by the lug 48, and latch member 33 with tappet 50 are retained in the illustrated position (FIG. 3). Now the winding station is at standstill with driving roller 16 disconnected from the guiding drum 22.

At this stage, the yarn guard 37 cannot move from the position which it occupies during normal winding operation, although the winder drive is now stopped. Such locking of the yarn guard prevents untimely servicing operations by the tender; that is, while a completed yarn package is being exchanged for a new spool core, the resulting reduction in yarn tension would otherwise make the yarn guard respond and initiate a knotting operation despite such operation being unnecessary at that stage and apt to interfere with the proper exchange of the take-up spool. After the full take-up spool 21 is replaced by an empty spool core, the attendant depresses the pushbutton 128. This returns the lever 106 into engagement with the periphery of segment 105 so that the above-described stopping and locking actions are terminated. The extension 107 then withdraws the lug 109 from the bell-crank lever 45. The damper rod 102 drops together with the journalling frame 20, and the winding operation is resumed.

As explained, the main control lever 31 can assume the following three different positions which cause it to perform respectively different control actions.

First position: during normal operation of the yarn guiding drum 22 for producing the cross-wound package on the take-up spool 21, the main control lever 31 occupies the position illustrated in FIG. 1. In this position, a driving connection is maintained between the drive shaft 16 through coupling roller 25 to the guiding drum 22.

However, due to the above-described oscillating motion of relatively slight amplitude continuously imparted to the control lever 31, the control lever moves inter-

mittently toward the position illustrated in FIG. 3, so that the coupling roller 25 is periodically disengaged from the driving roller 16 for a short interval of time in order to prevent "patterning" of the yarn package and permit stopping or otherwise controlling the winding operation by an only slight controlling force.

Second position: the position of main control lever 31 shown in FIG. 3 is permanently established when the take-up spool 21 being wound reaches the desired diameter. In this position of lever 31, the coupling roller 25 is kept away from the driving roller 16 and the drum 22, and the winding operation is stopped until the completed yarn package is removed and an empty spool core is substituted manually or automatically.

Third position: in this position of main control lever 31, its lower arm is shifted farther toward the right and its upper arm farther toward the left than shown in FIG. 3. Now the latch arm 35 of member 33 can snap downwardly out of the recess 36. Tappet 50 is pushed toward the right and can actuate the switch arm 52 of the tender 13 to initiate the yarn-end seeking and knotting operations in the manner described above. When control lever 31 passes from second position (FIG. 3) to third position, the connecting rod 41 turns the drive control lever 23 clockwise so that the coupling roller 25 is placed in ready position close to the reverse driving roller 18 but does not enter into contact therewith. Such contact engagement is established subsequently by actuation of the tappet 59 in tender 13 (FIG. 1) and has the effect of turning the take-up spool in the reverse direction for the purpose of a yarn seeking and knotting operation.

It will be apparent that the main control will stop the winder drive in second position as well as in third position, namely whenever the yarn guard responds to absence of yarn or the take-up spool is filled, but in each case the control lever discriminates by its amount of deflection between the causes of stoppage and initiates the then proper servicing operation. By virtue of such a combined control with the aid of a single centralized control member, and due to the connection of that member with the coupling means for connecting the guiding drum with the forward and reverse drives, a relatively simple and reliable construction of the machine is achieved. A further simplification is due to the fact that the main control member also operates as a periodic checking device thus permitting a reduction in the number of necessary components.

Indicated in FIG. 1 by a dot-and-dash line M is the curved and essentially 7-shaped center line of a winding station. While the lower portion of center line M is to some extent arbitrarily shown, it is essential that, in any event, the magazine 39 and the tender 13 are located on opposite sides of the center line M or on opposite sides of the yarn path extending from the supply coil C through a yarn tensioner T to the guiding drum 22 and onto the take-up spool 21. This affords a relatively simple and reliable construction of the tender as well as of the winding station. Due to the curvature of the center line M, a relatively long path is available along which the control components of the winding station and the running yarn, as well as any broken yarn ends, are conveniently accessible. On one side of a winding station, the tender can act upon the components or the yarn of the station. On the opposite side, and partly beneath the control components, there remains ample space for the storing and conveying of new yarn-supply coils, and the winding station is conveniently accessible to the attending personnel. Relatively little space is required for installing the machine; and since the tender is located behind all yarn paths, it can readily be taken out of the winding machine on the rear side thereof, for inspection or repair. With a large number of individual winding stations combined in a single machine, it is also possible to provide two or three simultaneously operating tenders with separate or mutually overlapping working ranges, such tenders being well accessible from the rear of the machine while the winding stations remain equally well accessible from the front.

It will be obvious to those skilled in the art, upon a study of this disclosure, that my invention is not limited to the particular machine design illustrated and described herein, but permits of various modifications as well as its use with multi-station machines and mobile servicing units of different type and design, without departing from the essential features of my invention and within the scope of the claims annexed hereto.

I claim:

1. A yarn-package winding machine, comprising a rigid machine frame structure, a number of individually operative winding stations spaced from each other along said structure and having respective supports fastened to said structure, said supports having respective top portions extending transversely away from said structure downwardly from said top portions and forming together therewith a bight space extending longitudinally of said structure, each of said winding stations having yarn-winding means mounted on said support and defining a yarn path upwardly along said support, and each station having condition-responsive means mounted on said support for checking the winding operation, a tender movable in said bight space along said winding stations and being arrestable at each of said winding stations for eliminating stoppage conditions therein, a main control member pivotally mounted in each winding station and deflectable under control by said condition-responsive means, said main control member being linked to said winding means for controlling it to stop when said control member is deflected, tender control means mounted on said support and movable into the travel path of said tender due to deflection of said main control means, whereby said tender is arrested when thereafter arriving at the winding station, said tender having a resetting means linked with said main control member when said arrested tender completes its operation, whereby said main control member is reset to start said winding means.

2. In a winding machine according to claim 1, said winding means in each station comprising a winder drive having a coupling member journalled on said support, a drive shaft extending along said winding stations and having transmission means engageable by said respective coupling members for operating said winder drives, said supports being individually removable from said machine frame structure, and said drive shaft being journalled on said structure independently of said supports, whereby each winding station can be removed without affecting the operation of the other winding stations.

3. In a winding machine according to claim 1, said tender being removable from said track in a direction toward the rear of the machine.

4. In a winding machine according to claim 1, said top portion merging with said front portion by an arcuately curved shape of said support corresponding generally to one-quarter circle, said yarn-winding means comprising a take-up spool frame and a rotatable guiding drum which are both mounted on said top portion and accessible from the front of the machine, and said condition-responsive means comprising parts mounted on said front portion and extending rearwardly into said bight space so as to be engageable with said tender.

5. A yarn-package winding machine, comprising a rigid machine frame structure, a number of individually operative winding stations horizontally spaced from each other along said structure, each of said stations having a supply-coil holder and a take-up winder above said holder, a yarn guard mounted in each station between said holder and said winder and deflectable in response to absence of yarn, a fixed track extending horizontally along said winding stations, a tender movable on said track and having stop means for arresting the tender at a selected wind-

ing station and servicing means for eliminating stoppage conditions in said winding station, said tender having a start-stop control mechanism for jointly controlling said stop means and said servicing means, a release control member movably mounted on said tender and connected with said mechanism to release it for one cycle of start-stop operation, a main control member pivotally mounted in each winding station and deflectable under control by response of said yarn guard, said main control member being coupled with said winder for stopping said winder when said main control member is deflected, each winding station having tender control means coupled with said main control member to move into the travel path of said release control member when said main control member is deflected, said start-stop mechanism of said tender having two resetting devices operative near the end of said cycle to engage said tender control means and said yarn guard respectively for resetting them to normal positions, whereby said main control member is reset to start said winder.

6. A winding machine according to claim 5, comprising a guide rail extending beneath said track in parallel relation thereto and being engageable by said tender for maintaining it in proper position during travel along said track, said track and said rail comprising respective tubular members and forming part of said machine frame structure.

7. A yarn-package winding machine, comprising a rigid machine frame structure, a number of individually operable winding stations spaced from each other along said structure, a tender movable along said number of stations and selectively engageable therewith for eliminating stoppage conditions therein, each of said winding stations comprising yarn-winding means having a controllable coupling member, a drive shaft extending along said winding stations and having transmission means engageable by said respective coupling members for operating said yarn-winding means, each of said stations having a condition-responsive main control device connected with said coupling member and having a normal position in which said member engages said transmission means, said control device being movable in response to winding irregularity in said station to another position for disengaging said coupling member from said transmission means to thereby stop said winding means, each of said stations having normally inactive tender control means connected with said main control device and displaceable into the travel path of said tender due to movement of said control device to said other position for causing said tender to operate when next arriving at said station, and oscillating means connected with said coupling member under control by said control device for periodically disengaging said coupling member from said transmission means when said control device is in said normal position, whereby said winding means when in operation are intermittently disconnected from said drive shaft.

8. A yarn-package winding machine, comprising yarn-package winder means, drive means continuously rotating when the machine is in operation, a controllable coupling member for coupling said winder with said drive means, first sensing means responsible to absence of yarn ahead of said winder means, second sensing means responsive to completion of the yarn package wound by said winder means, a control member connected with said coupling member and having a normal position in which said coupling member engages said drive means for normal winding operation, said control member being movable under control by said first and second sensing means away from said normal position to disengage said coupling member from said drive means due to response of either one of said sensing means, and oscillatory drive means connected with said coupling member under control by said control member for intermittently disengaging said coupling member from said drive means when said control member is in said normal position, whereby said winder when in operation receives intermittent driving torque from said drive means.

9. In a winding machine according to claim 7, said oscillating means comprising a rotationally oscillating control shaft extending along said number of winding stations in parallel to said drive shaft.

10. In a winding machine according to claim 7, said oscillating means comprising a rotationally oscillating control shaft extending parallel to said drive shaft, along said number of winding stations, said yarn-winding means of each station having a take-up spool and a yarn-guiding drum for peripherally entraining said spool, said drum being axially displaceable along said spool, and drum displacing means connected with said oscillating control shaft under control by said main control device for axially reciprocating said drum during winding operation.

11. In a winding machine according to claim 7, said yarn winding means of each station having a take-up spool and a yarn guiding drum for peripherally entraining said spool, a brake engageable with said drum, and connecting means between said brake and said main control device for actuating said brake when said control device moves to said other position.

12. A yarn-package winding machine, comprising a number of individually operable winding stations horizontally spaced from each other, a tender movable along said number of stations and selectively engageable therewith for eliminating stoppage conditions therein, each of said winding stations comprising yarn winding means and a yarn guard deflectable in response to absence of yarn, each station having a controllable drive for actuating said winding means and a pivotally mounted main control member connected with said drive and having a first position in which said drive is active and a second position in which said drive is inactive, a lever pivoted on said main control member at a point spaced from the pivot point of said latter member, a rotationally oscillating control shaft extending along said stations and linked to said lever in each station for imparting oscillatory movement thereto, said lever having an arm engageable with said yarn guard only when said guard is deflected due to absence of yarn whereby said oscillatory movement causes said main control member to deflect to said second position for stopping said winding means.

13. In a winding machine according to claim 12, each winding station comprising a latch member normally engaging said main control lever to hold it in said first position, said latch member having a biasing spring and being releasable from said main control member to be moved by said spring when said main control member is deflected to said second position, and a displaceable tender control member normally in inactive position and linked to said latch member so as to be displaced into the travel path of said tender due to said spring-biased movement of said latch member, said tender having a control part engageable by said displaced tender control member for causing said tender to operate when next arriving at said tender control member.

14. In a winding machine according to claim 12, said drive comprising two shafts extending parallel to each other along said stations and revolving in mutually opposed directions, and a coupling controlled by said main control member to engage and disengage one of said shafts when said main control member is in said first and second positions respectively, auxiliary control means in each winding station for placing said coupling into engagement with said other shaft to reverse said yarn winding means, said tender having a service control mechanism for stopping the tender travel and causing the tender to operate when said main control member is in said second position, said mechanism having a part temporarily displaceable into engagement with said auxiliary control means for temporarily reversing said yarn winding means.

15. In a winding machine according to claim 12, said

tender having a stop member for disconnecting the linkage between said oscillating shaft and said lever in each of said stations when said tender is near said station.

16. In a winding station according to claim 12, each of said winding stations comprising an entrainer fastened to said oscillating control shaft and a swing arm having a spring connected with said entrainer for normally linking said shaft through said swing arm with said lever, and said tender having a stop member engageable with said swing arm for stopping it from transmitting oscillatory motion while said tender is near said station.

17. In a winding machine according to claim 12, each winding station comprising a linking rod disposed between said oscillating control shaft and said lever and axially displaceable to transmit oscillating motion to said lever, a fixed tube surrounding said rod, and a supply coil holder mounted on said tube for supplying yarn to said winding means.

18. In a winding machine according to claim 12, said drive comprising two shafts extending parallel to each other along said stations and revolving in mutually opposed directions, each of said shafts having respective friction rollers near each of said winding stations, and an intermediate coupling roller displaceable under control by said main control member to engage and disengage one of said two friction rollers when said main control member is in said first and second positions respectively, auxiliary control means in each winding station for placing said coupling roller into engagement with said other friction roller, said tender having a service control mechanism for stopping the tender travel and causing the tender to operate when said main control member is in said second position, and said mechanism having a part temporarily displaceable into engagement with said auxiliary control means for temporarily reversing said yarn winding means.

19. A yarn-package winding machine, comprising a rigid machine frame structure, a number of individually operable winding stations spaced from each other along said structure, a tender movable along said number of stations and selectively engageable therewith for eliminating stoppage conditions therein, each of said winding stations comprising yarn-winding means and a controllable drive for operating said winding means, each station having first sensing means responsive to absence of yarn and second sensing means responsive to completion of the yarn package wound, a movable main control member in controlling connection with said drive and having a first position in which said drive is active to operate said winding means, said main control member being deflectable a given distance to a second position due to response of said second sensing means and being deflectable a larger distance to another position due to response of said first sensing means, said drive being inactive when said main control member is in said second position and in said other position, and each of said winding stations having displaceable tender control means controlled by said main control member to move into the travel path of said tender only when said main control member is in said other position whereby said tender is caused to stop its travel and to operate at said station.

20. In a winding machine according to claim 19, each of said winding stations having locking means connected with and controlled by said second sensing means and lockingly engageable with said first sensing means for preventing the latter to cause a servicing operation of said tender when said winding means is stopped in response to completion of the yarn package being wound.

21. A winding machine according to claim 20, comprising signal means connected with said second sensing means, and resetting means connected with said locking means for unlocking said first sensing means after exchange of the yarn package.

22. In a winding machine according to claim 19, said winding means comprising a yarn-guiding drum, a take-up spool peripherally engageable with said drum to be entrained thereby, and a pivotally movable journalling frame for said take-up spool; said second sensing means comprising structure linked to said frame for displacement due to diametric increase of said take-up spool, and spring-biased latch means releasable by said structure when the latter reaches a given amount of displacement, said latch means being engageable with said main control member when released for placing said main control member to said second position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,045,872	Reiners et al.	June 30, 1936
2,208,930	Kahlisch	July 23, 1940
2,338,914	Esser et al.	Jan. 11, 1944