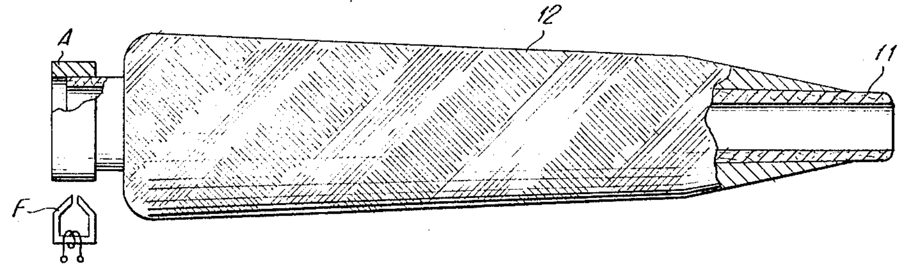
Aug. 2, 1966 W. GITH ETAL **3,263,499**
METHOD FOR TESTING THE YARN QUALITY OF
MULTI-FRAME SPINNING OPERATIONS
Filed Feb. 18, 1963 3 Sheets-Sheet 1

FIG. 1



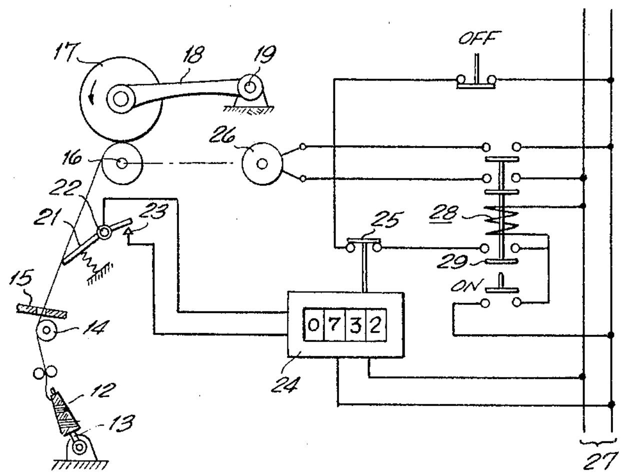


FIG. 2

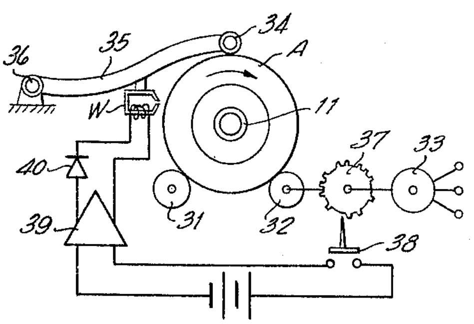


FIG. 3

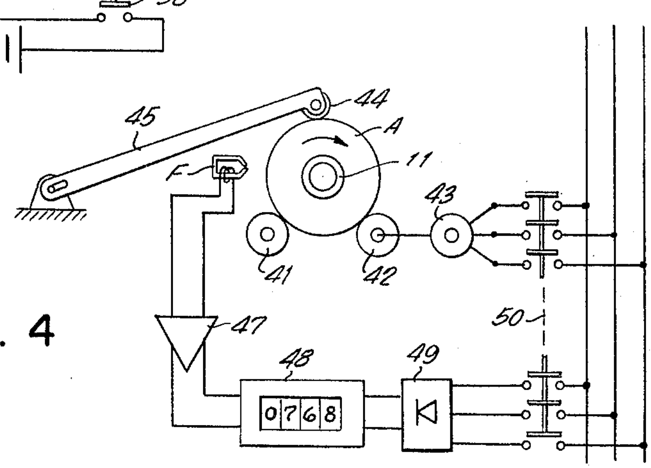


FIG. 4

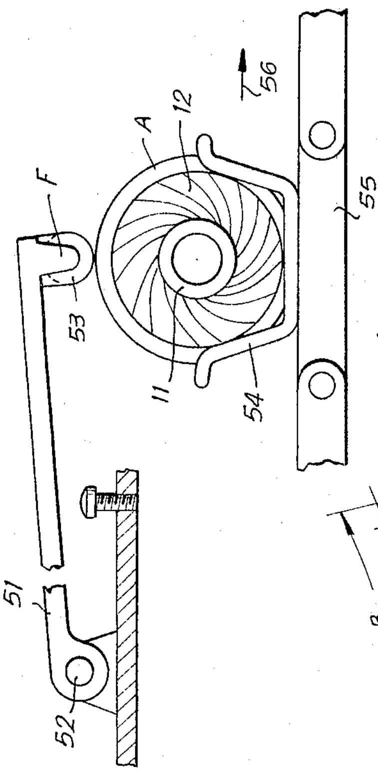


FIG. 6

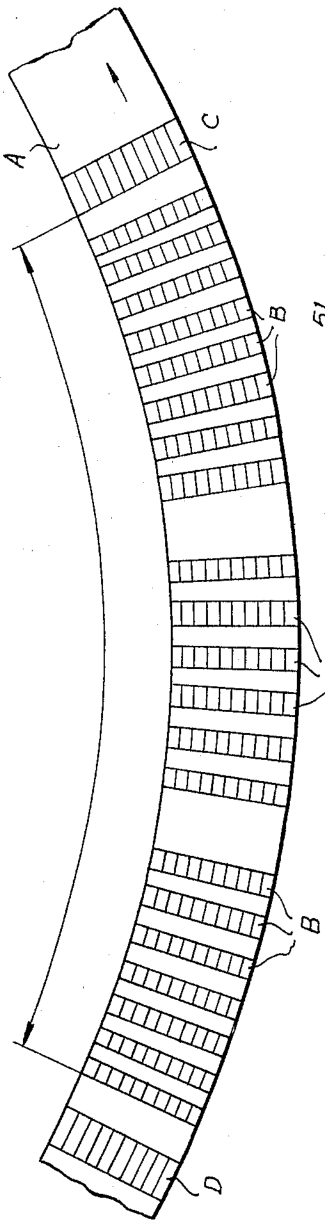


FIG. 5

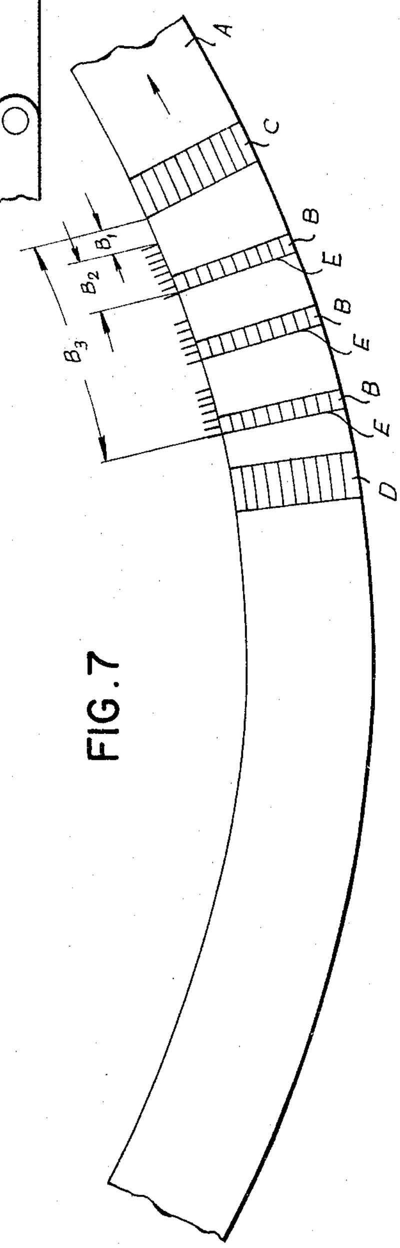


FIG. 7

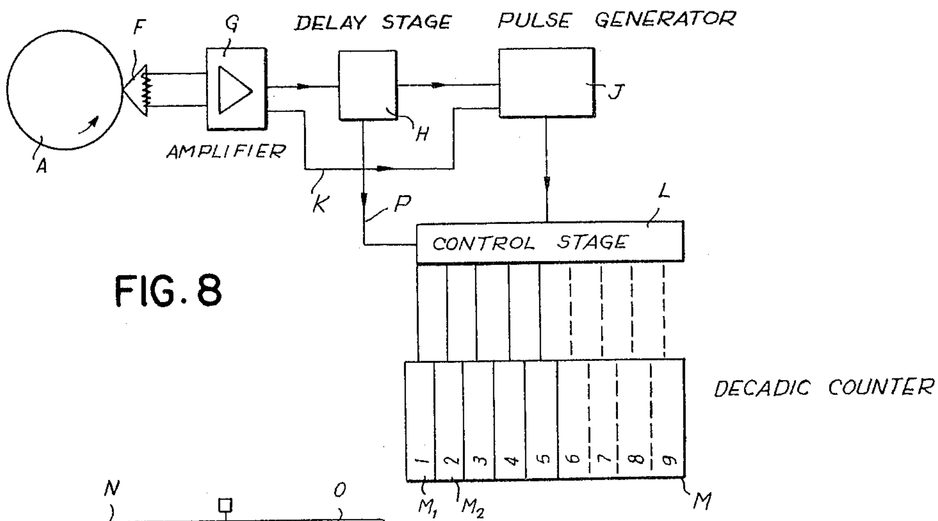


FIG. 8

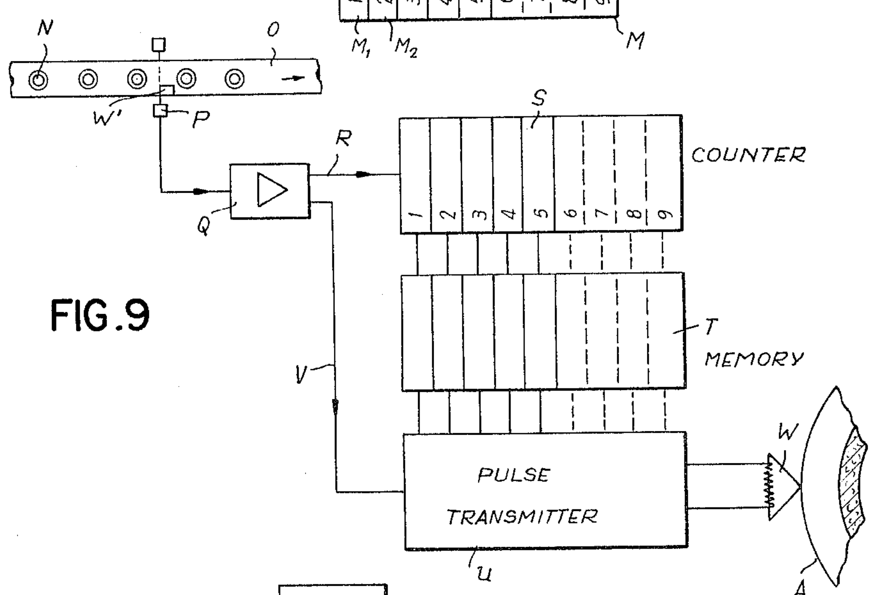


FIG. 9

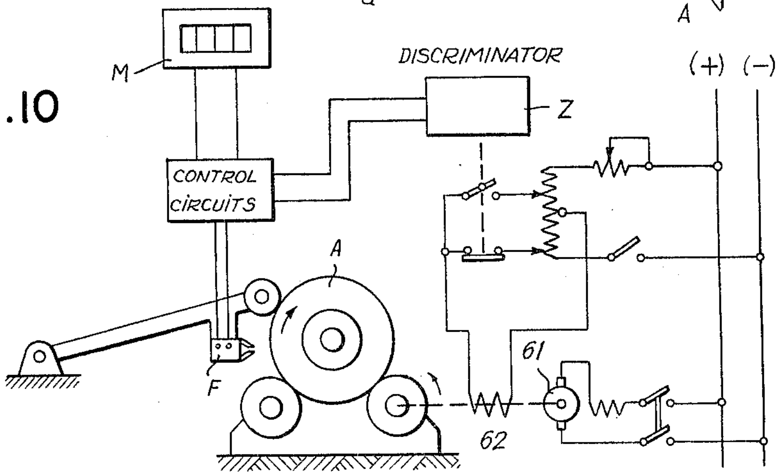


FIG. 10

United States Patent Office

3,263,499

Patented August 2, 1966

1

3,263,499
METHOD FOR TESTING THE YARN QUALITY OF MULTI-FRAME SPINNING OPERATIONS

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Filed Feb. 18, 1963, Ser. No. 259,117
Claims priority, application Germany, Feb. 17, 1962, R 32,118
5 Claims. (Cl. 73—160)

Our invention relates to a method for testing the quality of yarn output of multi-frame spinning machines or plants.

The quality control of the spun material in such plants has been limited to random testing performed from time to time with a few spinning cops taken from one side of a multi-spindle machine or picked at random from the entire machine. Such quality tests relate to maintenance of the desired yarn count (degree of fineness), twist (amount of twist per unit length) and other properties essential to the yarn being produced. In the event of faults, these are ascribed to the entire machine or machine side, and are eliminated, for example by changing the necessary transmission gears, rings, spinning rotors or runners, and the like machine components.

Often, however, only individual spinning frames or spindles of the multi-frame machine contribute to the production of faulty yarn, such as yarn with excessively thick or thin spots, excessive variations in yarn count, slubs, or other defects as may be due to excessive or irregular wear of machine parts at one particular spindle, improper loading of the yarn stretching mechanism, worn or rough stretching rollers or the like. Random testing as heretofore employed can detect such defects only if by chance a cop from the improperly operating spinning frame is subjected to observation. Otherwise these faults become disagreeably manifest only in the subsequent fabrication of the yarn, such as when using it in weaving operations.

It is an object of our invention to provide a quality control of the yarn output from multi-frame spinning plants which affords determining rapidly and at the earliest feasible occasion whether each individual spinning frame furnishes satisfactory yarn, and which affords immediately locating that particular spinning frame for eliminating any local deficiency causing the unsatisfactory yarn output.

To this end, and in accordance with a feature of our invention, we provide each individual spinning cop with a discriminatory marking that identifies the one spinning frame on which the cop originated, and we then unwind yarn from the completed cop while simultaneously counting any occurring yarn faults. This is done by supplying the completed cops to a yarn re-winding machine such as used for winding cheeses or cones from the spinning cops. When thus an excessively large number of yarn defects is counted during unwinding operation, each cop furnishing the defective yarn can immediately be traced back by its identifying marking to the one originating spinning frame of the spinning machine or plant, thus permitting an elimination of the cause at the one spinning frame involved, without further searching and within a minimum of time.

In order to keep the identifying marking on a spinning cop intact in cases where the yarn defects or their excessive number are observed only after a relatively large portion of the yarn has been unwound from the cop, the marking is preferably applied to the core of the cop on a surface area that remains bare of the body of yarn. It is most advantageous to impress or apply the markings at the foot end of the cop or core.

2

The winding machine on which yarn is unwound from the completed cops is preferably provided with a fault-responsive counting device operating mechanically, electrically, electronically or in any other suitable manner. As a result, the defects occurring in the yarn as it runs from the cop onto a take-up spool are being counted consecutively, and when a given maximum number is exceeded, a signal is released to indicate that the spinning cop is defective. The marking of the cop or core then indicates the particular spinning frame or location at which the cop originated. The cause of the defect, consisting for example in the selection of an incorrect ring or runner number, excessive wear of the ring or runner, incorrect loading of the stretching mechanism or the like, can then be eliminated before an appreciably large number of further defective cops is produced on that spinning frame.

As mentioned, it is of advantage to provide the identifying marking on a surface portion of the core, usually a tubular core or quill, that is not covered by the body of yarn when the cop is completed, the most suitable location being at the foot of the core. It is known to employ tubular cores of sheet metal for spinning cops, or tubes whose foot portion is reinforced by sheet metal consisting of an iron ring. By employing such cores with an at least partially magnetizable surface area, and in accordance with another feature of our invention, the identifying marking of the cops is obtained by impressing magnetic marking pulses upon the magnetizable area.

Applying such a magnetic recording method for quality control of spinning operations has the advantage that a large number of discriminating markings can be accommodated on a very small surface area, and that this can be done with the aid of readily available and reliable magnetic recording means such as employed for the recording of sound, the reproduction of the markings being likewise readily performable by available transducers as known, for example, from magnetic tape recorders. Indeed this method is of advantage not only for quality control of spinning operations but is generally suitable for applying discriminating marks to textile coil cores or spools.

Used for marking purposes according to the invention are preferably code combinations that denote plural-digit numbers and/or letters, each individual character, for example each individual numerical digit value or letter, being expressed by predetermined pulses of respectively different number, length, frequency of succession, or mutual spacing. In cases where the pulses are in form of a circular function, for example sinusoidal-wave pulses, the frequency of pulse succession is identical with the pulse frequency itself. However, in cases where pulses with steep flanks are employed, for example rectangular pulses, the pulse sequence frequency corresponds to the spacing between successive ascending pulse flanks. Such rectangular or particularly steep pulses are particularly advantageous for the purposes of our invention and are employed in the preferred embodiments described hereinafter.

The above-mentioned and further objects and features of our invention, said features being set forth with particularity in the claims annexed thereto, will be apparent from, and will be mentioned in, the following with reference to the embodiments of devices suitable for performing the method of the invention illustrated by way of example on the accompanying drawings as follows:

FIG. 1 shows schematically a spinning cop with magnetic markings, in correlation to a mark producing or reproducing transducer.

FIG. 2 shows schematically the essential devices for unwinding yarn from a cop and simultaneously counting the occurring yarn defects.

FIG. 3 is a schematic illustration of a device for recording magnetic pulse markings on a cop according to FIG. 1 supplied to, or coming from, a particular spindle.

FIG. 4 shows schematically a device for reproducing the magnetic pulse markings in the event a cop was found, according to FIG. 2, to contain yarn with an excessive number of defects.

FIG. 5 shows part of a magnetizable ring provided with magnetic pulse markings and forming part of a cop as shown in FIG. 1.

FIG. 6 illustrates another device for recording magnetic pulses on such a ring.

FIG. 7 also shows part of the same magnetizable ring but exhibits a modified form of magnetic markings.

FIG. 8 is a block diagram of another recording device similar in principle to that of FIG. 3 but comprising a system predominantly of electronic components.

FIG. 9 is the block diagram of another reproducing device similar in principle to that of FIG. 4 and also relating to electronic components.

FIG. 10 shows separately the cop rotating means and the transducer assembly used in the reproducing system according to FIG. 9.

According to the embodiment of the invention shown on the drawings, we employ spinning cops whose tubular core **11** of elongated and slightly conical shape carries on its foot end a ring A of iron as shown in FIG. 1. The core foot and iron ring remain bare of the body of yarn **12** when the cop is completed in the spinning machine. Prior to placing the spun yarn onto the core, or preferably shortly before we pass the just completed cop from the spinning frame to a yarn-package winding machine, we impress upon the peripheral surface of the iron ring A, or a sectional area thereof, a sequence of magnetic code markings indicative of a letter or number combination. For this purpose, we place a transducer F opposite the peripheral surface of the ring A and energize the transducer winding by electric pulses while maintaining a relative rotational movement between ring A and transducer F, it being irrelevant in principle whether the cop with ring A is held stationary while the transducer F is being rotated, or vice versa. The recording of the magnetic pulse marks, having the result of impressing upon the magnetizable surface area of the cop or ring a number of corresponding marks of remanent magnetism, corresponds to the manner in which magnetic signals are generally recorded for such purposes as recording sound or data processing.

Each of the many spinning cops thus issuing from a multi-frame spinning machine or plant thus carries an identifying mark indicative of the one particular spinning frame from which the cop originated. It is preferable to promptly convey the completed spinning cops from the spinning machine to a winding machine. Applicable for this purpose are machine combinations in which a conveyor directly connects the spinning machine with a multi-station winding machine such as described in Patent 3,043,529 of S. Fürst, assigned to the assignee of the present invention.

Since it is usually necessary to rewind the spinning cops into yarn packages of different shape and size depending upon the next step of textile fabrication for which the yarn is to be used, the same yarn-package winding machinery is employed to advantage for the purpose of quality control according to the invention. It is only necessary to provide the winding machine with a counting device that supervises the number of occurring yarn defects and preferably stops the winding operation or otherwise identifies a defective cop which is then to be traced back to its locality of origin by way of its magnetic markings.

Such a counting device is schmatically shown in FIG. 2 and described presently.

The cop, denoted in FIG. 2 by its yarn body **12**, is seated on a peg **13**. The yarn passes from the cop through a tensioner **14** and a slub catcher **15** over a rotary yarn guiding drum **16** onto a take-up spool **17** which is journalled on a frame **18** pivoted at **19** to the fixed frame structure of the machine. The periphery of the yarn package being wound thus rests upon the guiding drum **16** and is frictionally entrained thereby as the guiding drum is driven at constant speed. As the yarn passes from the cop **12** onto the take-up spool **17**, a yarn guard or feeler **21** is lightly biased by spring force against the travelling yarn. When the yarn breaks, the guard **21** turns clockwise about its pivot **22** and closes an electric contact **23** which controls a decadic counter **24** to advance one step. When the counter has reached a preadjusted maximum number, it opens a contact **25** which stops the drive **26** of the guiding drum **16** and thus discontinues the winding operation. Due to the action of the tensioner **14**, the yarn will break if an excessively thin or weak spot occurs between tensioner **14** and guiding drum **16**. Any slubs or excessively thick spots are caught by the slub catcher **15** which then also causes the yarn to break. Consequently, any such defects will cause the yarn guard **21** to close the contact **23** and to advance the counter **24** one step.

While we generally prefer controlling the drive of the guiding drum **16** mechanically in the manner and by the means known for example from U.S. Patent No. 3,033,-478, the particular counter-controlled stop means chosen for illustration in FIG. 2 are electrical because these particular details are not essential to the invention proper and can be more easily illustrated and explained with reference to an electric circuit diagram. As shown schematically, the drum **16** is driven from an electric motor **26** which is started by temporarily depressing an "ON" switch and can be stopped at any time by depressing an "OFF" switch. The closing of the on switch causes a contactor **28** to pick up for energizing the motor **26** and to hold itself picked up through a self-holding contact **29**. The self-holding circuit becomes interrupted when the counter **24** reaches the selected maximum count and then opens the contact **25**. The contact **25** may also be used for initiating a cop-doffing operation if desired. The counter **24** must be reset to zero for re-closing the contact **25** to permit starting a new winding operation. Such resetting of the counter may take place together with doffing or exchanging the cop. If no cop is excessively defective among those of an entire series, the contact **25** will remain closed.

As mentioned above, each cop is provided with magnetic markings at or near the spinning location where the cop originated. A device for thus impressing magnetic markings is shown in FIG. 3. The cop, of which only the core **11** and the iron ring A according to FIG. 1 is illustrated by a view from the top side, is temporarily accommodated on rollers **31** and **32** which engage the periphery of the ring A. The roller **32** is driven from a motor **33**, such as a synchronous motor, at a given constant speed. During rotation of the cop, a roller, **34** journalled on an arm **35** is lowered about a fixed pivot **36** until it engages the ring A. Mounted on the arm **35** is a transducer W which in this manner is placed in proper recording relation to the peripheral surface of the ring A. Also driven from the motor **33** is a pulse disc, here schematically shown as a cam **37**, which actuates a pulse contact **38**. The pulses are amplified by an amplifier **39** and supplied as unidirectional current pulses to the transducer W which impresses magnetically upon the ring A. If desired, a demagnetizing magnet (not shown) can be mounted on the arm **35** ahead of the transducer W in order to erase any magnetic markers previously recorded, in the manner well known from magnetic tape recorders. The drive **33–32** can be set for one full rotation of the ring A, but the transducer may be operated to repetitively place the coded marker onto the ring, for example, three or four times in peripheral succession, each complete marker covering less than one-quarter of the periphery.

If a cop has been found to contain defective yarn, due to the fact that the predetermined limit number of defects has been reached during the winding operation described above with reference to FIG. 2, the magnetic markings can be transposed back to visible readings by employing a device similar to FIG. 3 but equipped with a suitable signal converter. Thus, the reproducing device as shown in FIG. 4 is suitable for the reading of digital code marks. The cop is placed on rollers **41**, **42** and driven by means of a motor **43**, such as a synchronous motor. An arm **45** with a roller **44** is lowered onto the surface of the ring A so that the reproducing transducer F is placed into proper relation to the ring surface. The magnetic pulses acting upon the transducer F and translated into corresponding electric voltages are passed through an amplifier **47** and applied to a digital counter **48** which may be energized through a rectifier from the same alternating-current supply that energizes the motor **43** under control by a switch **50**. Pulse-responsive digital or decadic counters and indicators as shown at **48** are known and commercially available, as are the above-mentioned other electrical components, for example transducers F, W, contactors, motors, switches and amplifiers.

It will be recognized that the read-out device of FIG. 4 operates essentially like a dial telephone. The recorded start pulse, lasting sufficiently long and being followed sufficiently rapidly by number pulses, initiates the decadic counter in the same manner, and if desired by similar means, as the lifting of a telephone receiver, and the groups of number pulses actuate the counter decades in the same manner as the telephone selector switches are actuated by the digit groups of dial pulses.

With this method, therefore, the tubular cores are to be marked by groups of digit pulses corresponding to identifying multi-digit numbers of the respective spinning locations. This will be further explained by way of example with reference to FIG. 5. The illustration shows only a portion along the periphery of the iron ring A, or a corresponding magnetizable surface portion of the tubular core. Assume that the number 768 is to be marked. Corresponding magnetic pulses are recorded on the magnetizable surface area shown in FIG. 5. These pulses are denoted by B. The digit value 8 is represented by eight individual pulse records B. The digit value 6 is represented by six such pulses, and the value 7 by seven pulses. Each digital group is separated from the next group by a relatively large spacing. As a rule, it is of advantage to precede the group of marking pulses by a start pulse C and to terminate the entire recording by a stop pulse D. The start and stop pulses facilitate reproducing the markings as described above with reference to FIG. 4.

Five groups of pulses are sufficient to provide markings for most industrial purposes. For example, assume that a spinning plant comprises forty machines with 288 spindles per machine side. In this case the following pulse assignment is suitable: The machine sides are consecutively numbered from 1 through 80. Consequently two pulse groups are needed for identifying a particular machine side, one group having a maximum of ten pulses and the other group a maximum of eight pulses. For identifying the 288 spindles on each machine side, there are needed three pulse groups of which two must possess a maximum of ten pulses and one group need only go up two pulses. These five pulse groups, as well as any additional start and stop pulse, can be conveniently accommodated on an area extending over only one-quarter to one-third of the ring periphery of a tubular core as conventionally used for spinning cops.

This makes it possible to mount the transducer head W for recording the pulses, as well as the transducer head F for reproducing the pulses, on a drag lever as shown at **51** in FIG. 6. The lever **51** is pivoted at **52** and carries a roller **53** so that when the roller is in rolling engagement with the iron ring A it maintains an approximately constant spacing between the transducer head and the iron ring. In this case the cop can be seated in a holder **54** on a conveyor chain **55**. When the conveyor travels in the direction indicated by an arrow **56**, the roller **53** of the drag lever **51** passes over approximately one-quarter of the cop periphery, corresponding to the length of the area along which the magnetic pulses are to be recorded or reproduced, and this performance can then be effected without rotational movement of the ring A or cop.

In this manner, the pulse recorder or the reproducer or both can be mounted for example at the conveyor chain on which the cops are transported from the spinning machine to the lay-off or winding location. The conveyor chain or its drive may then also serve for controlling the equipment that issues the electric pulses through the transducer (corresponding to pulse transmitters **37**, **38** in FIG. 3).

While the transducers so far described are on the electrodynamic principle, it will be obvious that for impressing magnetic signals upon the cops or cores and for reproducing these magnetic signals, other types of transducers may also be used. Particularly for transducing the recorded signals into electric voltages, a transducer operating on the Hall principle and responsive to the intensity of the magnetic recordings rather than to the rate of change in the magnetic field acting upon the transducer, may be used to advantage, such transducer heads being known, for example, from the German patent application S 38,962 VIIId/42g published in print September 13, 1956. However, other marking methods, preferably those permitting an electric reproduction method, are applicable, such as those based upon the reflection of coded dipoles as described in Control Engineering of March 1962, pages 102 and 103.

After the core of a cop is depleted of yarn and no excessively high number of faults has been counted, the magnetic pulses can be erased from the core or magnetizable ring by a demagnetizing field before the cores are transported back to the spinning machine for production of further spinning cops, or the erasing can be done when the next magnetic markings are recorded as described above in conjunction with FIG. 3. However, if the number of faults during unwinding of the cop has exceeded the permissible maximum value, the cops are supplied to a read-out or reproducing device as described above with reference to FIG. 4 so that the location of origin becomes readably identified and, if desired, may be recorded on a recording instrument.

The particular method described above with reference to FIG. 5, however, may not be sufficient when the marked cops are subject to particularly rough handling. In such cases the iron ring may possibly become indented just at the location of a recorded pulse with the result that the air gap between the iron ring and the reproducing transducer becomes enlarged. No active electric voltage pulse may then be generated in the transducer. For example, assume that in the digital pulse group according to FIG. 5 an indentation is pressed into the iron ring at the location of the fourth pulse denoting the digit value 8 and that, as a result, this fourth pulse is omitted in the electric reproduction. The read-out device of FIG. 4 then operates as if there was no value 8 on this location of the iron ring but as if in this particular group two separate values, namely 3 and 4, were marked, due to the fact that the eliminated fourth pulse acts, in effect, like a pause between two pulse groups. This results in faulty identification. It is also possible that the pulses, particularly when the multi-digit numbers are large, occupy such a large peripheral portion of the iron ring, that the above-described reproducing method can no longer be used with sufficient reliability.

In any such cases, and in accordance with another feature of our invention, it is particularly advantageous to employ a marking method in which the mutual spacing of the rear pulse edges or flanks constitutes the characterizing magnitude for the figure or bit of information to be conveyed. Such a method will be explained with reference to the example of FIG. 7, also showing a portion of the iron ring A with recorded magnetic number pulses B, a start pulse C and a stop pulse D. For simplicity, the identifying code combination marked in this example is identical with the one represented in FIG. 5, namely the code number 768.

A comparison of FIGS. 7 and 5 will show that the marking method according to FIG. 7 requires considerably less marker space because each individual digit figure is no longer represented by a number of pulses but only by the position of a single pulse. The particular figure to be designated is determined by the peripheral spacing between the rear edges or flanks E of two successive pulses.

In principle, magnetic code pulses of the type exemplified by FIG. 7 can be recorded on the magnetizable surface area or ring periphery of the cop by a device as shown in FIG. 3 and described above. The reproducing device, however, must be provided with time discriminating means in order to distinguish between the character-denoting spacing of successive pulse flanks. Such a reproducing device is schematically shown in FIG. 8. The device is equipped with means for accommodating and rotating the cop with its iron ring A along a transducer in the same manner as shown in FIG. 3, although in FIG. 8 only the iron ring A and the transducer F are illustrated diagrammatically. The pulses sensed by the transducer head F are supplied through a pulse amplifier G and through a time-delay stage H to a pulse generator J. When the transducer head F passes over the start pulse C in FIG. 7, the rear edge E of this pulse produces in the transducer a positive voltage pulse which, upon elapse of a delay interval adjusted in the delay stage H, causes the pulse generator J to start issuing pulses of even time spacing. The pulse generator J then continues producing these pulses until the rear edge of the first figure, in this case the figure **8**, again issues a voltage pulse. This voltage pulse performs two functions. In the first place, it is supplied through a shunt path K directly to the pulse generator J, bypassing the delay stage H, and stops the pulse generator. Up to this moment, the pulse generator J has issued eight pulses which passed through a pulse control stage L to an electronic decadic counter M. The first decade M_1 thus reaches the count **8** and then stops.

The first positive voltage pulse produced by the rear edge of the recorded magnetic pulse is simultaneously applied to the delay stage H and this, as mentioned above, has the effect that the pulse generator J, upon elapse of the adjusted period of delay, is again started and then issues another sequence of pulses through the control stage L to the counter M until the next magnetic pulse rear edge, corresponding in this case to figure **6**, stops the generator J through the line K, and thereafter again starts the pulse generator upon elapse of the delay period adjusted in the delay stage H. The next following stop signal again stops the pulse generator J. In the meantime, the counter M has received a total of six pulses from the pulse generator which have set the second decade M_2 to the number 6. These operations are repeated until the stop pulse D according to FIG. 7 terminates all operations.

If the stop pulse D were identical with the code pulses proper, it would not only have the effect of stopping the pulse generator J through the line K but it would again start the pulse generator upon elapse of the delay period adjusted in the delay stage H. This, however, is prevented as follows.

As far as described, consideration has been given only to the rear edges of the magnetically recorded pulses. The front edges of the pulses likewise produce a peaked voltage pulse in the transducer which, however, has negative polarity in comparison with the positive signal pulses so far considered. The distance between the positive voltage peak and the negative voltage peak corresponds to the pulse length of the magnetically recorded pulses. Now, in order to differentiate the start and stop pulses C and D from the other marker pulses, the pulses C and D are twice as long. That is, the negative voltage peaks caused by the start and stop pulses precede the positive pulses by twice the interval of time occurring with the regular code pulses. This permits distinguishing the start and stop pulses in the delay set H by means of a suitable timing member from the other pulses of the combination. The first occurrence of a wide pulse (C in FIG. 7) initiates with its rear edge the counting operation, and the second occurrence of a wide pulse terminates with its front edge the counting operation. This switching function can be performed by a bistable multi-vibrator which forms part of the delay stage H and directly controls the pulse control stage L as is indicated by a connecting line T.

As mentioned above, magnetic signals of the type exemplified by FIG. 2 can be recorded with the aid of equipment as shown in FIG. 3. However, more elaborate electronic devices may also be used, as will be understood from the equipment described presently with reference to FIG. 9.

It is assumed in FIG. 9 that all spinning cops N produced on one side of a multi-spindle spinning machine are simultaneously deposited upon a conveyor belt O travelling in the direction indicated by an arrow from the spinning machine to a lay-off station such as the magazine of a multi-station winding machine. With this type of operation, and assuming for example that there are 288 spindles on the machine side, the cops N on the conveyor O will travel by a given fixed point in regular order, the first arriving cop coming from spindle No. 1, the second cop from spindle No. 2, and so forth, of the same machine side. Consequently, this operation makes it possible to simply count the travelling cops as they pass by a fixed locality and then impress upon each of them an identifying magnetic marker automatically selected in the counted order for distinguishing each cop as to its origin on the machine side as well as relative to the totality of spinning machines in the plant.

The system schematically shown in FIG. 9 operates in the manner just mentioned. Located at a fixed locality along the conveyor O is a photoelectric device P. Whenever one of the cops N passes through the light beam of device P, a pulse is issued through an amplifier Q and and output line R to an electronic counter S. The counted result is supplied through a pulse storer or memory unit T to a pulse transmitter U. The pulse generator U is started by the pulse issuing from the photoelectric device P through the amplifier Q and a line V. Connected to the output circuit of the pulse generator U is a transducer W which impresses upon the iron ring A of the cop the magnetic code pulses corresponding to the result of the counting operation. The transducer W may be mounted on a drag lever as shown at **35** in FIG. 3, but is shown in FIG. 9 only schematically and separately from the conveyor O, although it will be understood that in reality the transducer head W is located at the conveyor, namely at the location W'.

More in detail, the recording operation in a device as shown in FIG. 9 proceeds as follows. When the photoelectric device P responds to arrival of a cop, the pulse transmitter is started and first impresses upon the magnetizable ring A the start pulse C (FIG. 7). The electronic counter S is simultaneously supplied with a pulse through line R and advances one step or figure. This figure is stored in the memory unit T. The pulse furnished from the photoelectric device P passes simultaneously through line V to the pulse transmitter U which scans the number counted by the electronic counter S and stored in the memory unit T. The memory unit then furnishes the marking pulses B according to FIG. 7 corresponding to the particular spindle on which the cop originated.

In order to make certain that for a given length of the marking pulse B, the rear pulse edge E may occupy any position between the values 1 and 0, the value 1 is arranged at such a distance from the rear edge E of the stop pulse C, that this spacing corresponds to the width of the pulse B. This spacing is provided for by a delay interval B_1 (FIG. 7). The unit of time, whose percentile amount serves to characterize the particular figure, corresponds to the time required for the transducer head to pass along the positions 1, 2, 3 . . . 9, 0 on the iron ring. Consequently, when the pulse rear edge E of the first pulse is to designate the value 8, then this pulse is impressed at 80% of the unit time. These 80% of unit time are denoted in FIG. 7 by B_2. The distance from the rear edge of the starting pulse C to the rear edge of the last counting pulse B corresponds to the travel distance and is designated by B_3.

As mentioned, upon each counting pulse issuing from the photoelectric device P, the code sequence of signals stored in the memory unit T for the particular number of the cop is scanned by the pulse transmitter U. Relative to the example of FIG. 7, eight stored pulses elapse before a magnetic pulse is impressed upon the ring, this corresponding to the length of the delay interval plus the scanning time. The travel time needed for thus impressing the eight pulse signals corresponds to 80% of the unit time. Simultaneously, six further stored pulses are scanned. After elapse of the delay time and the scanning time, which now amounts to 60% of the unit time, another magnetic pulse is supplied from the photoelectric device P. Now the six pulses are transmitted by the transducer upon the iron ring. This operation is repeated until all figures of the code combination are transmitted, and ultimately the stop pulse D is impressed upon the ring.

It will be recognized that while the operation of the read-out equipment according to FIG. 4 is essentially based upon the automatic telephone selector principle, the principle of performance in the read-out system according to FIG. 9 is essentially that of converting the analog values represented by different lengths of time to digital values in the electronic counting stages.

Electronic components for use according to FIGS. 8 and 9, including suitable systems for operating an electronic counter by time discriminating signals in the described manner, as well as counters with pulse memory stages, are known as such from data-processing and digital-control techniques. For example, electronic decadic counters and appertaining circuitry suitable for the purposes of the invention are available from Grundig-Radio-Werke (German corporation) and described in the German periodical Elektronik, 1962, No. 5, pages 135 to 138. Reference may also be had to the same periodical 1959, No. 9, pages 265 to 267 relating to analog-digital converters; 1961, No. 11, pages 325 to 328 and 1962, No. 2, pages 50 to 54 and No. 3, pages 79 to 83, relating to memory circuits; 1961, No. 11, pages 336 to 340 relating to electronic counting networks. Reference as to these electronic components may also be had to the U.S. periodicals Electronics, May 1962, pages 62 to 66 and Control Engineering, January 1963, pages 77 to 86, the latter giving a listing of manufacturers and suppliers in the United States.

When impressing the magnetic signals on the cops while they continue travelling on the conveyor, for example with the aid of devices as shown in FIG. 6, the speed at which the magnetic pulses are recorded on the cop depends upon the travel speed of the conveyor O. In this case the start and stop pulses C and D (FIG. 7) may also be used in known manner for automatically regulating the reproducing device, such as the one described above with reference to FIG. 8, so that the reproduction is also adapted to the conveyor speed. For this purpose, the reproducing device may be provided with a controllable-speed motor for rotating the cop as exemplified in FIG. 10. The cop is rotatably mounted on a holder which is driven from a direct-current series motor **61**, the transducer means and the devices controlled thereby being as described above with reference to FIG. 8. After the motor **61** is switched on, it increases its rotating speed until the peripheral speed of the ring A corresponds to the time required by the entire width of the start or stop pulse to pass by the field gap (sensing gap) of the transducer head F. A pulse discriminator Z is supplied with pulses corresponding to the unit time and also with the scanned-off start-stop pulses. The discriminator Z performs a time comparison, such as with the aid of coincidence gate circuits. This produces a positive or negative regulating voltage depending upon whether the width-period of the start and stop pulses are in proper proportion to the unit time. This positive or negative voltage is applied to the motor **61**, for example and as shown, by means of an auxiliary control field winding **62** for regulating the motor to the proper speed. The counting operation of counter M can then be started when synchronism is established. It will be understood, however, that when provision is made to employ alternating-current motors of the synchronous type throughout, so as to secure reliably a constant-speed operation at the conveyor and in the recording and reproducing devices, no additional speed regulating means are necessary and the reproducing performance becomes virtually as reliable as in conventional sound recording and data processing equipment.

The pulse configuration and duration of the magnetic recordings used for the purposes of the invention can be modified in various respects. For example, instead of employing pulses of constant length as shown in FIG. 7, the cop may be impressed with pulses of variable length whose respective length values differ from the unit time B_2. Employing pulses of the same, shortest feasible length, as represented in FIG. 7, however, has the advantage of being less susceptible to trouble due to mechanical damage occurring at the iron ring A. The narrower are the recorded magnetic pulse, the lower is the probability that mechanical damage may occur just at this location. However, if nevertheless mechanical damage occurs accidentally at the location of a recorded pulse, no faulty mounting is entailed as mentioned above with reference to the example of FIG. 5, but the count would simply be omitted. For example, if damage of the iron ring A occurs at the place where the pulse B for figure **6** is located, the reproducing device according to FIG. 8 would have to scan the entire distance between the pulse rear edge for figure **8** and the pulse rear edge for figure **7** before the pulse generator is stopped. In this interval of time, however, the pulse generator issues considerably more than ten pulses so that a counting operation is no longer possible. The electronic counter M of the device according to FIG. 8 would then indicate that the origin of the particular cop is no longer definable. Although this is a disadvantage, it is greatly preferable to a false indication of origin.

To those skilled in the art it will be obvious upon a study of this disclosure that our invention permits of various modifications with respect to applicable equipment and components and hence may be incorporated or performed by means of embodiments other than particularly illustrated and described herein, without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim:

1. The method of testing the quality of yarn spun on multi-frame spinning plants, which comprises providing each resulting spinning cop with a core having magnetizable surface area and impressing upon said area a magnetic recording of discriminatory markings identifying the corresponding one of the respective spinning frames, immediately thereafter unwinding yarn from the completed cop and simultaneously counting any yarn faults, and magnetically reproducing and reading the markings for thereby tracing excessively faulty cops back to said corresponding one spinning frame.

2. The method of testing the quality of yarn spun on multi-frame spinning plants, which comprises providing each resulting spinning cop with a core having a magnetizable surface area and impressing upon said area a code combination of magnetic pulse recordings, each combination comprising a plurality of pulse groups recorded in sequence and identifying the corresponding one of the respective spining frames, immediately thereafter unwinding yarn from the completed cop and simultaneously counting any yarn faults, and magnetically reproducing and reading the code combination for tracing excessively faulty cops back to said one corresponding spinning frame.

3. The method according to claim 2, wherein said magnetic pulse recordings are impressed and reproduced in accordance with a digital numerical code, each pulse group comprising a number of pulses corresponding to the digit value of an identifying multi-digit number.

4. The method according to claim 2, wherein said individual pulse recordings in said groups have substantially constant length, and the mutual spacing of respective pulse flanks is used as active marking.

5. The method according to claim 2, comprising the step of impressing upon said magnetizable area a magnetic start pulse before commencing the recording of said code combination, and impressing a stop pulse when the recording of the code combination is completed.

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