Dec. 30, 1969 C. D. LEE, JR., ET AL 3,486,319

APPARATUS AND METHOD FOR DETECTING, PIECING-UP AND REPORTING ENDS DOWN ON SPINNING MACHINES

Filed June 24, 1968 16 Sheets-Sheet 1

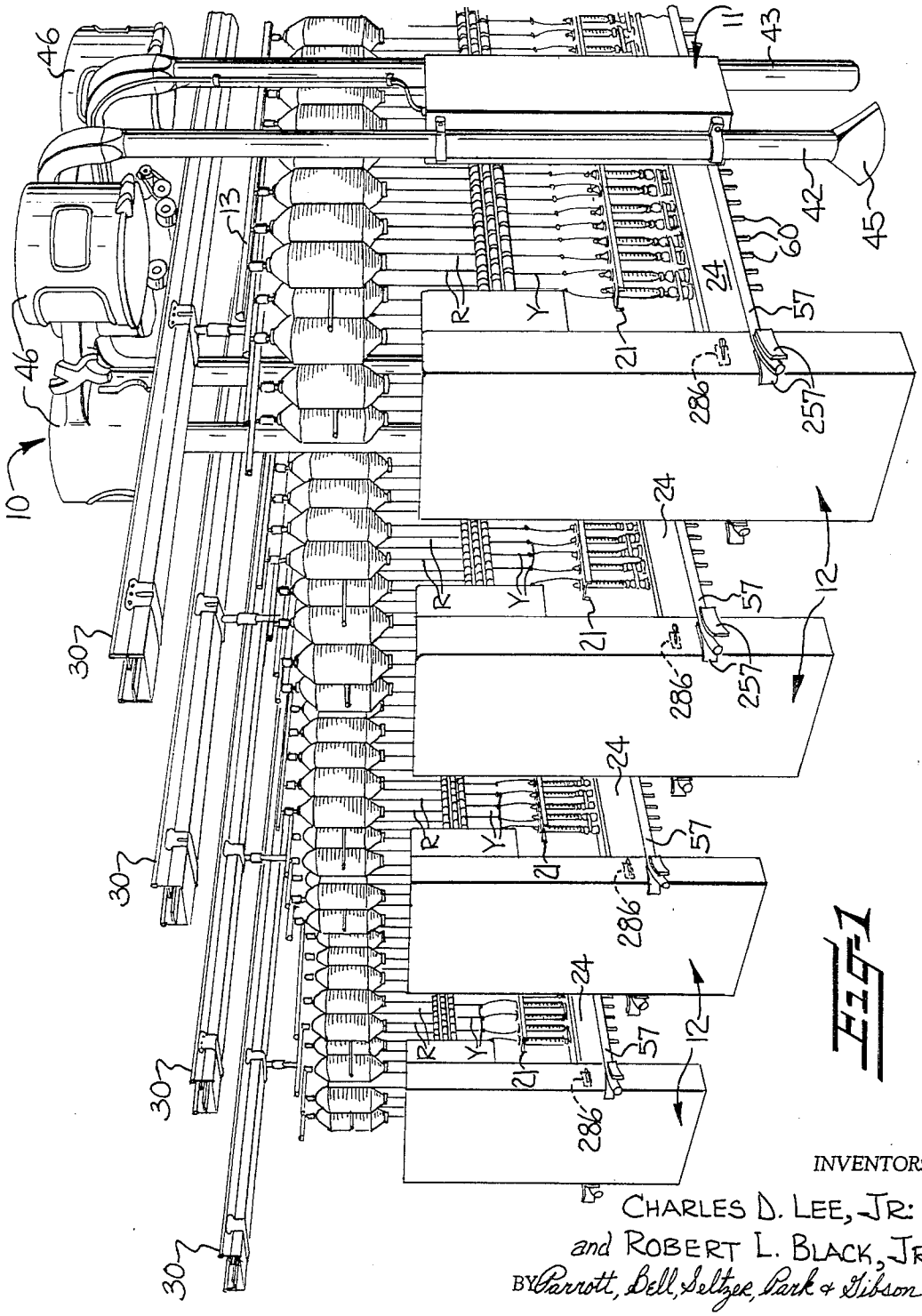

FIG. 1

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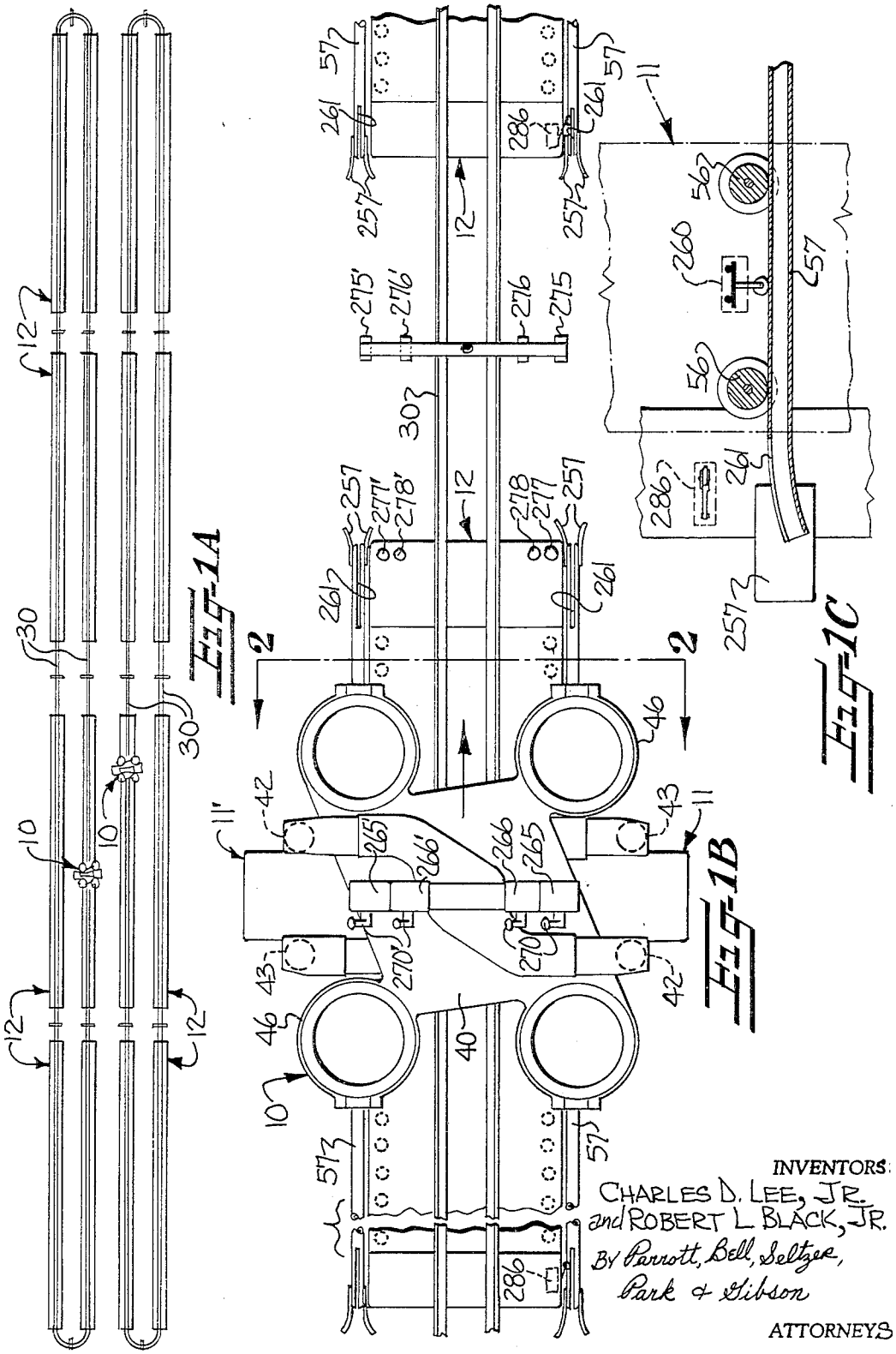
Fig-1A
Fig-1B
Fig-1C
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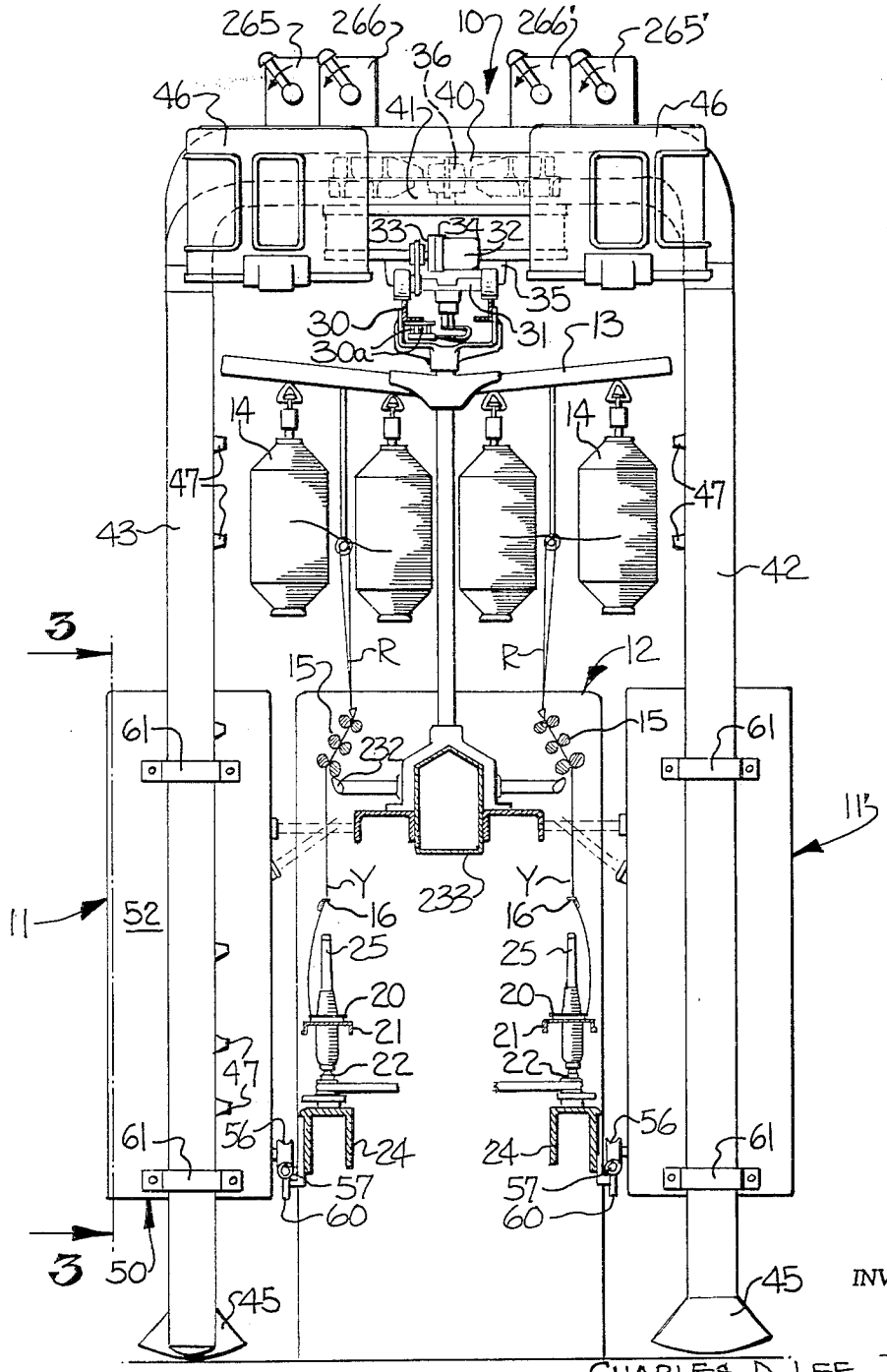

FIG-2

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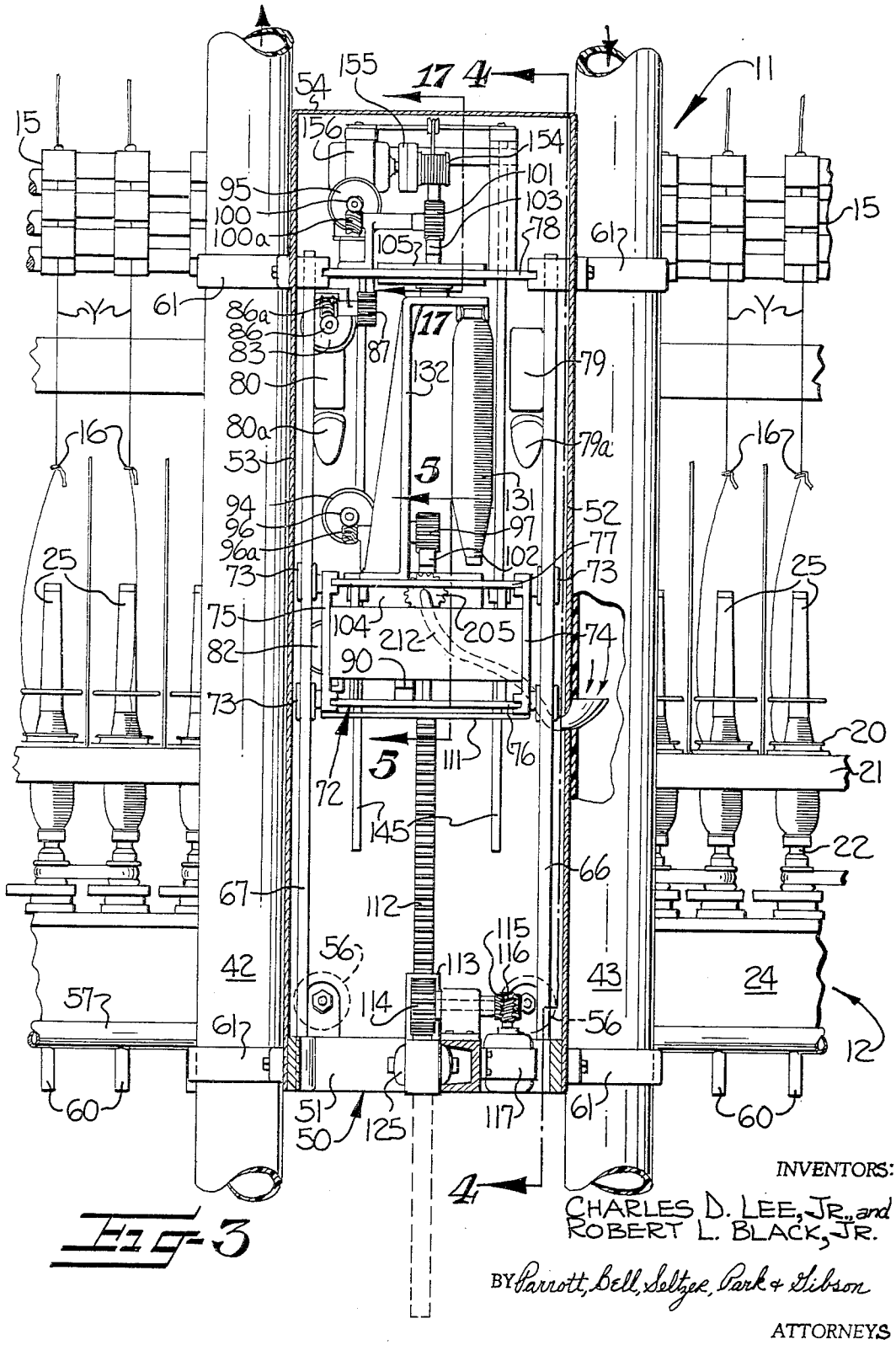

Fig-3

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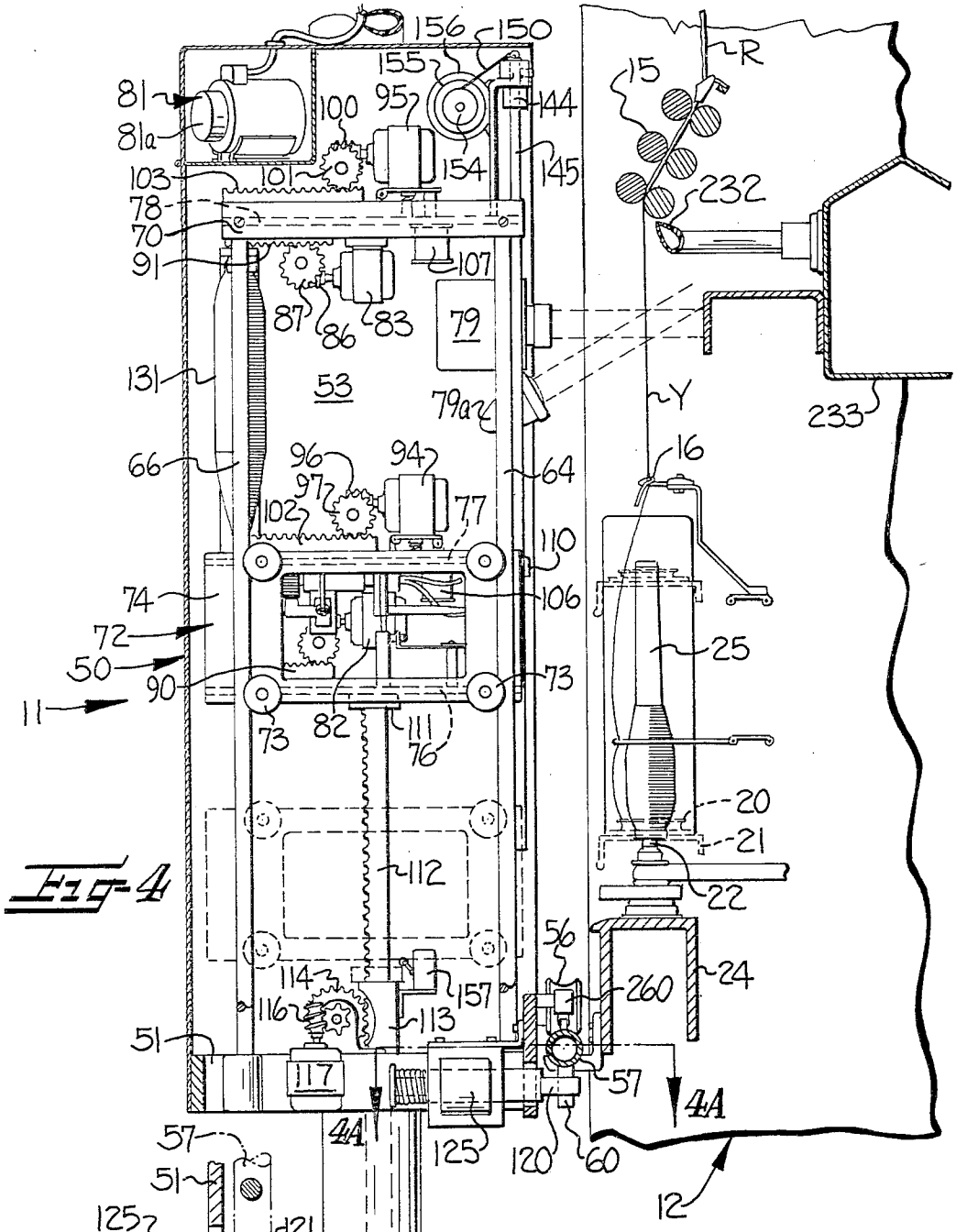

Fig-4

Fig-4A

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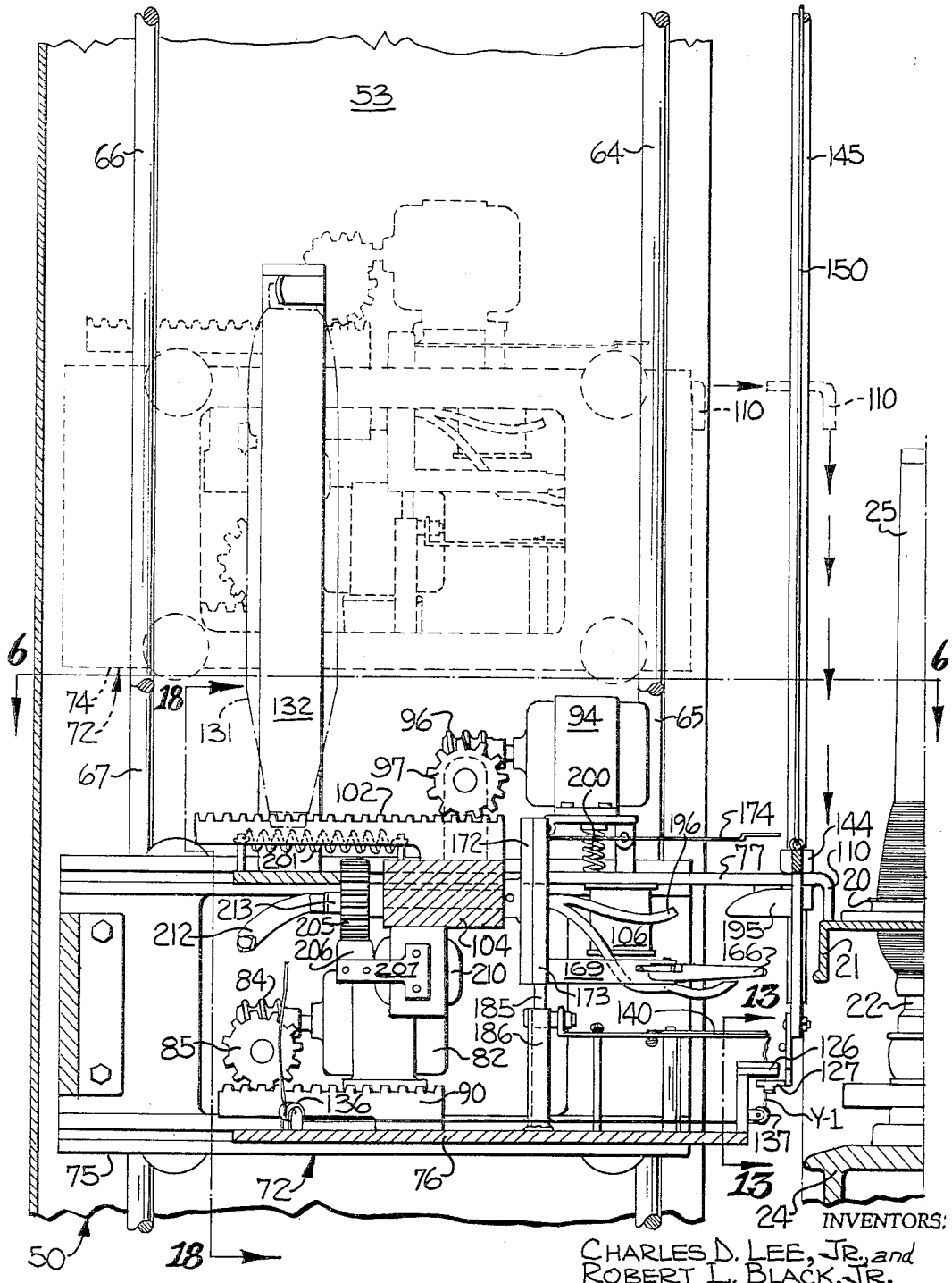

FIG-5

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APPARATUS AND METHOD FOR DETECTING, PIECING-UP AND REPORTING ENDS DOWN ON SPINNING MACHINES

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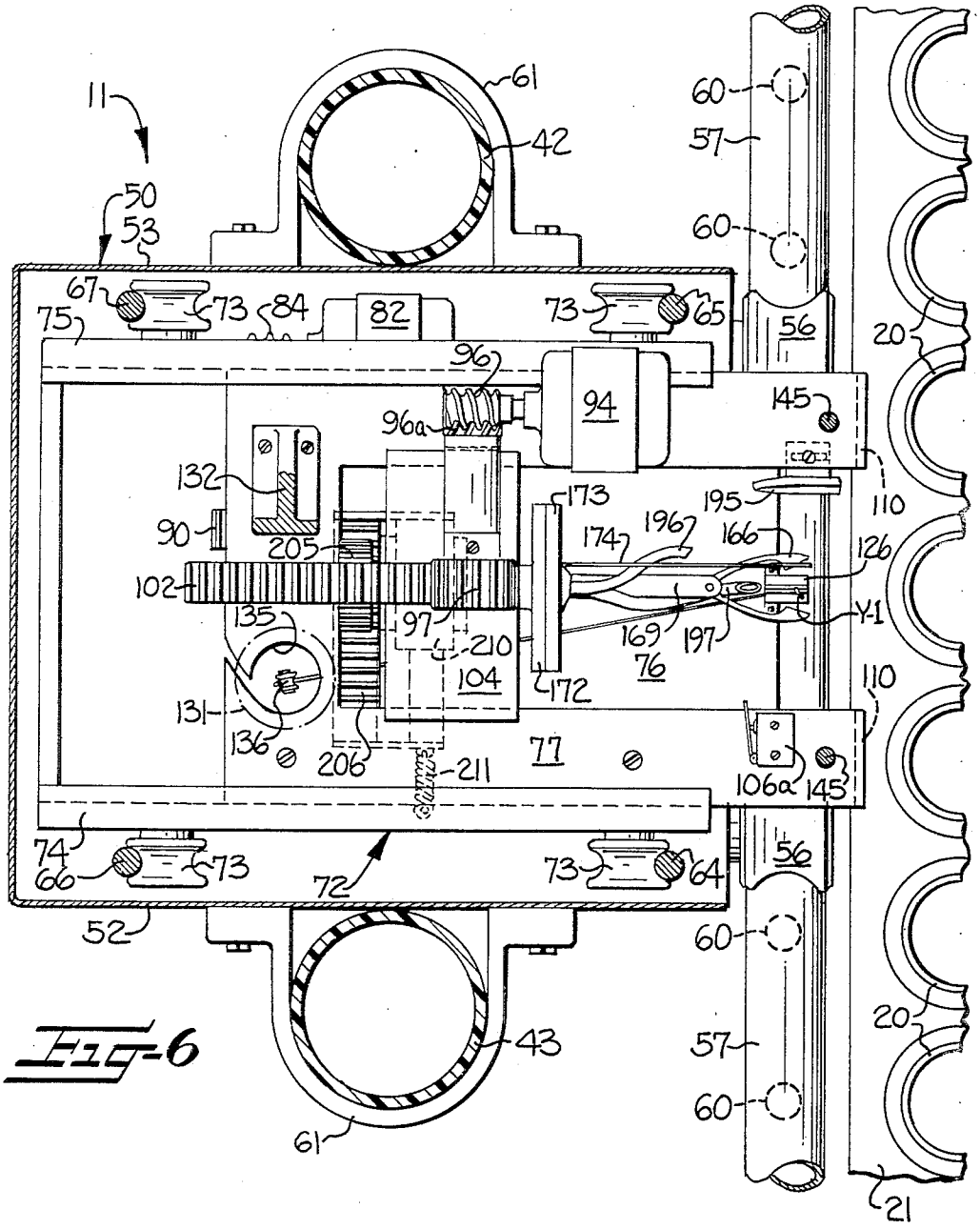

Fig-6

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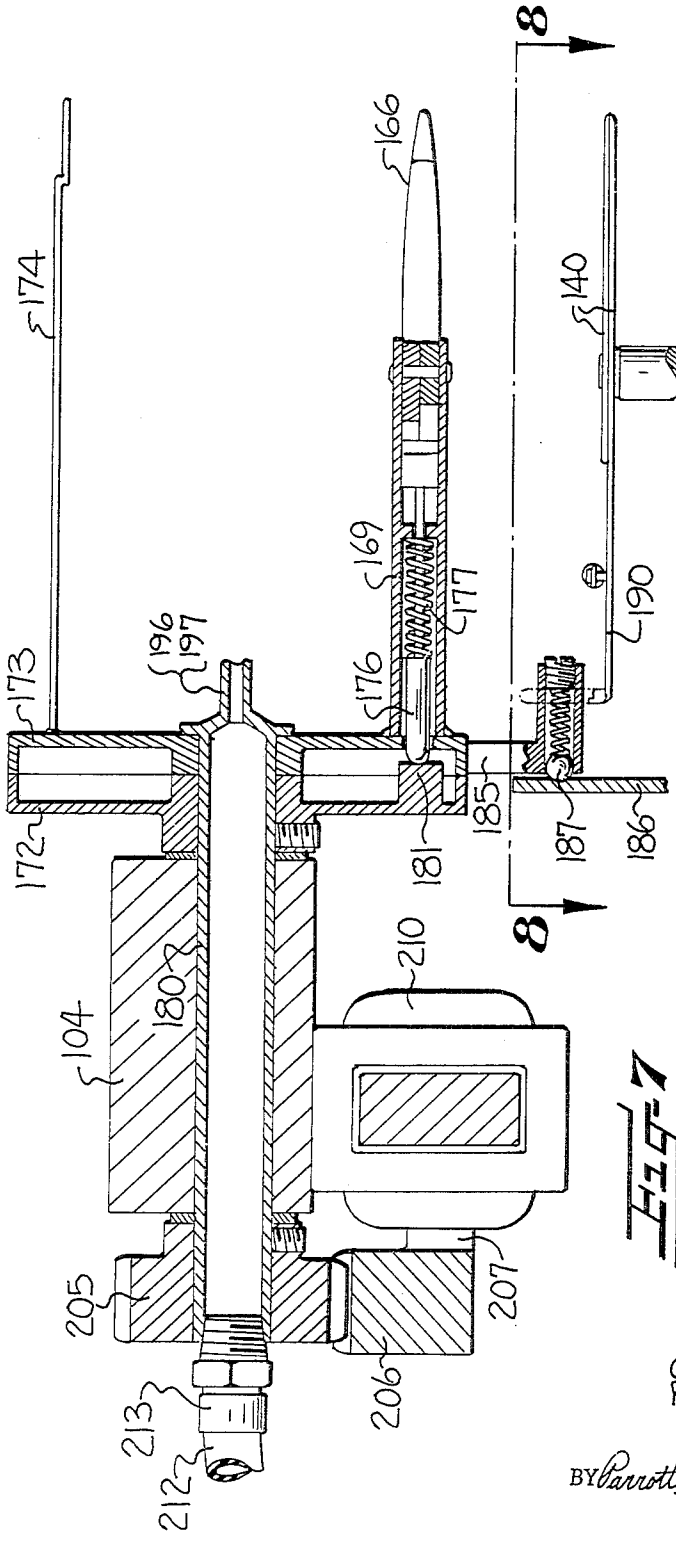

FIG 7

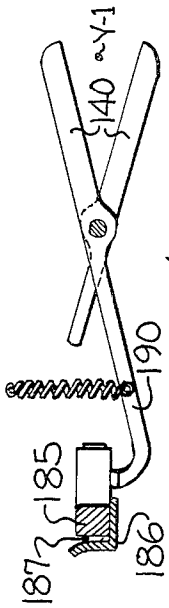

FIG 8

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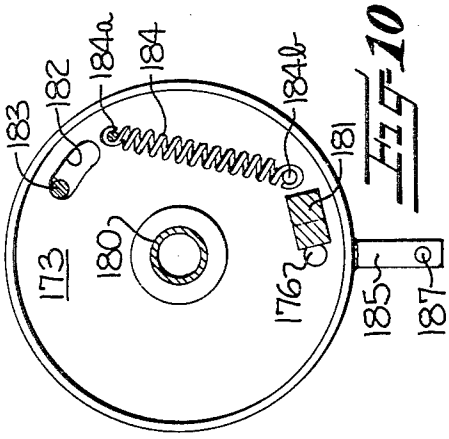

FIG. 10

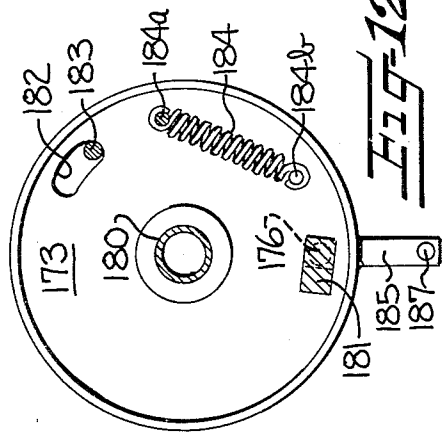

FIG. 12

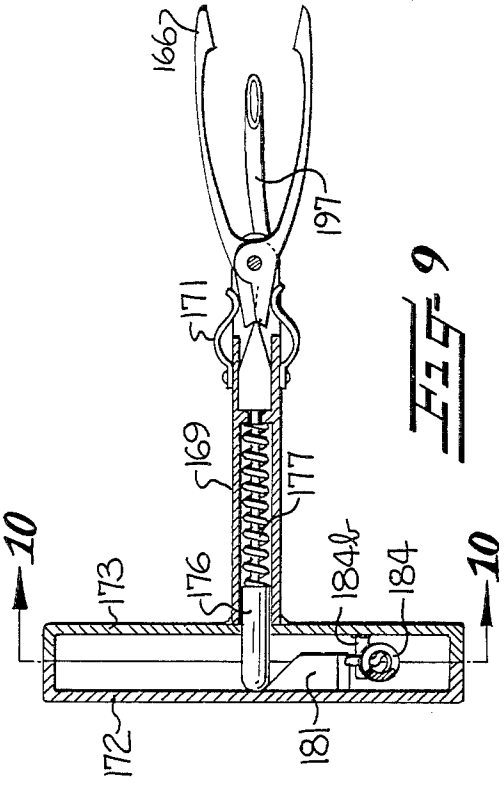

FIG. 9

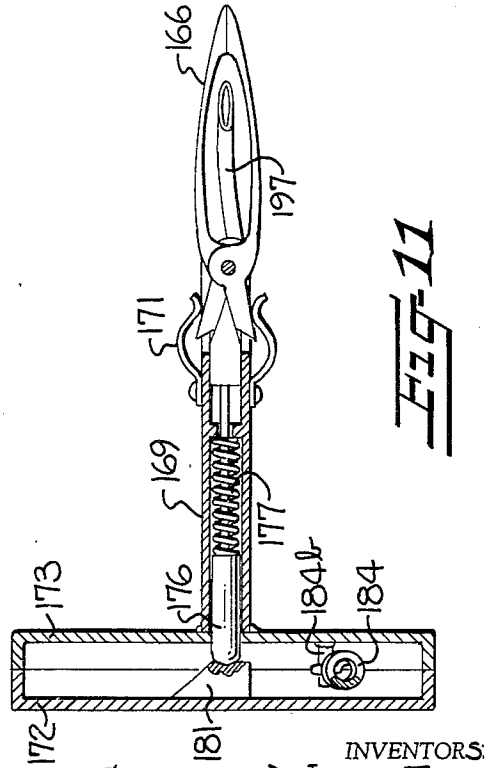

FIG. 11

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Fig-14

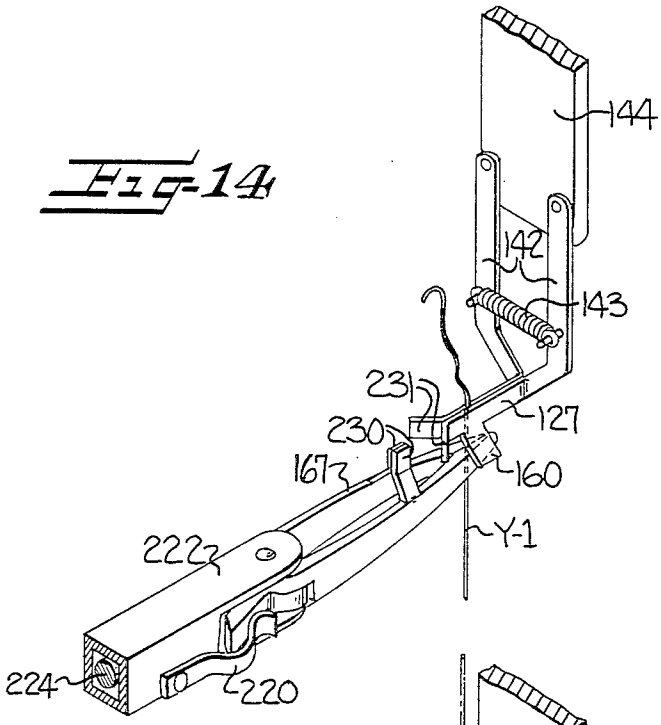
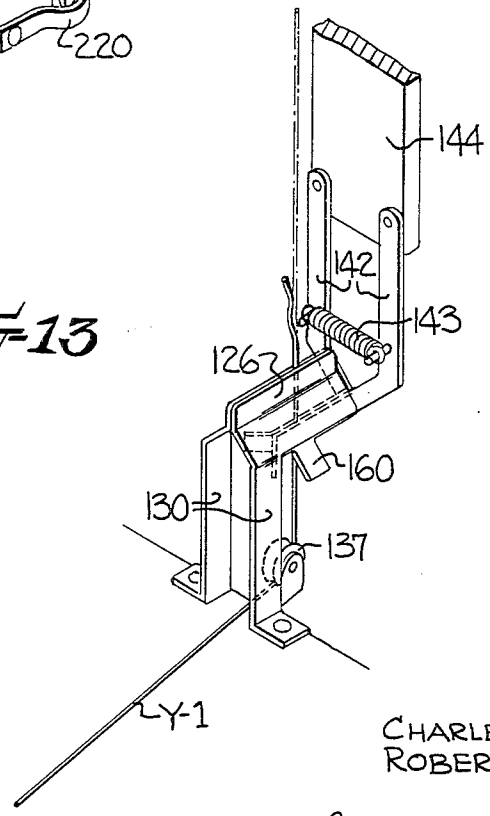


Fig-13



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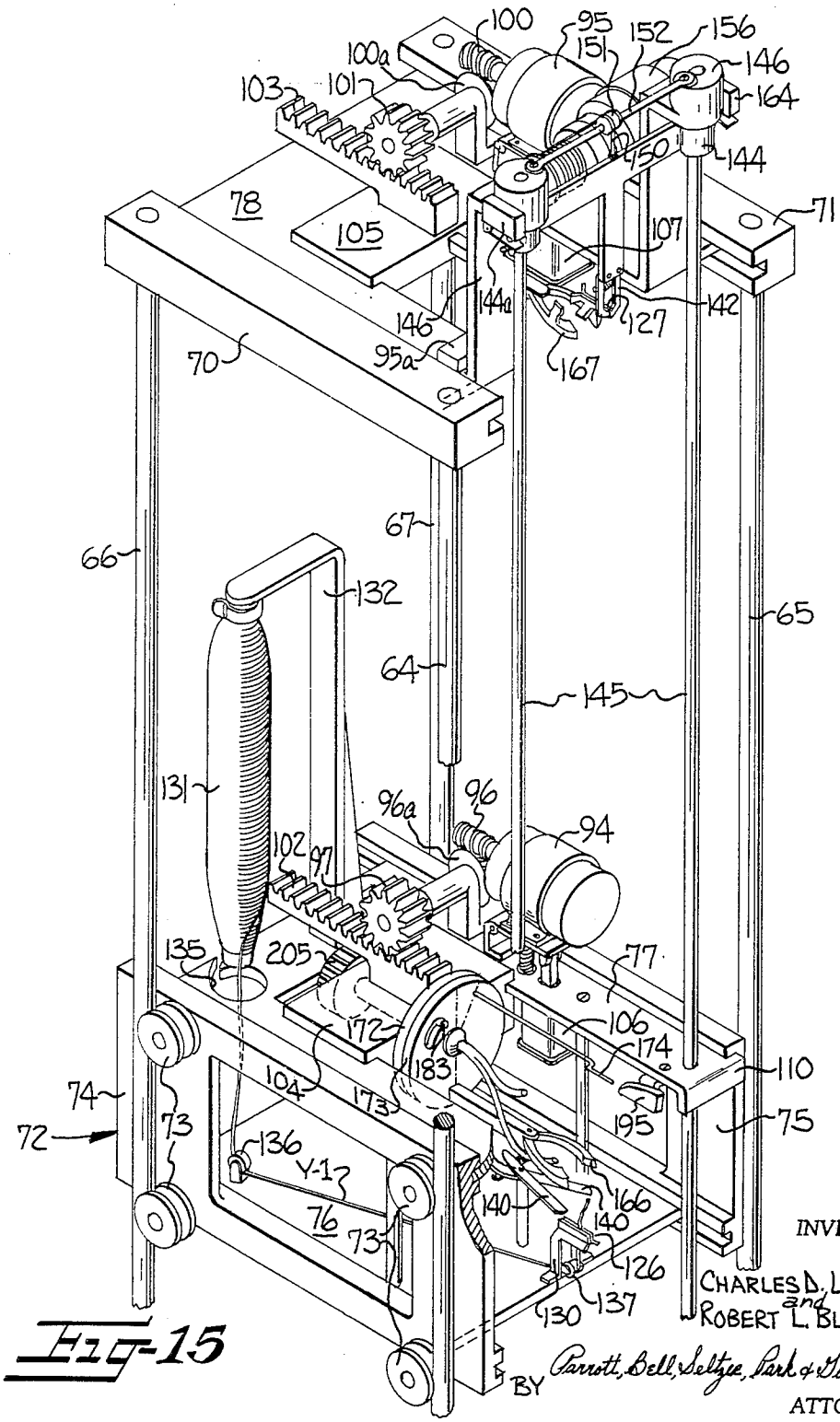

Fig-15

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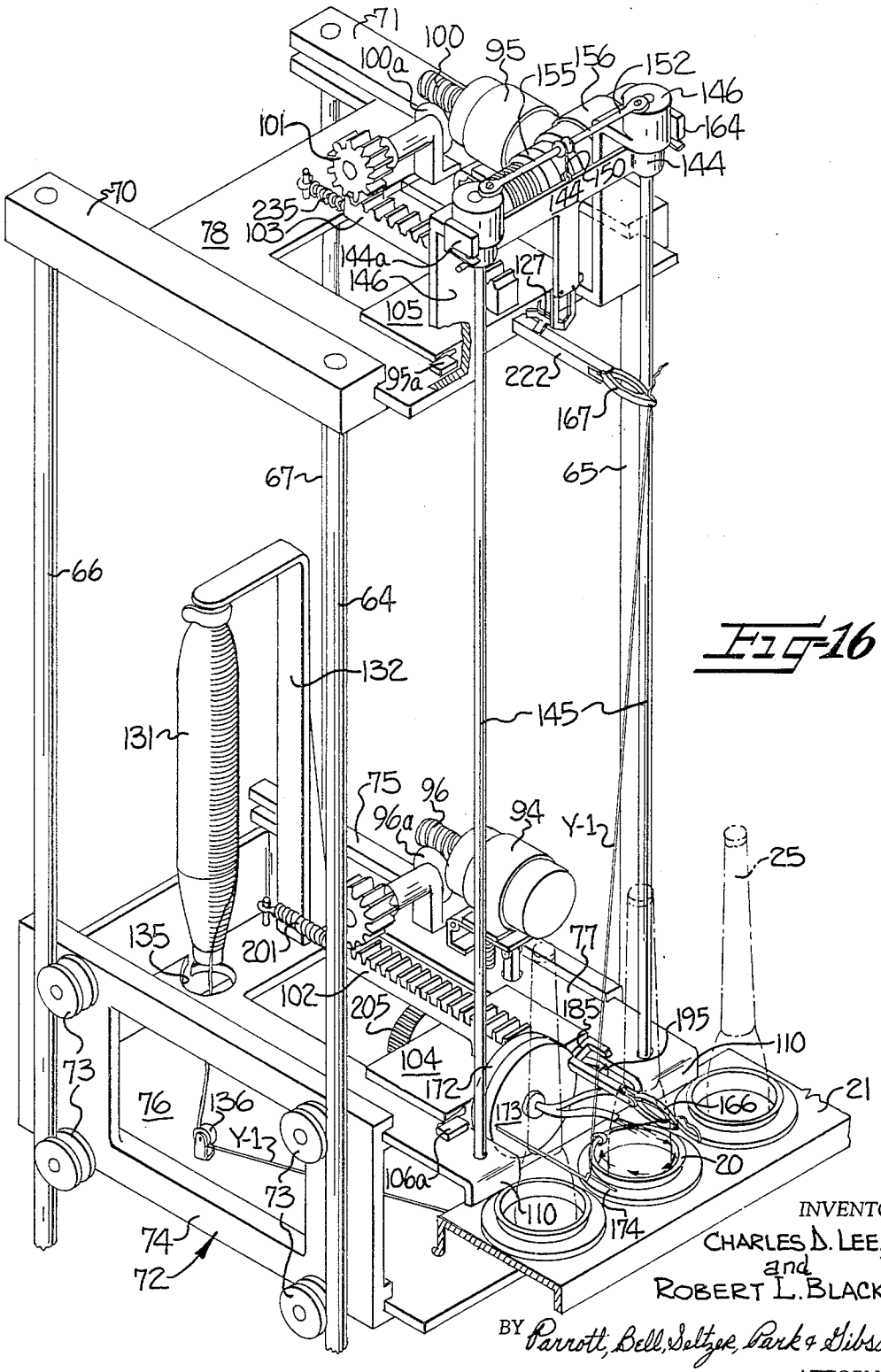

Fig-16

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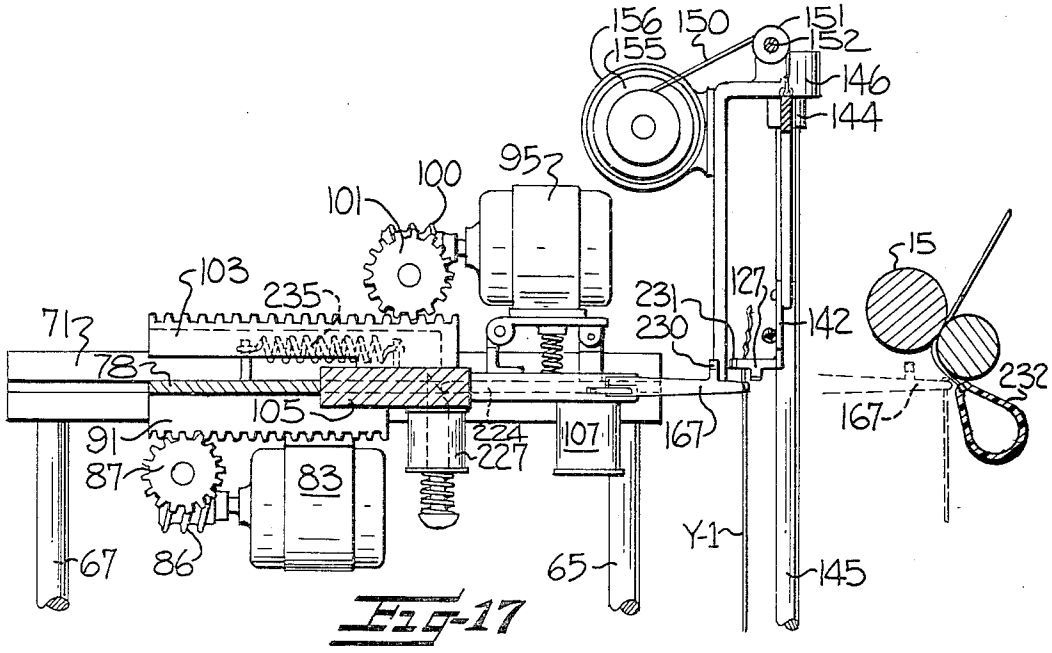

Fig-17

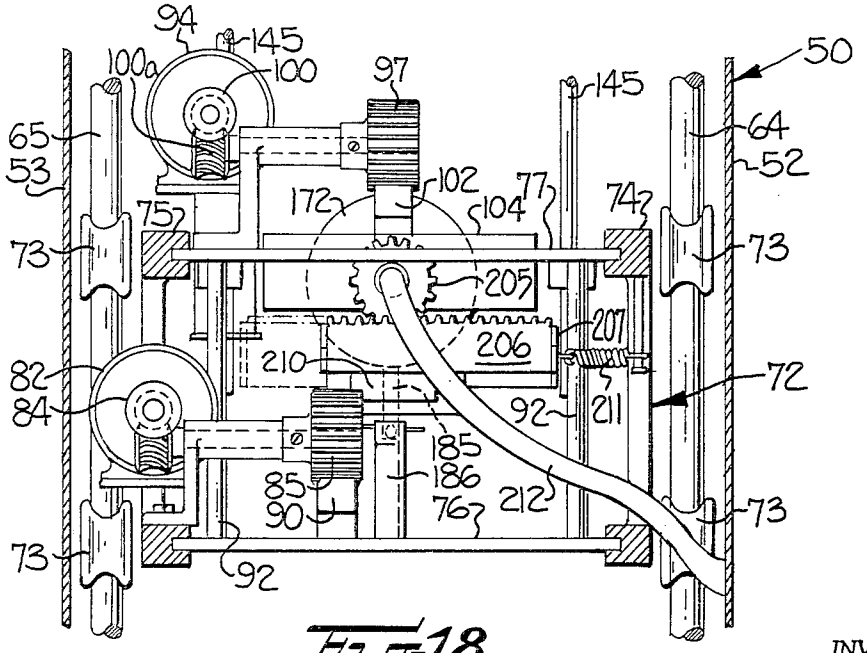

Fig-18

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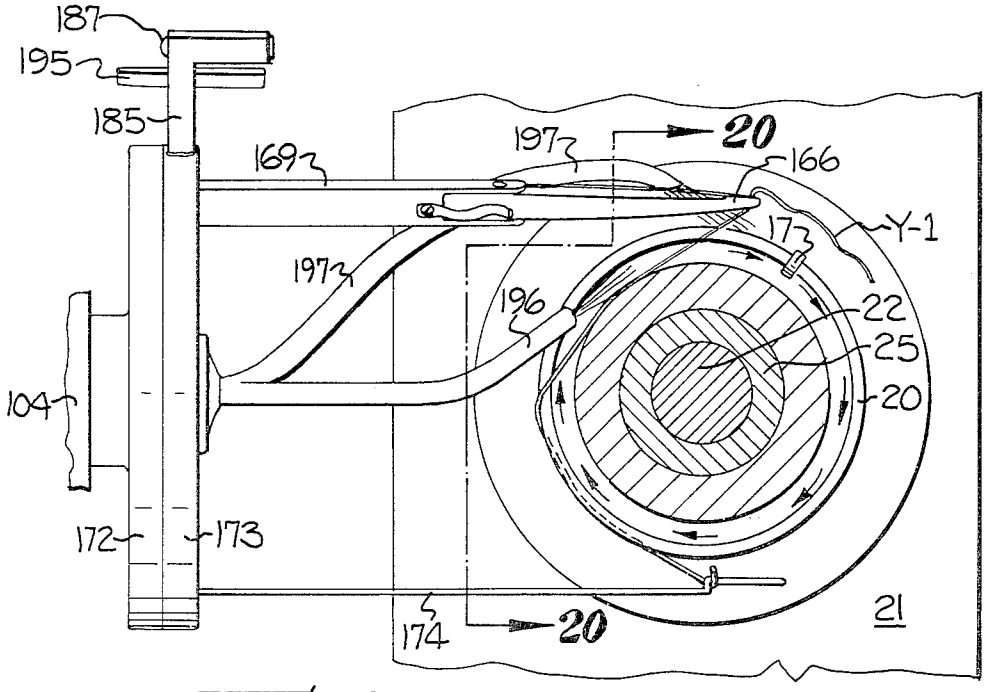

Fig-19

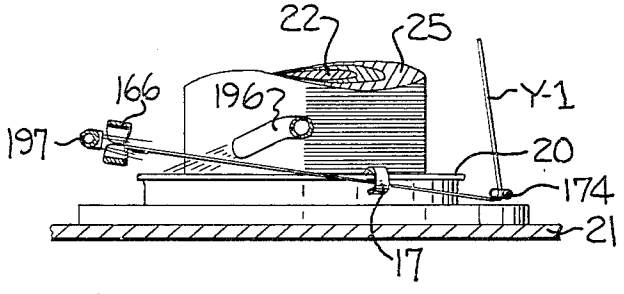

Fig-20

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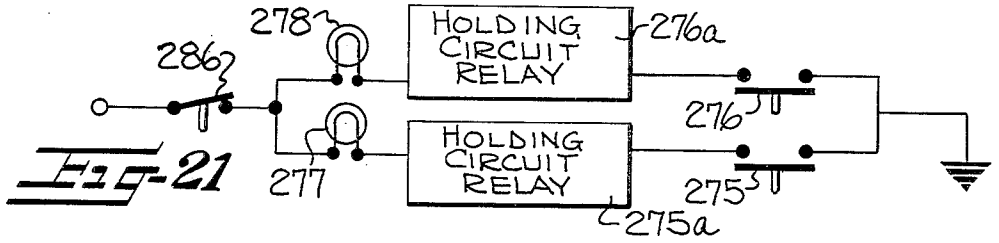

Fig-21

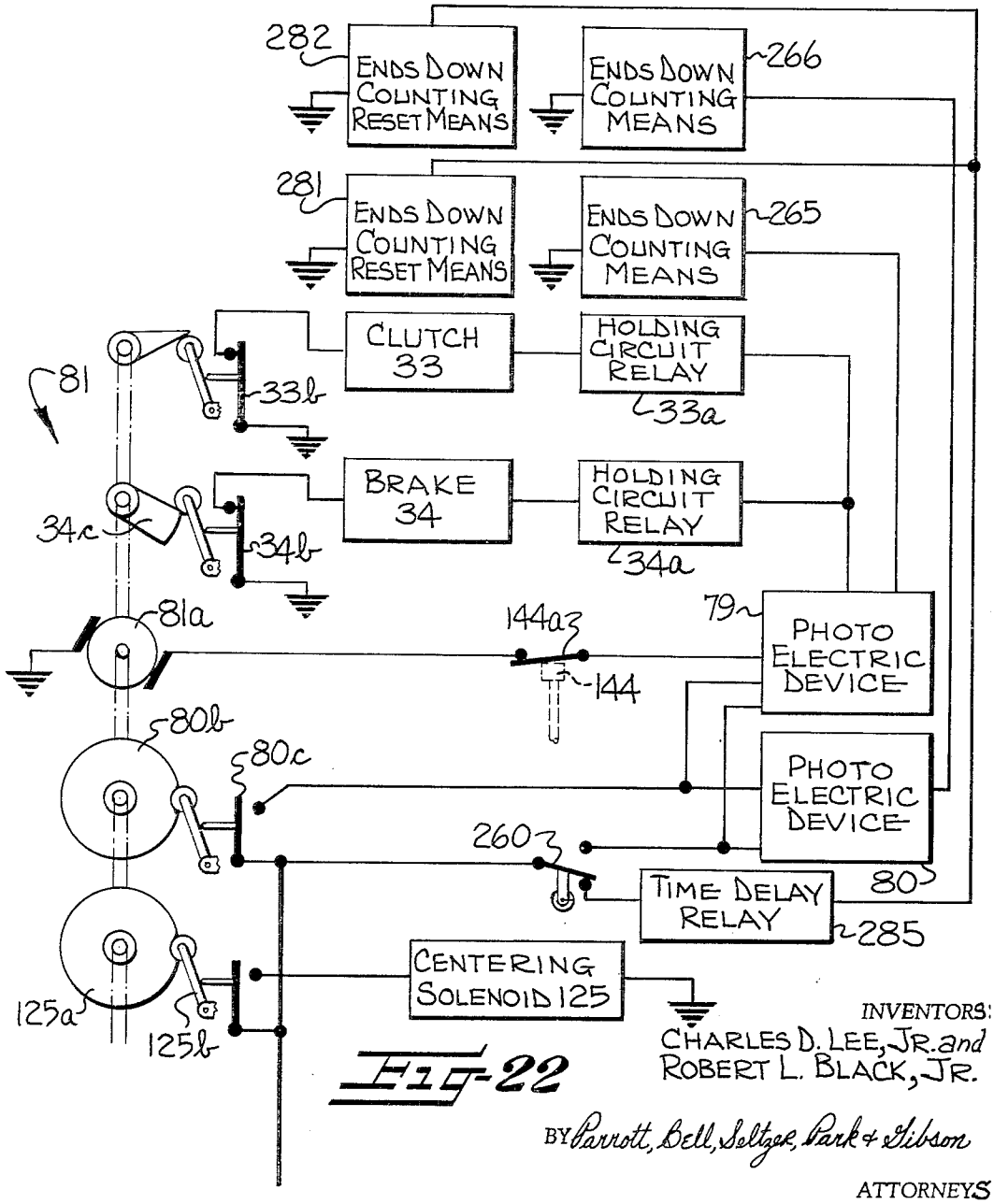

Fig-22

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APPARATUS AND METHOD FOR DETECTING, PIECING-UP AND REPORTING ENDS DOWN ON SPINNING MACHINES
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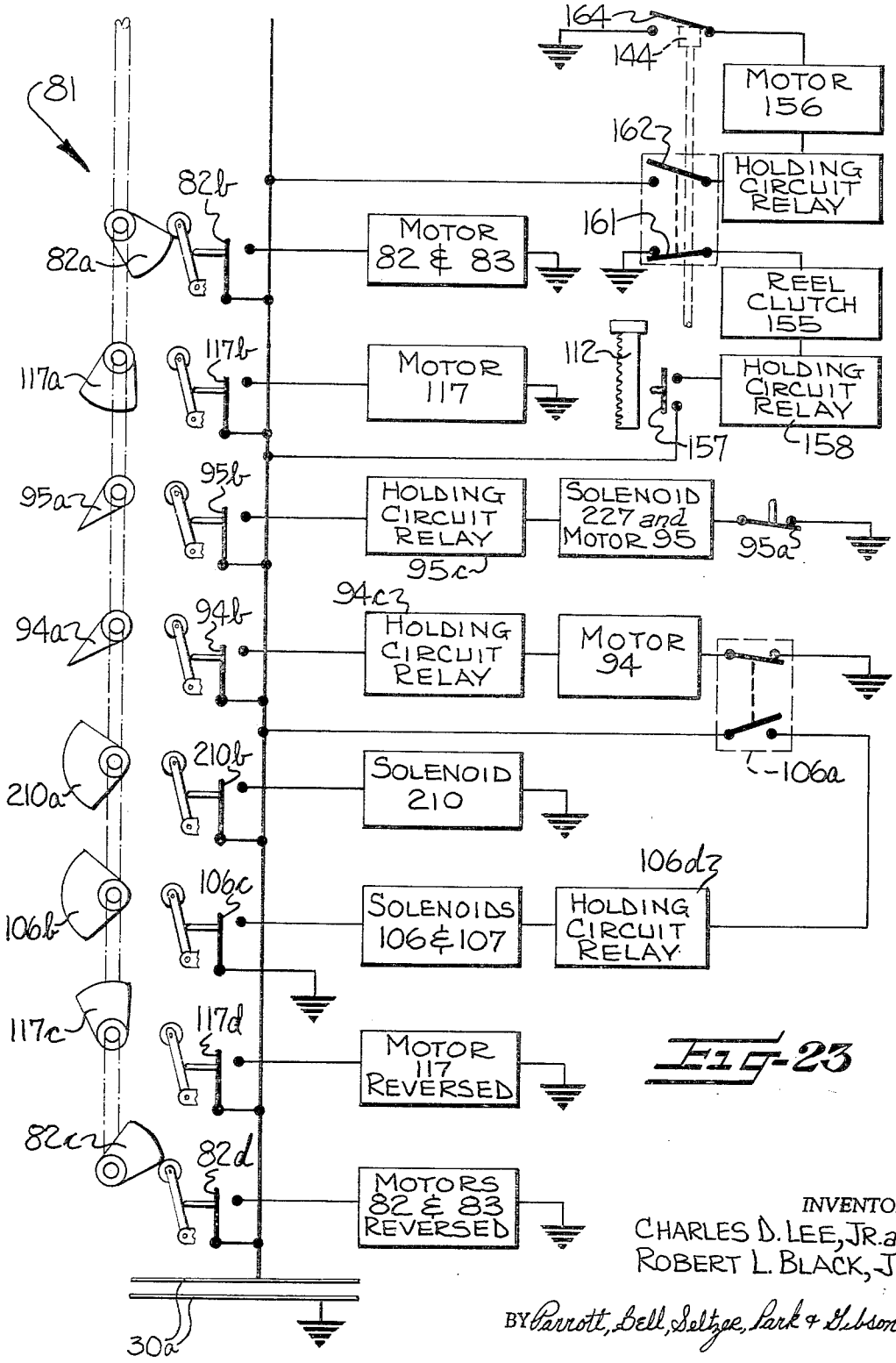

FIG-23

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United States Patent Office 3,486,319
Patented Dec. 30, 1969

3,486,319

APPARATUS AND METHOD FOR DETECTING, PIECING-UP AND REPORTING ENDS DOWN ON SPINNING MACHINES

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Filed June 24, 1968, Ser. No. 739,462
Int. Cl. D01b *13/26, 11/00, 13/16*
U.S. Cl. 57—34 37 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus and method for operating upon and improving the productivity of ring spinning machines and in which detector means supported by and moving with a traveling track-mounted patrolling device, scan the ends of yarn being formed on the spinning machine and sense the absence of yarns between the delivery drafting rolls and the spindles of the spinning machine to originate a signal which initiates a cycle of operation of a yarn piecing means traveling with the patrolling device. The yarn piecing means then threads a length of yarn through the traveler of the spinning machine and joins the same with an end of attenuated roving issuing from the delivery rolls to re-establish the production of yarn. Other means traveling with the patrolling device perform pneumatic cleaning functions for the spinning machine and the textile room and also perform reporting functions for advising an attendant or operator of the ends down condition of the spinning machines.

This invention relates to an improved apparatus and method for improving the efficiency of operation of spinning rooms and more particularly to a novel apparatus and method for automatically detecting, piecing-up and reporting ends down on spinning machines.

While the operation of ring spinning machines has been automated to a certain extent, it is well known that a spinning machine operator must patrol such machines and correct improper operating conditions of the machines in order to maintain efficiency of production. The most frequently occurring condition which reduces efficiency of operation is yarn breakage, referred to in the trade as an end down. Upon detection of an end down, the operator must piece the yarn together to re-establish production of the yarn end, in an operation known as putting up or piecing-up an end. Highly skilled operators are required to discover ends down on spinning machines and perform the piecing-up operations, as well as to perform other tasks essential to maintaining efficiency of production on spinning machines.

In order to improve the efficiency with which an operator's time may be employed in tending spinning machines, there is proposed, in a related copending application owned in common with the present invention, filed on Feb. 19, 1968, under Ser. No. 706,287, and entitled, "Ends Down Detecting and Reporting Apparatus and Method," an invention in which a traveling pneumatic cleaner is utilized as a patrolling device to patrol for ends down, detect the absence of a yarn indicating an end down, and report to a data collecting and display system the occurrence of such a number of ends down on a particular spinning machine side as to indicate an improper operating condition of the machine. Thus, instead of the operator patrolling along a predetermined route as has been conventional mill practice, the operator need only direct his attention to those machines which are known to be in need of having ends put up, and generally to a particular machine side where an excessive number

of ends are down, thus substantially increasing the efficiency of the operator in performing the critical part of his assigned task.

Notable among the other approaches which have been made to increasing the efficiency of operators of spinning machines, so that a single operator may tend a substantially increased number of spindles, is the use of automatic yarn-piecing equipment. Specific examples of such equipment are disclosed in United States Patent No. Re. 26,360, issued on June 27, 1967, to Roberto Escursell-Prat; and United States Patent No. 3,373,551, issued on Mar. 19, 1968, to Matteo Gillono et al. The units disclosed in these patents are similar, in that each unit comprises a carriage movable along one side of a spinning frame, and provided with detecting means for sensing the absence of an end yarn, and means responsive to the detection of the absence of an end of yarn for stopping motion of the carriage in alignment with the spindle at which an end is down, engaging and stripping a length of yarn from the bobbin, threading that length of yarn through the corresponding ring traveler, and joining the same to the attenuated roving issuing from the respective delivery rolls of the spinning machine. It also has been proposed in Japanese Patent No. 35/5,674, published May 23, 1960, and owned by Kanegafuchi Boseki K.K., to provide yarn piecing equipment in which an auxiliary length of yarn is severed from a source carried by the yarn piecing equipment carriage, thus obviating the necessity of braking and reversing a spindle or bobbin and searching for the free end of the yarn wound thereon, as is done, for example, in the aforementioned United States patents.

As recognized in the aforementioned copending application, it is usual practice to provide in the spinning room of a textile mill traveling pneumatic cleaners which are propelled along overhead tracks and which remove lint and the like from the spinning machines and the mill room by flowing currents of air. Such traveling pneumatic cleaners are, in fact, one of the factors which has contributed to successful adoption of many modern techniques in the operation of spinning rooms, including patroling route work assignments of spinners.

In accordance with the present invention, it has been discovered that the overhead tracks which support, and furnish the electric power for, modern traveling pneumatic cleaners can be used also for supporting and furnishing the power to operate automatic ends down piecing-up equipment, such that a single piecing-up unit may be employed not only for detecting and piecing-up broken ends on a single machine, but also for a plurality of spinning machines as well.

Accordingly, it is an important object of this invention to provide a unitary patrolling device mounted on an overhead track extending above and along a spinning machine or a row or rows of spinning machines and combining in a single unit a traveling pneumatic cleaner, an ends down detecting means, a yarn piecing apparatus responsive to the detecting means for piecing-up ends down thus detected, and means for reporting to a data collecting and display system the operating condition of a spinning machine found to be operating improperly.

It is a further object of the present invention to provide a method of reducing the personnel required to tend a predetermined number of spinning machines, which includes traveling a source of flowing air in a predetermined path adjacent and along a row of spindles of a spinning machine, or rows of spindles of a row of spinning machines, and directing currents of air therefrom for cleaning the machines and areas adjacent the machines; concurrently scanning the yarns produced at the spindles of the machines and detecting the ends down

condition of the machines; and, upon detection of an end down, interrupting travel of the air flow source and automatically piecing-up the yarn end thus detected; then automatically resuming the travel of the source and the scanning of the yarns upon completion of the piecing-up operation, and reporting the ends down thus detected.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a perspective view of several rows of spinning machines or frames with corresponding track portions thereabove, on one of which an embodiment of the combined traveling cleaner and ends down piecing-up apparatus of the present invention is mounted for travel therealong;

FIGURE 1A is a layout of the rows of machines shown in FIGURE 1, with two endless tracks extending thereover, each track serving two machine rows and having a respective traveling cleaner-piecing-up apparatus mounted thereon;

FIGURE 1B is an enlarged plan view of a portion of FIGURE 1A;

FIGURE 1C is a fragmentary view of one end portion of a piece-up carriage guide rail **57** of FIGURE 1B;

FIGURE 2 is an enlarged transverse vertical sectional view through a typical spinning frame, taken substantially along line **2—2** in FIGURE 1B and also showing an end elevation of the combined traveling pneumatic cleaner and ends down piecing-up apparatus of the instant invention in association therewith;

FIGURE 3 is an enlarged fragmentary vertical sectional view, mostly in elevation, taken substantially along line **3—3** in FIGURE 2;

FIGURE 4 is an enlarged vertical sectional view taken substantially along line **4—4** in FIGURE 3 and showing the various parts of the piecing-up apparatus occupying positions of rest; i.e., between succeeding cycles in the operation thereof;

FIGURE 4A is a sectional plan view taken along line 4A—4A in FIGURE 4;

FIGURE 5 is an enlarged transverse vertical sectional view through the lower yarn end joiner assembly taken substantially along line **5—5** in FIGURE 3, with parts thereof occupying different positions than that shown in FIGURES 3 and 4 and wherein a vertically movable carriage or elevator therefor is shown in a lowered operative position in solid lines and in a raised inoperative position in phantom lines;

FIGURE 6 is a sectional plan view of the elevator taken substantially along line **6—6** in FIGURE 5 and showing a ring rail finder means in extended position and a lower auxiliary yarn feed gripper assembly in retracted position relative to the finder means;

FIGURE 7 is an enlarged vertical sectional view of the lower feed gripper for the auxiliary yarn taken substantially along line **7—7** in FIGURE 6;

FIGURE 8 is a fragmentary plan view of the auxiliary yarn cutter means taken substantially along line **8—8** in FIGURE 7;

FIGURE 9 is a fragmentary sectional plan view through the lower feed gripper shown in FIGURE 7 with the gripper jaws occupying open position;

FIGURE 10 is a fragmentary vertical sectional view taken substantially along line **10—10** in FIGURE 9;

FIGURES 11 and 12 are views similar to the respective FIGURES 9 and 10, but showing the gripper jaws in closed position;

FIGURE 13 is an enlarged perspective view looking substantially along the line **13—13** in FIGURE 5 and showing a vertically movable auxiliary yarn distending gripper occupying a lowered position beneath a cooperating stationary auxiliary yarn distending gripper;

FIGURE 14 is a perspective view of the vertically movable auxiliary yarn distending gripper occupying uppermost position adjacent and above an upper yarn feed gripper;

FIGURE 15 is a perspective view of the elevator and the upper platform and associated parts looking in the general direction of arrow **15** of FIGURE 6, and showing the ring rail finder means and the feed gripper slides in fully retracted positions;

FIGURE 16 is a perspective view similar to FIGURE 15 showing the auxiliary yarn feed grippers in fully forwardly extended positions;

FIGURE 17 is an enlarged vertical sectional view through the upper platform and adjacent parts taken substantially along line **17—17** in FIGURE 3;

FIGURE 18 is a vertical sectional view of the elevator taken substantially along line **18—18** in FIGURE 5;

FIGURE 19 is an enlarged fragmentary plan view showing the lower auxiliary yarn feed gripper in full forward position adjacent the corresponding bobbin and spindle, the location of parts in this view corresponding with the location thereof in FIGURE 16;

FIGURE 20 is a sectional view taken along line **20—20** in FIGURE 19;

FIGURE 21 is a schematic view of an electrical circuit for controlling the operation of signal devices associated with spinning frames; and

FIGURES 22 and 23 are, collectively, a schematic diagram of electrical circuitry for effecting a cycle in the operation of the ends down piecing-up devices in response to detecting ends down conditions and also for counting and reporting such conditions.

Referring more specifically to the drawings, the present invention generally comprises an overhead track-mounted traveling pneumatic cleaner **10**, serving as a patrolling device, combined with ends down piecing-up equipment. The piecing-up equipment is embodied in two piecing-up devices **11, 11'** carried by traveling cleaner **10** and positioned to travel adjacent respective opposite sides of a spinning machine or a row or rows of spinning machines.

In FIGURES 1 and 1A several rows of spinning machines are shown wherein each spinning frame is generally designated at **12** with a common overhead track **30** extending longitudinally of and above each pair of adjacent rows of spinning frames in the particular embodiment herein. Each of the tracks is shown in the form of an endless track, although double ended tracks may be employed for each machine or each row of machines. Referring to FIGURE 2, each spinning frame is the usual type having a creel **13** from the roving bobbins **14** of which roving R is directed to drafting rolls **15** adjacent each side of the spinning frame **12**. The lowermost drafting rolls **15** are commonly known as delivery drafting rolls and the attenuated roving R passing therefrom is twisted into yarn Y which normally passes through a pigtail guide **16** (FIGURE 4), then downwardly through or under a corresponding ring traveler **17** which revolves about a spinning ring **20** carried by a vertically reciprocating ring rail **21** (FIGURES 3 and 4). A row of spindles **22** at each side of the spinning frame is carried by a corresponding stationary spindle rail **24**, and a bobbin **25** is positioned on each spindle and projects upwardly through the corresponding spinning ring **20** for receiving and winding up the yarn directed thereto by the corresponding traveler **17**. As is well known, the spindles and bobbins are rotated continuously during operation of each spinning frame **12** so that the yarn Y is wound about each bobbin during vertical reciprocation of the corresponding ring rail **21**.

It is apparent that a separate traveling cleaner may be used with each overhead track **30**. However, only a single one of the traveling cleaners **10** will be described in detail. By way of example, traveling cleaner **10** is shown as being of the general type disclosed in FIGURES 19–22 of United States Patent No. 3,304,571, issued Feb. 21, 1967, to which reference is made for a more

detailed disclosure. Generally, traveling cleaner **10** comprises a wheeled carriage **31** whose wheels ride upon the rails of track **30** and at least one of the wheels of which is driven normally by an electric motor **32** which may be equipped with a suitable electromagnet clutch **33** and electromagnetic brake **34** which are controlled in a manner to be later described to start and stop the travel of the traveling cleaner **10** along the rack **30** a predetermined intervals; i.e., following and preceding each end down piecing-up operation. Track **30** is provided with the usual longitudinally extending conductor rails **30***a*, connected to a source of electrical energy, not shown. Conductor rails **30***a* and cooperating brushes on traveling cleaner **10** may be arranged as disclosed in U.S. Patent No. 2,184,880, issued Dec. 26, 1939, and therefore do not require further description. It is important to note, however, that all electric power for operating the traveling cleaner **10**, the ends down counters and the piecing-up devices **11**, **11'** is obtained from these overhead track-supported conductor rails **30***a*.

Carriage **31** also carries an electric motor **35** which drives a fan **36** for producing suction and blowing air in respective superposed suction and blowing housings **40**, **41**, also carried by carriage **31** or motor **35**.

Rigidly connected to each side of suction and blowing housings **40**, **41** are respective dependent suction and blowing sleeves or tubes **42**, **43** which support therebetween, at one side of the spinning frame **12**, the piecing-up device **11**, and which supports therebetween at the opposite side of the spinning frame **12** the other piecing-up device **11'**. The suction sleeves **42** may terminate adjacent the floor and have suitable suction nozzles **45** thereon for travel closely adjacent the floor and along opposite sides of the spinning frames so as to draw lint and other light material thereinto from the floor, which lint is directed into suitable collection chambers **46** connected to corresponding outlets of the suction housing **40**, as is more fully described in said U.S. Patent No. 3,304,-571. The blowing tubes **43** also preferably terminate adjacent the floor upon which the spinning frames rest and each has a plurality of blowing nozzes **47** thereon which may be strategically positioned so as to direct blasts of air toward various critical areas of the corresponding spinning frames to remove lin therefrom. Such lint is subsequently picked up by the suction nozzles **45**.

Since the means for propelling the traveling cleaner **10** along the overhead track **30** is the sole means by which the piecing-up devices **11**, **11'** are caused to travel along the spinning frames, it is apparent that the suction and blowing tubes **42**, **43** should be relatively rigid, or other suitable rigid framework should be provided between the housings of the traveling cleaner **10** and the piecing-up devices **11**, **11'**.

Since both of the piecing-up devices **11**, **11'** may be of substantially the same construction, only the piecing-up device **11** will be described in detail. As shown in FIGURE 3, piecing-up deivce **11** comprises a main carriage broadly designated at **50** and which is in the form of a housing, to the extent that it comprises a base **51**, upwardly extending side walls **52**, **53**, and a top wall **54**. The entire front of the piecing-up housing or carriage **50**, adjacent the spindles of the corresponding spinning frame **12**, is open and, to aid in guiding the piecing-up device **11** in proper relation to the spinning frame, the front portion of base **51** carries a pair of grooved wheels **56** which ride upon a corresponding guide rail **57** suitably supported by the corresponding spindle rail **24** of each spining frame. Each guide rail **57** extends longitudinally of the corresponding spinning frame and has a plurality of longitudinally spaced vertically depending lugs or abutments **60** thereon, there being one of the lugs positioned outwardly of but in substantially the same vertical plane as each spindle **22**. Other details of the guide rails **57** will appear later in this context.

Although the wheels **56** may support the main carriage **50** to some degree, the primary function of each guide rail **57** is for the purpose of accurately positioning the piecing-up device **11** with respect to the rows of spindles, since the full weight of the piecing-up device, at least during its passage between the proximal ends of adjacent spinning frames in a corresponding row, may be supported by the traveling cleaner. In this instance, suitable clamping members **61** are provided for securing the opposed sidewalls **52**, **53** to the suction and blowing sleeves **42**, **43** of traveling cleaner **10**. Additional wheel means, not shown, may be mounted on main carriage **50** so as to ride upon the room floor to further stabilize the apparatus, if desired.

Base **51** of main carriage **50** supports the lower ends of rigid substantially vertically disposed front and rear or inner and outer pairs of guide posts **64–67** to the upper ends of which substantially horizontal upper platform guide bars **70**, **71** are suitably secured (FIGURES 3, 4, 15, 16 and 17). A vertically movable carriage or elevator **72** is guided for free vertical reciprocatory movement on guide posts **64–67**, preferably by means of grooved wheels **73** journaled on opposite sides of elevator **73** and riding in engagement with corresponding posts **64–67**.

Guided for inward and outward or forward and rearward movement between opposed sideframe members **74**, **75** of elevator **72** is a lower platform **76** above which is spaced a ring rail finder platform **77** (FIGURES 5 and 15). Platforms **76**, **77** normally occupy the fully retracted position shown in FIGURE 15 so these platforms and the elements carried thereby will clear the head end and foot end frame members of each spinning frame in the course of movement of the traveling cleaner and piecing-up device from one spinning frame to the next spinning frame in the corresponding row. An upper gripper platform **78** is guided between the guide bars **70**, **71** and is adapted to move inwardly and outwardly substantially in synchronism with lower platform **76** and rail finder platform **77**.

First and second detecting means, in the form of photoelectric devices **79**, **80**, are carried by main carriage **50** for scanning the yarns in their course from the delivery rolls **15** to the spindles **22**. The photoelectric devices **79**, **80** and cooperating light sources or lamps **79***a*, **80***a* are mounted on the respective front guide posts **64**, **65** and, when operative, the light reflected from the successive yarn ends between delivery rolls **15** and pigtail guides **16** to the lenses and photocells of the photoelectric devices prevents such photoelectric devices from completing respective circuits to be described. Upon the absence of a yarn end between delivery rolls **15** and a pigtail guide **16**, known as an "end down condition" at the respective spindle **22**, the light is not reflected to the corresponding photoelectric device, thus triggering the operative amplifier thereof to complete a corresponding circuit.

For purposes of description, it may be assumed that traveling cleaner **10** and piecing-up device **11** travel unitarily from left to right in FIGURES 1B and 3. Therefore, first photoelectric device **79** serves as the leading photoelectric device for initiating an automatic piecing-up operation upon detecting an end down condition through the medium of an electric programmer or timing device **81** mounted in the upper portion of main carriage **50** (FIGURE 4). Second photoelectric device **80** thus serves to detect any end down condition which may still exist immediately after a piecing-up cycle of the piecing-up device **11** has been completed. Both photoelectric devices are arranged to actuate respective counting means upon detecting each end down condition.

Since the lenses, photocells and amplifiers of each photoelectric device **79**, **80** may be of conventional or other construction and may be operated substantially as disclosed in said copending application Ser. No. 706,287, a detailed illustration and description thereof is deemed

unnecessary. See FIGURES 21 and 22 for electrical circuitry associated with photoelectric devices **79**, **80**.

Lower and upper primary gripper-operating electric motors **82**, **83** of the reversible type are suitably secured to sideframe member **75** of elevator **72** and guide bar **71**, respectively. Motors **82**, **83**, under control of timing device **81**, drive respective racks **90**, **91** through gearing including respective worms and pinions **84**, **85**; **86**, **87** (FIGURES 4, 17 and 18). Racks **90**, **91** are suitably secured to the respective lower and upper platforms **76**, **78**. Since lower platform **76** and rail finder platform **77** are suitably interconnected, as by posts **92** (FIGURE 18), it is thus seen that energization of motor **82** will alternately impart inward and outward movement to platforms **76**, **77** in unison. Motor **83** is energized and deenergized at the same times as that of motor **82** so that upper platform **78** is also moved inwardly and outwardly in unison with platforms **76**, **77**.

A pair of lower and upper secondary gripper-operating electric motors **94**, **95**, whose bases are suitably pivotally secured upon the respective platforms **77**, **78**, are connected by respective worms **96**, **100**, form gears **96***a*, **100***a*, and pinions **97**, **101** to respective racks **102**, **103** suitably secured to respective lower and upper slides **104**, **105** (FIGURES 5, 6, 15, 16, 17 and 18). Slides **104**, **105** are guided for inward and outward movement on, and in suitable openings in, the respective platforms **77**, **78**. Since secondary motors **94**, **95** are pivoted at their outer portions to the platforms **77**, **78**, the worms **96**, **100** thereof are normally retained in engagement with the respective worm gears **96***a*, **100***a* by the vertically movable plungers of respective solenoids **106**, **107** (FIGURE 4) carried by respective platforms **77**, **78**.

Upon detection of the absence of a strand of yarn (end down condition) by photoelectric device **79**, between the drafting rolls **15** and the corresponding spindle **22** during travel of piecing-up device **11** along a row of spindles, traveling cleaner **10** and main piece-up carriage **50** are immediately brought to a standstill. Thereupon, primary motors **82**, **83** (FIGURE 4) are energized by timing device **81** (FIGURES 22 and 23) to advance platforms **76**, **77**, **78** so that downwardly projecting ring rail finder elements **110** (FIGURES 4, 5, 6, 15 and 16) depending from the inner end of rail finder platform **77**, overlie ring rail **21** with elevator **72** occupying a fully raised position.

Means are provided for then lowering elevator **72** until finder elements **110** engage the upper surface of ring rail **21** as shown in FIGURES 5 and 16. Carriage or elevator **72** is then supported by and reciprocates vertically with ring rail **21**. Following the piecing-up operation to be described, elevator **72** is lifted and returned to its normal or fully raised position and then primary motors **82**, **83** are again energized by timing device **81**, but in the reverse manner, to retract platforms **76**, **77**, **78**. Means for raising and lowering elevator **72** independently of ring rail **21** will now be described.

As best shown in FIGURES 3 and 4, in the interim between successive cycles in the operation of piecing-up device **11**, the sideframe members **74**, **75** of elevator **72** rest upon a transverse bar **111** on the upper end of a substantially vertically disposed rack **112** guided for vertical movement in a tubular member **113** carried by the base **51** of main carriage **58**. Rack **112** is engaged by a pinion **114** connected through an intervening worm gear **115** and a worm **116** to reversible electric elevator motor **117** fixed to base **51**. Thus, assuming that elevator **72** occupies its uppermost position, energization of elevator motor **117** by timing device **81** lowers rack **112** and elevator **72** and, upon finder elements **110** engaging ring rail **21**, rack **112** continues to move downwardly until its bar **111** is spaced below the level to which the lower portion of elevator **72** can move when ring rail **21** reaches its lowermost position. Obviously, motor **117** is deenergized when rack **112** reaches its desired lowermost position and, following each piecing-up operation, motor **117** is again energized by timing device **81**, but in a reverse manner, for a sufficient length of time to return elevator **72** to its fully raised position.

The proper alignment of the main carriage **50** with a corresponding spindle, upon detection of an end down condition, is obtained, in part, by means of a centering device **120** (FIGURES 4 and 4A) whose outer end is of substantially V-shaped configuration providing converging cam surfaces **121** thereon which converge into a notch or recess **122** of such shape and size as to snugly engage the corresponding lug **60** depending from guide rail **57**. Centering device **120** is fixed to the plunger of a solenoid **125** suitably secured to the inner portion of carriage base **51** and positioned in substantially vertical alignment with a pair of lower and upper auxiliary yarn distending grippers **126**, **127** carried by the respective lower and upper platforms **76**, **78** (FIGURES 5, 13, 14 and 15).

The jaws of lower distending gripper **126** extend rearwardly and are normally biased to closed position because they are connected to or formed integral with a pair of upstanding flexible brackets **130**, made rfom spring steel or the like, whose lower ends are suitably secured to the forward portion of lower platform **76**. An auxiliary yarn strand Y–**1** is normally clamped in the lower gripper **126** and is directed thereto from a supply package **131** removably fixed to and suspended from the upper portion of a cop support bracket **132** (FIGURES 3 and 15) suitably secured to rail finder platform **77**. Auxiliary yarn strand Y–**1** may be guided from package **131** to gripper **126** in any desired manner. As shown, auxiliary yarn strand Y–**1** extends downwardly from the lower end of package **131**, then passes through a suitable opening **135** (FIGURE 6) provided in platform **77**, then extends downwardly beneath a roller or guide **136** carried by lower platform **76**, and then extends forwardly and upwardly in engagement with another roller or guide **137** carried by the forward portion of lower platform **76**. From the roller **137**, the strand Y–**1** extends upwardly through the gripper **126** and normally terminates at the level of a pair of cooperating cutter blades **140** (FIGURES 5, 7, 8 and 15), one of which is stationary and the other of which is movable and biased toward closed position with respect to said one of the cutter blades **140**.

The upper auxiliary yarn distending gripper **127** is also biased to normally occupy closed condition and the jaws thereof extend forwardly and have their front ends secured to respective pivoted arms **142** interconnected by a tension spring **143** (FIGURE 14) and pivotally connected to the lower end portion of a gripper elevating bracket **144** of generally T-shaped configuration. Bracket **144** is guided for vertical sliding movement on a pair of vertical rods **145** (FIGURES 5, 6 and 15) whose upper ends are secured to standards **146** carried by upper platform **78**. Guide rods **145** extend downwardly and loosely penetrate the forwardly extending wing portions of rail finder platform **77**, thus stabilizing guide rods **145** while permitting vertical reciprocation of platform **77** relative to guide rods **145**.

An elevator cable **150** is connected to a medial upper portion of elevating bracket **144** and extends upwardly over a pulley **151** carried by a transverse rod **152** suitably secured to the upper portions of standards **146**. Cable **150** extends downwardly and rearwardly and is connected to a reel **154** (FIGURES 3 and 4) connected by a suitable electromagnetic clutch **155** to the shaft of an electric windlass motor **156** suitably secured to one of the standards **144**. Clutch **155** is normally deenergized and normally maintains a fixed connection between reel **154** and the shaft of motor **156**, and also serves normally to prevent rotation of reel **154** when motor **156** is not in operation. When clutch **155** is energized, reel **154** may

rotate freely. Thus, in the interim between successive piecing-up cycles of the device **11**, motor **156** and its clutch **155** normally hold reel **154** in such a position that the gripper elevating bracket **144** normally occupies the fully raised position shown in FIGURE 15. However, upon detection of an ends down condition and following the extension of platforms **76**, **77**, **78** and the lowering of elevator **72** to "rail finding position," bar **111** on vertical rack **112** (FIGURES 3 and 4) momentarily closes a switch **157** (FIGURE 23) to activate a holding circuit relay **158** establishing a circuit from rail conductors **30***a* to reel clutch **155**. Thus, reel **154** is released and permits bracket **144** and upper distending gripper **127** to fall freely until the distal portions of bracket **144** strike and come to rest against the rail finder platform **77**, as shown in FIGURE 5. In so doing, lateral downwardly diverging wing members **160** on the jaws of upper distending gripper **127** engage the downwardly diverging upper surfaces of the jaws of lower distending gripper **126**, thus opening the jaws of gripper **127** as they move downwardly so that they will close against the auxiliary yarn strand Y–**1** between gripper **126** and pulley **137** as shown in FIGURES 5 and 13.

Also, as bracket **144** comes to rest against rail finder platform **77**, it opens a normally closed switch **161** (FIGURE 23) to inactivate holding circuit relay **158** and thereby deenergize clutch **155**. At the same time, bracket **144** closes a normally open switch **162** to activate a holding circuit relay **163** which, in turn, energizes reel motor **156**. In the course of upward movement of distending gripper **127** from the position of FIGURES 5 and 13 to that of FIGURES 14 and 15, gripper **127** draws the auxiliary yarn strand Y–**1** upwardly therewith and passes between the jaws of stationary gripper **126** which then permits the auxiliary yarn strand Y–**1** to slip therethrough as it is drawn upwardly to provide a fully distended length of auxiliary yarn Y–**1** between stationary grippers **126**, **127** when the latter reaches fully raised position. When gripper **127** returns to fully raised position, it opens a switch **164** (FIGURE 23) to inactivate relay **163** and interrupt the circuit to motor **156**.

During the successive downward and upward movements of upper distending gripper **127**, it passes between the open jaws of lower and upper auxiliary yarn feed grippers **166**, **167** carried by and movable inwardly and outwardly with the respective slides **104**, **105**. As best shown in FIGURES 7, 9 and 11, the rear portions of the jaws of lower feed gripper **166** are pivotally mounted in the bifurcated forward end of a tubular carrier **169** and are normally biased toward open position by a pair of leaf springs **171** carried by carrier **169**. Carrier **169** is secured to and extends parallel to and eccentrically of the secondary one of a pair of axially aligned primary and secondary rotors **172**, **173**. Projecting forwardly from rotor **173**, in substantially circularly spaced relation to and substantially parallel with carrier **169**, is a traveler threading finger **174** which cooperates with lower feed gripper **166**, in a manner to be later described, to position the substantially distended length of auxiliary yarn Y–**1** in engagement with the corresponding spinning ring **20** and yarn wound on the corresponding bobbin **25**, substantially as shown in FIGURES 19 and 20, in the process of threading the auxiliary yarn length through the traveler **17** and casting the lower end portion of the yarn length onto the rotating bobbin **25**.

Referring again to FIGURES 9 and 11, it will be observed that a gripper controlling plunger **176** is mounted for longitudinal movement in tubular carrier **169** and is normally yieldably urged to inoperative position with respect to gripper **166** by a suitable spring **177**. The forward end of plunger **176** is tapered or pointed so as to enter between the tails of the jaws of gripper **166** to move the same to closed position in opposition to springs **171**. Accordingly, primary rotor **172** is fixed on a tubular shaft **180** and is provided with a forwardly projecting cam **181** thereon which, upon initiation of an active angular stroke in motion of shaft **180** and primary rotor **172**, engages the rear end of plunger **176** to move the same forwardly into gripper closing position (FIGURE 11).

Secondary rotor **173** is rotatably mounted on tubular shaft **180** and has an arcuate slot **182** therethrough which is generated about the axis of rotors **172**, **173** and is loosely engaged by a pin **183** secured to and projecting forwardly from rotor **172**. A spring **184**, having one end connected to rotor **172** at **184***a* and having its other end connected to rotor **173** at **184***b*, normally urges rotor **173** counterclockwise of rotor **172** in FIGURES 10 and 11. Thus, the end of slot **182** adjacent cam **181** is normally urged toward pin **183**. However, upon initial clockwise rotation being imparted to primary rotor **172** in FIGURE 10, the secondary rotor **173** is yieldably restrained from corresponding rotation, by means to be later described, and this, coupled with the force of spring **184**, ensures that rotor **172** moves cam **181** and pin **183** in a clockwise direction from the position of FIGURE 10 to that of FIGURE 12, before rotor **173** starts to turn, thus causing the jaws of gripper **166** to occupy the closed position of FIGURE 11 and to clamp the auxiliary yarn strand Y–**1** adjacent and above the cutter blades **140** before gripper **166** starts to rotate with rotor **173**. Thereafter, spring **184** maintains rotors **172**, **173** in the latter relative positions, as shown in FIGURES 11 and 12, during further rotation of tubular shaft **180** and until the lower feed gripper **166** is opened momentarily to release the strand Y–**1** therefrom and, thereafter, until gripper **166** is returned to the lowered position shown in FIGURES 5 and 7.

As rotors **172**, **173** return to their inoperative positions, a radially projecting abutment **185** on secondary rotor **173** strikes a standard **186** mounted on lower platform **76** (FIGURE 5) so that further counterclockwise rotation of tubular shaft **180** in FIGURE 12 imparts counterclockwise rotation to rotor **172**, cam **181** and pin **183** in opposition to tension spring **184** and relative to rotor **173**, thus permitting plunger **176** to retract relative to the jaws of gripper **166** so the latter jaws return to open position as shown in FIGURES 9 and 15. In order to ensure that rotor **172** rotates in a clockwise direction relative to rotor **173** upon initiation of a clockwise movement of shaft **180** in FIGURES 10 and 12, radial abutment **185** contains a detent **187** which engages a lateral portion of standard **186** (FIGURE 7).

As heretofore stated, cutter blades **140** are normally inherently biased toward closed position. It is apparent, by referring to FIGURE 8 in particular, that while gripper **166** occupies its lowermost or inoperative position shown in FIGURES 5 and 7, the movable one of the blades **140** is held in open position relative to the stationary blade by virtue of the radial abutment **185** on rotor **173** engaging a tail portion **190** of the movable blade **140**. Thus, as gripper **166** starts to move outwardly of the vertical plane of stationary distending gripper **126**, radial abutment **185** moves away from the tail **190** of the movable one of the cutter blades **140**, thereby permitting the cutter blades to close and sever the auxiliary yarn strand Y–**1** at a point spaced above stationary distending gripper **126** and spaced below lower feed gripper **166**.

Thereupon, shaft **180** and rotors **172**, **173** move gripper **166** in a counterclockwise direction in FIGURE 15 to substantially the position occupied thereby in FIGURE 16 relative to lower slide **104**, during the course of which gripper **166** moves to a position to one side of and above the level of the corresponding spinning ring **20** (FIGURE 20). At the same time, traveler threading finger **174** moves downwardly in opposition to the upward movement of lower feed gripper **166** and the hook-like outer end portion of finger **174** thus engages and moves the corresponding portion of the auxiliary yarn strand length Y–**1** downwardly. The lower feed gripper **166** and finger **174** finally come to rest with the finger **174** occupying a lower level

than gripper **166**, the finger **174** being then positioned on a level below that of the upper surface of the corresponding spinning ring and above that of the upper surface of the ring rail as in FIGURE 20. Thus, the portion of auxiliary yarn extending between gripper **166** and finger **174** extends at an acute angle with respect to the level of the ring rail **21**.

With the rotors **172, 173** occupying the latter position, the slide **104** is advanced inwardly or forwardly under control of lower secondary motor **94** and in response to timing device **81**, to thus move the rotors **172, 173**, the drive means therefor to be later described, and the lower feed gripper **166** and the traveler threading finger **174** to fully extended position. In the latter position, the gripper **166** and finger **174** straddle the corresponding spindle substantially as shown in FIGURES 16 and 19. Immediately prior to the gripper reaching fully extended or foremost position adjacent the corresponding bobbin **25**, the radially projecting abutment **185** on rotor **173** engages and rides upon a stationary gripper-opening cam **195** (FIGURES 5, 6, 15 and 16) which rotates secondary rotor **173** sufficiently relative to primary rotor **172** to open gripper **166** sufficiently to release auxiliary yarn strand Y–1 therefrom.

In the meantime, means are provided for threading the strand Y–1 under the substantially C-shaped traveler **17** and to entrain the strand Y–1 upon bobbin **25**. As shown in FIGURES 19 and 20, a traveler propelling blowing or blast nozzle or tube **196** and a yarn casting or wrapping blast nozzle or tube **197** move in fixed relation with primary rotor **172** to occupy a position adjacent the corresponding spinning ring as in FIGURE 19. In the latter position, traveler propelling tube **196** will direct an air stream into and against the inner periphery of the corresponding ring **20**, thus causing traveler **17** to move over the portion of auxiliary yarn strand Y–1 which is engaging the outer periphery of the ring to thread the strand through the traveler. Also, when the lower feed gripper **166** is opened in the manner last described, the blast of air from casting nozzle **197** will blow the free end of the auxiliary yarn strand toward the bobbin or the yarn thereon so that the auxiliary yarn strand adheres to and is taken up by the rotating bobbin **25**.

Immediately upon the auxiliary yarn strand being cast from the lower feed gripper **166** in the manner last described, solenoid **106** is activated by a switch **106***a* (FIGURES 6 and 23) to raise worm **96** out of engagement with worm gear **96***a* (FIGURE 15) in opposition to a spring **200** (FIGURE 5), thereby permitting a spring **201** to quickly retract slide **104** and parts carried thereby and thereby withdraw lower feed gripper **166** and finger **174** from the immediate vicinity of bobbin **25** so that they will not interfere with the subsequent winding operation. As lower feed gripper **166** is withdrawn, it is apparent that radial abutment **185** (FIGURE 10) moves out of engagement with stationary cam **195**, thereby permitting spring **184** to return secondary rotor **173** to the position shown in FIGURE 12 relative to primary rotor **172** and, of course, to return gripper **166** to closed condition. However, as heretofore stated, the jaws of movable gripper **166** are again opened upon return of gripper **166** to its lowermost position shown in FIGURES 5 and 15. The means for rotating rotors **172, 173** through the desired angular distance indicated heretofore will now be described.

Tubular shaft **180** (FIGURE 7) is journaled in the central portion of slide **104** and has a pinion **205** fixed on its rear or outer end. Pinion **205** engages a rack **206** carried by a pair of arms **207** which extend forwardly or inwardly and are secured to opposite ends of the plunger of a solenoid **210** (FIGURES 5 and 18). A spring **211** normally urges rack **206** from left to right in FIGURE 18 to, in effect, normally urge rotor shaft **180** in a counterclockwise direction in FIGURES 10 and 12. The spring **211** of FIGURE 18 is sufficiently stronger than the spring **184** of FIGURE 10 to ensure that cam **181** and pin **183** occupy the positions shown in FIGURE 10 when the radial abutment **185** is in engagement with standard **186**. As shown, when solenoid **210** is energized by timing device **81**, rack **206** moves a predetermined distance from right to left in FIGURE 18 to impart about 120° rotation to rotor shaft **180** and rotor **172**. Solenoid **210** is maintained in energized condition from the time at about which the length of auxiliary yarn strand Y–1 is withdrawn from supply package **131** by the upward motion of upper distending gripper **127**, until about the time that slide **104** is fully retracted.

Blowing tubes or nozzles **196, 197** curve rearwardly and are suitably secured to tubular shaft **180** (FIGURE 7). One end of a small conduit **212** is connected, by a suitable rotary coupling **213**, to the rear end of shaft **180**. The other end of conduit **212** may penetrate blowing sleeve **43** of the traveling cleaner (FIGURE 3) and is suitably flared or formed otherwise to ensure that air flowing down sleeve **43** enters conduit **212** to be discharged from nozzles **196, 197** at the desired velocity. Alternatively, conduit **212** may be connected to a small air compressor, not shown, carried by traveling cleaner **10**, if desired.

Although the platforms **76, 77, 78** are extended, the upper feed gripper **167** normally occupies the withdrawn position shown in FIGURES 14, 15 and 17 relative to platform **78**, during which the jaws of gripper **167** are held open by leaf spring members **220** (FIGURE 14) engaging tail portions of the latter jaws rearwardly of the point at which the latter jaws are pivotally mounted in the bifurcated end portion of a carier **222**. Carrier **222** extends rearwardly or outwardly and is suitably secured to or formed integral with upper slide **105**, and has a longitudinally extending cam plunger **224** loosely mounted therein which may cooperate with the jaws of upper feed gripper **167** in substantially the same manner as that in which plunger **176** cooperates with the jaws of lower feed gripper **166**, as shown in FIGURES 9 and 11.

The plunger **224** is normally urged to retracted or inoperative position, such as by the same type of spring as that indicated at **177** in FIGURE 9, so that the jaws of gripper **167** normally occupy the open position shown in FIGURES 6 and 15. However, at about the same time that the jaws of lower feed gripper **166** close on the distended length of auxiliary yarn strand Y–1, a solenoid **227** (FIGURE 17), carried by upper slide **105**, is energized by timing device **81** so its plunger moves upwardly in engagement with the rear or outer end of plunger **224**, thus moving the same forwardly relative to carrier **222** to cause the jaws of gripper **167** to clamp the auxiliary yarn strand Y–1 immediately below the upper distending gripper **127**, substantially as shown in FIGURE 14.

At about the same time that lower secondary motor **94** is energized to advance lower slide **104** relative to rail finder platform **77**, upper secondary motor **95** also is energized by timing device **81** (FIGURES 4, 15 and 17) to advance and fully extend slide **105** and gripper **167** so that gripper **167** occupies the phantom-line position shown in FIGURE 17, closely adjacent the nip of the delivery drafting rolls **15** at about the same time that the lower feed grippers **166** occupy the position closely adjacent the corresponding bobbin **25** as shown in FIGURE 19. In the course of the latter advancing motion of upper feed gripper **167**, upstanding ears **230** (FIGURE 14) on the jaws of gripper **167** enter between forwardly converging cam flaps **231** on the rear portions of the jaws of the upper distending gripper **127** to spread the latter jaws apart and thereby release the corresponding end of the auxiliary yarn strand Y–1 therefrom. Thus, the cut length of strand Y–1 then extends between and is carried inwardly solely by the lower and upper feed grippers **166, 167**.

At about the same time that cam **195** (FIGURE 5) causes lower feed gripper **166** to open and release the lower portion of the length of auxiliary strand closely adjacent a bobbin **25**, upper feed gripper **167** also releases the yarn therefrom. To this end, upper slide **105** engages a switch **95***a* (FIGURES 15 and 23) to deenergize motor

95 and solenoid 227 (FIGURE 17). Thus, the spring of solenoid 227 retracts its plunger and permits the horizontal plunger 224 to withdraw from engagement with the rear portion of upper feed gripper 167, thereby permitting the leaf springs 220 (FIGURE 14) to instantly open upper feed gripper 167 to release the auxiliary yarn therefrom.

It will be noted in the right-hand portion of FIGURE 17 that the end of attenuated roving R issuing from the drafting rolls 15 is being drawn into a conventional suction head 232 connected to a source of suction embodied in a suction duct 233 (FIGURES 2 and 4) extending lengthwise of the corresponding spinning frame 12 so as to direct waste material to a suitable collection box, not shown. Such end collection systems are well known and a further detailed description thereof is deemed unnecessary. A typical end collection system is shown in U.S. Patent No. 2,893,196, issued July 7, 1959.

Since the attenuated roving thus extends from delivery rolls 15 into suction head 233, as upper feed gripper 167 moves into close proximity to the nip of delivery drafting rolls 15, the corresponding end of auxiliary yarn Y–1 becomes quickly entangled with the roving end issuing from the delivery rolls 15, and is also released at about the same time that such joining of the ends occurs, with the result that the piecing-up operation is substantially completed as the auxiliary yarn is taken up by the bobbin 25 therebeneath in the manner heretofore described.

Immediately upon the lower and upper feed grippers 166, 167 releasing the length of auxiliary yarn strand Y–1, switch 106*a* (FIGURES 6 and 23) also energizes solenoid 107 to raise worm 100 out of engagement with worm gear 100*a* (FIGURES 4 and 15), whereupon spring 235 (FIGURE 17) quickly retracts slide 105 to withdraw upper feed gripper 167 substantially to the position shown in FIGURE 17. Since the jaws of upper feed gripper 167 then occupy open position, the ears 230 thereon simply withdraw astraddle the cam wings 231 on the jaws of upper distending gripper 127.

It should be noted that, in the course of active inward or forward movement of feed grippers 166, 167, the length of auxiliary yarn strand Y–1 extending therebetween is pushed against the spirally formed pigtail yarn guide 16 and is thus automatically threaded into the corresponding pigtail yarn guide. In a similar manner, the auxiliary yarn strand Y–1 may be threaded into conventional node rings, if such are provided on the spinning frame.

Although the operation thus far completes the piecing-up of the corresponding ends down, the cycle of the piecing-up apparatus 11 continues, in that elevator motor 117 (FIGURE 4) is energized in a reverse manner, by timing device 81, to impart upward movement to rack 112 so that the transverse bar 111 moves into engagement with and elevates vertically movable carriage or elevator 72 to its normal fully raised position. Motor 117 is then deenergized and primary motors 82, 83 are energized by timing device 81 to operate in a reverse manner and retract the platforms 76, 77, 78 to their normal rest position.

The counting and recording means responsive to the ends down detecting means 79, 80 will be later described following a description of a cycle in the operation of piecing-up device 11.

A CYCLE IN OPERATION OF PIECING-UP DEVICE

It is to be assumed that traveling cleaner 10 is passing over a cross aisle between adjacent spinning frames in a corresponding row or at either end of a corresponding row and is approaching one end of a succeeding spinning frame with the fan motor 35 and the cleaner propelling motor 32 of FIGURE 2 receiving electric current from the conductor rails 30*a* which extend longitudinally of overhead track 30.

(1) As the main carriage 50 of piecing-up device 11 approaches the end of a spinning frame adjacent an aisle, the main carriage wheels 56 (FIGURE 4) are guided onto the downwardly curved free end of the corresponding horizontal guide rail 57 (FIGURE 1C) by means of curved guide plates 257 and, in so doing, the plunger of a normally closed switch 260 carried by carriage 50 enters a slot 261 in guide rail 57. The slot 261 terminates in a plane a lesser distance from the first spindle 22 in the corresponding row than that distance between adjacent spindles so that the plunger of switch 260 subsequently engages the upper surface of guide rail 57 and is actuated thereby. Switch 260 is interposed in an electrical circuit between conductor rails 30*a* and the amplifier portions of photoelectric devices 79, 80 such that upon lifting the armature of switch 260 (FIGURE 23), the corresponding amplifiers and light sources 79*a*, 80*a* are activated.

(2) Since first photoelectric device 79 is interposed in an electrical circuit between the conductor rails 30*a* and a motor 81*a* (FIGURE 22) of timing device 81 and is also interposed in an electrical circuit between the clutch 33 and brake 34 of carriage drive motor 32 and the rails 30*a*, the detection of an ends down condition by photoelectric device 79 energizes the normally deenergized clutch 33 through a holding circuit relay 33*a* (FIGURE 22) to prevent motor 32 from transmitting rotation to the wheels of carriage 31. Photoelectric device 79 also energizes electromagnetic brake 34 through a holding circuit relay 34*a* to instantly stop motion of cleaner carriage 31 along track 30 while also initiating a cycle in the operation of timing device 81. It is apparent that the piecing-up devices 11, 11' are also caused to stop movement along the corresponding row of spindles simultaneously with stoppage of the travel of traveling cleaner 10. The electric motor 81*a* of timing device 81 drives a plurality of cams which rotate through a single revolution during each cycle in the operation of piecing-up device 11.

(3) As indicated in FIGURE 12, upon actuation of timing device motor 81*a* by photoelectric device 79, a cam 125*a* of timing device 81 closes a switch 125*b* to complete a circuit from rails 30*a* to solenoid 125 of centering device 120 (FIGURE 4), causing the same to move forwardly against a corresponding lug 60 depending from guide rail 57.

(4) At the same time that solenoid 125 is energized, a switch 34*b* is engaged by timing cam 340 to break the circuit being held by relay 34*a* and render brake 34 inoperative. The cam surfaces 121 of centering device 120 then engage the corresponding lug and move the traveling cleaner and the piecing-up device 11 in the desired direction longitudinally of rail 57 to accurately position the piecing-up device in proper alignment with the corresponding spindle 22.

(5) A cam 82*a* of timing device 81 then operates a switch 82*b* (FIGURE 23) to energize primary motors 82, 83 for a predetermined period sufficiently to position the grippers 126, 127, 166, 167 in the desired close proximity to the corresponding spindle, and particularly, to position the finder elements 110 in the vertical plane of ring rail 21, whereupon the timer cam 82*a* deenergizes primary motors 82, 83.

(6) A cam 117*a* of timing device 81 then operates a switch 117*b* (FIGURE 23) to establish a circuit between conductor rails 30*a* and elevator motor 117, energizing elevator motor 117 in the forward direction to lower rack 112 and permit elevator 72 to move downwardly until its rail finder elements 110 contact the upper surface of ring rail 21 in the manner heretofore described.

(7) As the bar 111 on elevator rack 112 approaches lowermost position, it momentarily engages and closes switch 157 to effect a cycle in vertical downward and upward motion of upper distending gripper 127 in the manner heretofore described (see FIGURES 4 and 23), thereby drawing a length of yarn strand Y–1 from supply package 131 (FIGURES 3, 4, 5, 15 and 16).

(8) Upon gripper 127 starting downward in step 7, its bracket 144 releases normally open switch 144*a* (FIGURES 15 and 22) to break the circuit to the motor 81*a*

of timing device **81** at the same time that clutch **155** was energized to release upper distending gripper **127**. When upper distending gripper **127** subsequently returns to fully raised position, its bracket **144** closes switch **144***a* to again energize the motor **81***a* of timing device **81**.

(9) A timing cam **210***a* (FIGURE 23) then closes a switch **210***b* which energizes solenoid **210** (FIGURE 18) to impart the desired angular rotary motion to rotors **172, 173** (FIGURES 7 and 9–12). Thus, the distended length of yarn Y–1 is gripped in lower feed gripper **166** and a deflected length of the lower portion of the latter strand is deflected between gripper **166** and traveler threading finger **174** in the manner heretofore described; during the course of which auxiliary yarn strand Y–1 is severed by cutter blades **140** (FIGURES 5 and 8).

(10) Immediately following initiation of active rotary motion of rotors **172, 173**, a pair of timing cams **94***a*, **95***a* (FIGURE 23) close respective switches **94***b*, **95***b* momentarily to energize the secondary motors **94, 95** through respective holding circuit relays **94***c*, **95***c*. At the same time that motor **95** is energized, holding circuit relay **95***c* also energizes solenoid **227** (FIGURE 17) so that upper fed gripper **167** clamps the auxiliary yarn strand, in the manner heretofore described (FIGURE 14), as secondary motors **94, 95** advance lower and upper feed grippers **166, 167** to fully extended positions.

(11) At about the time that solenoid **210** is energized as in step 9, a timing cam **106***b* (FIGURE 23) closes a switch **106***c*. Thus, when lower slide **104** reaches fully extended position and engages switch **106***a* (FIGURES 6 and 23), one of the armatures of switch **106***a* is moved from a normally open position to a closed position to energize solenoids **106, 107** through a holding circuit relay **106***d*, during which the circuit is completed through the timer operated switch **106***c*. In so doing, solenoids **106, 107** (FIGURES 5 and 17) tilt the respective secondary motors **94, 95** to release horizontal racks **102, 103**, thereby returning slides **104, 105** to retracted position relative to the respective platforms **77, 78** and thereby to quickly retract lower and upper feed grippers **166, 167** in the manner heretofore described.

(12) At the time that switch **106***a* was operated by forward motion of lower slide **104** (FIGURE 6), a normally closed armature of switch **106***a* (FIGURE 23) was moved to open position to break the circuit to holding circuit relay **94***c* thereby deenergizing secondary motor **94**. Similarly, when upper slide **105** reached fully extended position relative to platform **78**, it engaged and opened normally closed switch **95***a* to break the circuit to holding circuit relay **95***c* and thereby break the circuit to upper secondary motor **95** and solenoid **227** to open the upper feed gripper **167** while it occupied fully extended position adjacent the nip of delivery drafting rolls **15**.

(13) Cam **210***a* (FIGURE 23) then permits switch **210***b* to open and interrupt the flow of current to solenoid **210**. Thus, spring **211** (FIGURE 18) reversely rotates rotors **172, 173**, lower feed gripper **156** and finger **174** to return them to their original inactive position shown in FIGURES 5, 9 and 10, and thereby to cause gripper **166** and cutter blades **140** to occupy open position.

(14) A timing cam **117***c* (FIGURE 23) then closes a timing switch **117***d* to reverse elevator motor **117** (FIGURE 4) for a sufficient time to return elevator **72** to the fully raised position, as heretofore described.

(15) Thereafter, primary motors **82, 83** are energized in a reverse manner by a timing cam **82***c* closing a switch **82***d* to reverse the operation of motors **82, 83** for a sufficient time to fully retract platforms **76, 77, 78** relative to elevator **75** and guide bars **70, 71** (FIGURES 5 and 15).

(16) Thereafter, a cam **80***b*, which had been maintaining a switch **80***c* in closed position (FIGURE 22) from the time the end down condition was originally detected by photoelectric device **79**, permits switch **80***c* to return to open position to cause a change of state in the amplifier of photoelectric device **79** such as to interrupt the flow of current to timer motor **81***a*. In so doing, holding circuit relays **33***a*, **34***a* are rendered operable to break the circuit to clutch **33** and brake **34** so that travel of the traveling cleaner **10** and the piecing-up devices **11, 11'** is again initiated.

(17) At the time that clutch **33** and brake **34** are deenergized, centering solenoid **125** is also deenergized under influence of timer cam **125***a* of FIGURE 22. The piecing-up device is then in condition for a repeat cycle upon subsequent detection of an end down condition by photoelectric device **79**.

ENDS DOWN COUNTING AND REPORTING MEANS

The photoelectric devices **79, 80** (FIGURES 3, 4 and 22) scan the yarn ends above each row of spindles, and each of the photoelectric devices **79, 80** detects an end down condition producing an electrical pulse in the corresponding amplifier. The electric pulse thus produced by the photoelectric device **79** not only initiates a cycle in the operation of piecing-up device **11**, but it also actuates a counting means. Similarly, in the event that the piecing-up device does not properly join the corresponding yarn end by connecting a length of the auxiliary yarn strand Y–1 to the attenuated roving issuing from drafting rolls **15** and to the bobbin **25** therebelow, an end down condition will still exist at the particular spindle, and the end down condition then will be detected by the second photoelectric device **80**. Each such detection of an end down condition by second photoelectric device **80** also produces an electrical pulse in its respective amplifier, operating a respective counting means, which will, in turn, operate a signal device so that an attendant may be informed that the piecing-up device **11** is not operating properly.

The ends down counting or registering means responsive to first photoelectric device **79** is indicated at **265** (FIGURES 1B and 2) and the second ends down counting means is indicated at **266**. Similar counting means for the piecing-up device **11'** are indicated at **265', 266'** and all four of the ends down counting means are suitably supported on the uppermost or suction housing **40** of traveling cleaner **10**. Each ends down counting means **265, 266, 265', 266'** may be constructed and operated in the manner disclosed in said copending application, Ser. No. 706,287, filed Feb. 19, 1968. Accordingly, a detailed description and illustration of each ends down counting means will not be given herein, but reference is made to the latter copending application for a more complete disclosure of the ends down counting means. It is to be noted that each ends down counting means **265, 266, 265', 266'** is provided with a movable abutment means **270** which normally occupies a lowered or withdrawn position out of the horizontal plane of signal control switch means positioned immediately above the path of travel of the respective ends down counting means **265, 266, 265', 266'**. The latter switch means for the respective ends down counting means **265, 266, 265', 266'** are respectively designated at **275, 276, 275', 276'** and are suitably supported about midway of the cross aisle between adjacent spinning frames as shown in FIGURE 1B.

As shown in FIGURE 22, the first ends down counting means **265** is in series circuit with first photoelectric device **79** so that an electrical impulse is directed from photoelectric device **79** to first ends down counting means **265** upon each detection of an end down condition by first photoelectric device **79**.

Upon a predetermined number of electrical impulses, say, six or more, being transmitted to first ends down counting means **265**, movable abutment means **270** thereof will then project above first ends down counting means **265** to an extent to actuate the corresponding switch means **275** after the traveling cleaner **10** has passed beyond one end of the corresponding spinning frame and has moved away from the same to a point about midway of

the succeeding cross aisle. Thus, it can be seen that the register or ends down counting means originates a signal indicative of the detection of a predetermined number of ends down. The second ends down counting means **266** operates in a similar manner to first ends down counting means, but in response to the second photoelectric device **80**.

Thus, upon second ends down counting means **266** having received a predetermined number of electrical impulses from second photoelectric device, its movable abutment means **270** also is elevated sufficiently to subsequently actuate the switch means **276**. The switch means **275**, **276** are disposed in series with respective holding circuit relays **275***a*, **276***a* which operate respective reporting devices **277**, **278** (FIGURES 1B and 21) whenever the respective switch means **275**, **276** are momentarily closed by the movable abutments **270** of the respective ends down counting means **265**, **266**. It is apparent that the reporting devices **277'**, **278'** and respective means **275'**, **276'** are arranged in the same manner as that described with respect to the reporting devices **277**, **278** and switch means **275**, **276**. The reporting devices **277**, **278**, **277'**, **278'** represent a data collecting and display system, and are mounted preferably adjacent or upon one end of the corresponding spinning frame **12** so that, if the reporting devices **277**, **278**, **277'**, **278'** are in the form of different colored electric lamps, for example, they may be readily visible to the attendant. It is to be understood, however, that the reporting devices **277**, **278**, **277'**, **278'** for all the spinning frames in a particular row or all the rows may be located at a common monitoring station which may be remote from the spinning frames, if desired. For example, a visible monitoring device may be suspended from the ceiling at a level above all the machines so as to be readily visible by the attendant or a data collecting device may be located in the office of the superintendent of the spinning room and connected to the register means **265**, **266**, **265'**, **266'** associated with all the machines in the room. It is contemplated also that the register means may be connected to suitable automatic data processing equipment for documenting the operating condition of the machines, if desired.

Since the reporting of ends down conditions should be detected at each side of the spinning frame independently of the other, each ends down counting means **265**, **266** is provided with a respective ends down counting reset means, there being two sets of reset means shown schematically in FIGURE 22 and respectively designated at **281**, **282** wherein it will also be noted that the reset means **281**, **282** are connected to the conductor rails **30***a* associated with the corresponding overhead track **30** and the switch **260** heretofore described is interposed in the circuit to the ends down counting reset means. Thus, in order to rest the ends down counting means **265**, **266**, **265'**, **266'** following travel thereof over each successive spinning frame **12**, the plunger of switch **260** drops into the corresponding slot **261** (FIGURES 1B and 1C) and not only breaks the circuit to the first and second photoelectric devices **79**, **80**, but also establishes a circuit to a suitable time delay relay **285** (FIGURE 22) which is effective to delay energization of the ends down counting reset means **281**, **282** until after any extended movable abutment means **270** on corresponding ends down counting means have actuated corresponding switch means **275**, **276**. Immediately thereafter, before the traveling cleaner reaches the next succeeding spinning frame, time delay relay **285** transmits an electrical pulse to the ends down counting reset means **281**, **282**, and similar such means associated with counting means **265'**, **266'** to retract any of those abutment means **270** which had previously been raised into the plane of switch means **275**, **276**, **275'**, **276'**.

Thereafter, as the traveling cleaner **10** starts to travel along a succeeding spinning frame, the housing or main carriage **50** of piecing-up device **11** engages and momentarily opens a normally closed switch **286** (FIGURES 1C and 21) mounted on the spinning frame and which is also interposed in the electrical circuit to the reporting devices or lamps **277**, **278** and holding circuit relays **275***a*, **276***a*. Upon switch **286** being opened momentarily, either manually or by the traveling piecing-up device **11**, switch **286** breaks the circuit of the holding circuit relays **275***a*, **276***a* thereby shutting off the lamps **277**, **278** until they are again energized by the respective switches **275**, **276** being operated in the manner heretofore described. Thus, switch **286** serves as reset means for the reporting devices **277**, **278**, **277'**, **278'** of each respective spinning machine **12**.

It is thus seen that there is provided a unitary traveling pneumatic cleaner **10** and ends down piecing-up means wherein the ends down piecing-up means traverse both sides of each spinning frame during travel of the cleaner therewith and are provided with means for detecting, counting and reporting ends down conditions and operating the respective piecing-up devices in response to the detection of and ends down condition to automatically put up the corresponding missing yarn and automatically resume the production of yarn at the corresponding spindle. Thereafter, travel of the traveling cleaner and the piecing-up devices **11**, **11'** therewith is resumed automatically without the necessity of stopping the corresponding spindle or spindles, thereby greatly reducing the time and labor required of an attendant or attendants in maintaining operation of the spinning frames, with consequent substantial economies in the production of yarn.

Although the traveling cleaner **10** and the associated piecing-up devices **11**, **11'** have been described in detail herein, it is to be understood that the traveling cleaner and its ends down detecting, counting, reporting and piecing-up devices may take various forms other than those specifically disclosed herein without departing from the invention.

In the drawings and specification there have been set forth preferred embodiments of the invention and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

We claim:

1. Apparatus for reducing the number of man-hours required to tend a predetermined number of spinning machines arranged in a textile mill in a predetermined pattern of rows and aisles by automatically detecting and putting up ends down on said machines and thereby permitting an operator to tend such machines in a more efficient manner; said apparatus comprising the combination with said machines of at least one patrolling device adapted to travel along a predetermined path for repeated and frequent traversal of at least one of said machines, pneumatic cleaner means traveling with said patrolling device for removing lint and the like from said one of said machines by air currents, detector means traveling with said patrolling device and operable in response to an end down on said one of said machines during traversal thereof by said patrolling device and said detector means, and yarn piecing-up means traveling with said patrolling device, operatively connected with said detector means and operable in response to discovery of an end down by said detector means for piecing up the end and thereby correcting the operating condition of said machine.

2. Apparatus according to claim **1**, in which said patrolling device, pneumatic cleaner means, detector means and yarn piecing-up means are arranged to travel along a plurality of said spinning machines.

3. Apparatus according to claim **1**, in which a pair of detector means and a pair of yarn piecing-up means are provided and travel with said patrolling device for simultaneous traversal of both sides of said machine.

4. Apparatus according to claim **1**, further comprising means including a track extending over said machine for supporting said patrolling device and said patrolling de-

vice including a tractor drive means engaging said track for driving said patrolling device therealong.

5. Apparatus according to claim 4, wherein said yarn piecing-up means is operatively connected to said tractor drive means and includes means responsive to said detecting means for interrupting movement of said patrolling device along said track upon discovery of an end down by said detector means.

6. Apparatus according to claim 4, wherein said supporting means further comprises frame means connected with said patrolling device and depending therefrom to extend alongside said machine, guide rail means secured to said machine at a predetermined distance below said track extending thereover, means on said frame means for engaging said guide rail means, said frame means, guide rail means and engaging means cooperating to stabilize and align said patrolling device, pneumatic cleaner means, detector means and yarn piecing-up means traveling therewith relative to said machine during traversal thereof.

7. Apparatus according to claim 1, wherein said detector means comprises an electrical device responsive to a modification of radiant energy characteristic of the presence of a yarn, means supporting said responsive device from said patrolling device and in a position for scanning yarns being formed by said machine as said patrolling device traverses said machine, and electrical circuit means operatively connected to said responsive device for originating a signal indicative of the direction of an end down on a traversed machine.

8. Apparatus according to claim 7, including a second detector means traveling with said yarn piecing-up means and arranged to detect the presence or absence of a yarn end following operation of said piecing-up means in putting up the corresponding yarn end, and register means responsive to said second detector means for indicating the absence of said yarn end last mentioned and thereby providing an indication of the operating efficiency of said piecing-up means.

9. Apparatus according to claim 7, wherein said electrical circuit means further includes register means for originating a signal indicative of the detection of a predetermined number of ends down on said machine and further comprising a data collecting and display system responsive to origination of said signal by said register means for indicating to a machine operator the ends down condition of the machine.

10. Apparatus according to claim 9, wherein said data collecting and display system comprises at least one electric lamp operable for indicating an improper operating condition in response to a signal originated by a respective register means, and reset means for restoring said lamp to a condition indicative of a proper operating condition.

11. Apparatus according to claim 1, wherein said machines are ring spinning frames each having drafting instrumentalities for delivering a plurality of attenuated strands of textile material and having sets of packaging instrumentalities for receiving respective attenuated strands, twisting said strands into ends of yarn and winding the ends into respective packages, said packaging instrumentalities including at least one ring rail and, for each end, a corresponding spindle, bobbin, ring and traveler, said yarn piecing-up means comprising traveler threading means disposed adjacent said ring rail during traversal of said one of said machines by said patrolling device and operable for threading a length of yarn through the traveler of a set of said packaging instrumentalities at which an end down is discovered, and yarn joining means disposed adjacent the drafting instrumentalities of said machine during traversal thereof by said patrolling device and operable for joining a free end of said length of yarn with the corresponding attenuated strand issuing from said drafting instrumentalities.

12. Apparatus according to claim 11, wherein said traveler threading means comprises a traveler air blast nozzle for directing an air stream against the ring of said set of packaging instrumentalities, wherein said pneumatic cleaner comprises a fan housing supported by and traveling with said patrolling device, a fan impeller rotatable within said housing for inducing a flow of air, means for driving said fan impeller, and communicative means between said fan housing and said traveler nozzle for furnishing thereto a flow of air under pressure producing said air stream.

13. Apparatus according to claim 11, wherein said yarn piecing-up means further comprises a source of auxiliary yarn, means for severing from said yarn source said length of yarn for threading through said traveler and joining to the attenuated strand, and means for initiating winding of the other free end of said length of yarn about the bobbin of said set of packaging instrumentalities, said last-named means comprising a wrapping air blast nozzle for directing an air stream against said bobbin, said pneumatic cleaner comprising a fan housing supported by and traveling with said patrolling device, a fan impeller rotatable within said housing for inducing a flow of air, fan drive means for rotating said impeller, and said fan housing operatively communicating with said wrapping nozzle for furnishing thereto a flow of air under pressure producing said air stream.

14. Apparatus according to claim 1, including a track extending over said machine and supporting said patrolling device for travel therealong, electrical conductor rails carried by said track, electrically operable means driving said device, said detector means and yarn piecing-up means being electrically operable, and said driving means, detector means and yarn piecing-up means being electrically connected to said conductor rails.

15. Apparatus for reducing the number of man-hours required to tend spinning machines arranged in rows in a spinning room by automatically detecting and putting up ends down on said machines and thereby permitting an operator to tend such machines in a more efficient manner; said apparatus comprising the combination with said machines of one or more patrolling devices each supported for travel along a predetermined path above one or more of said machines for repeated and frequent traversal thereof, detector means carried by and traveling with each of said patrolling devices and operable in response to an end down on a machine during traversal thereof by a patrolling device and its respective detector means, and yarn piecing-up means supported by and traveling with each said patrolling device, operatively connected to said respective detector means and operable in response to discovery of an end down by said respective detector means for piecing up the end.

16. Apparatus according to claim 15 further comprising a data collecting and display system responsive to operation of said detector means for indicating the ends down condition of each of said machines upon the same being traversed by said patrolling devices.

17. Apparatus according to claim 15, wherein said machines are ring spinning frames each having a plurality of sets of drafting instrumentalities for delivering a corresponding plurality of attenuated strands of textile material and having a corresponding plurality of sets of packaging instrumentalities for receiving said attenuated strands, twisting said strands into ends of yarn and winding the ends into packages, said packaging instrumentalities including for each end a corresponding spindle, bobbin, ring and traveler; said apparatus further comprising means for supporting said patrolling device for movement along said predetermined path and including a track extending over a plurality of said machines, said yarn piecing-up means being disposed below said track and comprising traveler threading means disposed adjacent the ring rails of said machines during traversal thereof by said patrolling device and operable for threading a length of yarn through the traveler of a set of said packaging instrumentalities at which an end down is discovered, and yarn joining means disposed adjacent the draft-

ing instrumentalities of said machines during traversal thereof by said patrolling device and operable for joining a free end of said length of yarn with the attenuated strand issuing from the corresponding set of said drafting instrumentalities.

18. Apparatus according to claim 17, wherein said supporting means further comprises frame means connected with said patrolling device and depending therefrom on both sides of said machines, guide means extending longitudinally of each of said machines at a predetermined distance below said track extending thereover, and means on said frame means for engaging said guide means so that said supporting means stabilizes and aligns said patrolling device and said yarn piecing means traveling therewith relative to said machines, and further wherein said yarn piecing-up means comprises locating means operable in response to discovery of an end down by said detector means and indexable along said guide means for positively locating said yarn piecing-up means relative to a spindle of said machine at which an end down has been discovered.

19. In combination, a traveling patrolling device movable along a predetermined path of travel along at least one of a plurality of spinning machines arranged in a textile mill in a predetermined pattern of rows and aisles for repeated and frequent traversal of said machine, pneumatic cleaner means operatively connected to and movable with said patrolling device for removing lint and the like from said machine by flowing currents of air, detector means mounted on and movable with said patrolling device for scanning the yarns being formed by said machine during traversal thereof by said patrolling device and for sensing the presence and absence of the yarns, and yarn piecing-up means supported by and movable with said patrolling device and operable in response to said detector means sensing the absence of a yarn for piecing-up the absent yarn and thereby correcting an improper operating condition of said machine.

20. The combination of claim 19 further comprising means mounted on said patrolling device and operatively connected with said detector means and responsive thereto for registering the absence of a yarn and reporting the ends down condition of said machine upon traversal thereof by said patrolling device.

21. The combination of claim 20 wherein said detector means comprises a photoelectric device responsive to a variation in levels of illumination characteristic of the presence of a yarn, means mounting said photoelectric device for scanning yarns being formed by said machine during traversal thereof by said patrolling device, and electrical circuit means operatively connected to said photoelectric device and responsive thereto for originating an electrical signal indicative of the absence of a yarn at a yarn forming location on said machine, and further wherein said yarn piecing-up means is operatively connected with said electrical circuit means for initiation of a yarn piecing-up sequence upon origination of a signal by said electrical circuit means.

22. The combination of claim 19 particularly adapted for use in association with a ring spinning frame having a plurality of sets of drafting instrumentalities for delivering a corresponding plurality of attenuated strands of textile material to a corresponding plurality of sets of packaging instrumentalities, each of said sets of packaging instrumentalities including a spindle, a bobbin, a ring encircling said spindle, and a traveler moving on said ring and wherein said patrolling device comprises a tractor drive means for traveling said patrolling device along said spinning frame and further wherein said yarn piecing-up means includes means for interrupting movement of said patrolling device along said frame upon discovery of an end down by said detector means, traveler threading means for threading a length of yarn through the traveler of the set of packaging instrumentalities at which the end is down, yarn joining means for joining a free end of said length of yarn with the attenuated strand issuing from the corresponding set of drafting instrumentalities, and means for re-establishing travel of said patrolling device along said machine upon completion of each yarn piecing-up operation.

23. The combination of claim 22 wherein said traveler threading means comprises a traveler blast air nozzle operatively communicating with said pneumatic cleaner and conveying therefrom a flow of air under pressure, said nozzle being arranged to direct the flow of air against the ring mounting said traveler for moving said traveler thereabout.

24. The combination of claim 22, and wherein said pneumatic cleaner comprises a fan housing, impeller means mounted for rotation within said housing for inducing a suction flow and a blowing flow of air therethrough, fan drive means for rotating said impeller means, airflow ductwork operatively communicating with said housing for directing said suction flow and blowing flow to remove lint and the like from said machine and the room floor therebeneath, and waste receiving means for collecting lint and the like so removed, and further wherein said yarn piecing-up means includes an airflow nozzle for performing part of the piecing function, and said nozzle being communicatively connected to said fan housing for deriving an air flow therefrom.

25. The combination of claim 22, and wherein said yarn piecing-up means further comprises a source of auxiliary yarn, means for severing said length of yarn from said source of auxiliary yarn, and means for wrapping the other free end of said severed length of yarn about the bobbin of said set of packaging instrumentalities, said bobbin wrapping means including a wrapping blast air nozzle operatively communicating with said pneumatic cleaner for directing a flow of air therefrom against said other free end and said bobbin.

26. In combination, a traveling patrolling device supported by and movable along a track extending over at least one of a plurality of spinning machines arranged in a textile mill in a predetermined pattern of rows and aisles for repeated and frequent traversal of said machine, detector means mounted on and movable with said patrolling device for scanning the yarns being formed by said machine during traversal thereof by said patrolling device and for sensing the presence and absence of the yarns, and yarn piecing-up means supported by and movable with said patrolling device and operable in response to said detector means sensing the absence of a yarn for piecing-up the absent yarn and thereby correcting an improper operating condition of said machine.

27. The combination of claim 26, further comprising means mounted on said patrolling device and operatively connected with said detector means and responsive thereto for registering the absence of an end of yarn and for reporting the ends down condition of said machine upon completion of a traverse thereof by said patrolling device.

28. The combination of claim 27 particularly adapted for use in association with a ring spinning frame having a plurality of sets of drafting instrumentalities for delivering a corresponding plurality of attenuated strands of textile material to a corresponding plurality of sets of packaging instrumentalities, each of said sets of packaging instrumentalities including a spindle, a bobbin, a ring encircling said spindle, and a traveler moving on said ring; and wherein said patrolling device includes a tractor drive means operatively engaging said track for propelling said patrolling device therealong and further wherein said yarn piecing-up means includes means responsive to discovery of an end down by said detector means for interrupting the movement of said patrolling device along said track, means for engaging said frame upon interruption of movement of said patrolling device for positively locating said yarn piecing-up means in predetermined alignment with the spindle of a set of packaging instrumentalities at which the end is down, traveler threading

means for threading a length of yarn through the traveler moving about the respective spindle, and yarn joining means for joining a free end of said length of yarn to the attenuated strand issuing from the corresponding set of drafting instrumentalities of said frame.

29. The combination of claim 28, wherein said traveler threading means comprises a traveler blast air nozzle for directing a flow of air under pressure against the ring mounting said traveler and thereby moving said traveler about said ring, and wherein said patrolling device has mounted thereon a fan housing, a fan impeller rotatable within said housing for inducing a flow of air under pressure, fan drive means for rotating said impeller, and airflow ductwork operatively connecting said housing and said traveler nozzle for directing a flow of air from said housing to said nozzle.

30. The combination of claim 26, wherein said airflow ductwork further has a plurality of cleaning nozzles positioned in predetermined relationship to the instrumentalities of said frame for directing thereagainst flows of air under pressure and for thereby removing lint and the like from said frame.

31. A method of reducing the man-hours required to tend a predetermined number of spinning machines arranged in a textile mill in a predetermined pattern of rows and aisles comprising the steps of automatically traversing the machines with at least one traveling patrolling device, scanning the yarns being formed by a machine and directing flowing currents of air onto machine surfaces as the patrolling device traverses the locations at which such yarns normally are present, automatically sensing the presence and absence of the yarns being scanned while removing lint and the like from the machine with the flowing currents of air, and automatically piecing-up an end of yarn in response to the sensing of the absence of the yarn at the corresponding location.

32. A method according to claim 31, wherein the steps of scanning the yarns and sensing the presence and absence of the yarns include passing an energy level responsive device adjacent an area of the spinning machine in which the yarns are exposed and registering the response of the energy level responsive device to the absence and presence of energy at a level indicative of the absence of a yarn.

33. A method according to claim 31, further comprising the step of registering the sensing of the absence of ends of yarn and indicating in response thereto the existence of an improper operating condition of the machine.

34. A method according to claim 33, wherein said step of registering the sensing of the absence of ends includes totalling the number of ends down sensed during traverse of a machine by the patrolling device, signalling the existence of an improper operating condition in the event the total number of ends down exceeds a predetermined number, and further wherein said step of indicating the existence of an improper operating condition includes energizing in response to said step of signalling an individual indicator representative of the location of the particular machine thus found to have an improper operating condition.

35. A method according to claim 31, wherein said step of piecing-up an end of yarn includes threading a length of yarn through a ring traveler of the spinning machine at which yarn production was interrupted and then joining the threaded length of yarn to an attenuated strand issuing from the corresponding drafting instrumentalities of the spinning machine so as to re-establish the production of yarn thereat.

36. A method according to claim 35, wherein the step of piecing-up an end of yarn further includes withdrawing the length of yarn to be threaded from an auxiliary source mounted on the patrolling device and severing the length from the source before threading and joining the length of auxiliary yarn to the attenuated strand.

37. The method of claim 31, wherein the step of traversing the machines with a patrolling device includes propelling the patrolling device along a trackway extending along and above the machines while drawing electrical power for operation of the device from conductors mounted on the trackway.

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CERTIFICATE OF CORRECTION

Patent No. 3,486,319 Dated December 30, 1969

Inventor(s) Charles D. Lee, Jr. and Robert L. Black, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 44, "lin", first occurrence, should be --lint--. Column 5, line 57, "deivce" should be --device-- Column 7, line 22, "form" should be --worm--. Column 8, line 24, "rfom" should be --from--. Column 18, line 21, "and" should be --an--. Column 19, line 29, "direction" should be --detection--.

SIGNED AND
SEALED
JUN 16 1970

(SEAL)
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