

May 9, 1967

N. V. LONG

3,319,253

TEXTILE PRODUCTION CONTROL APPARATUS

Filed Oct. 20, 1965

6 Sheets-Sheet 1

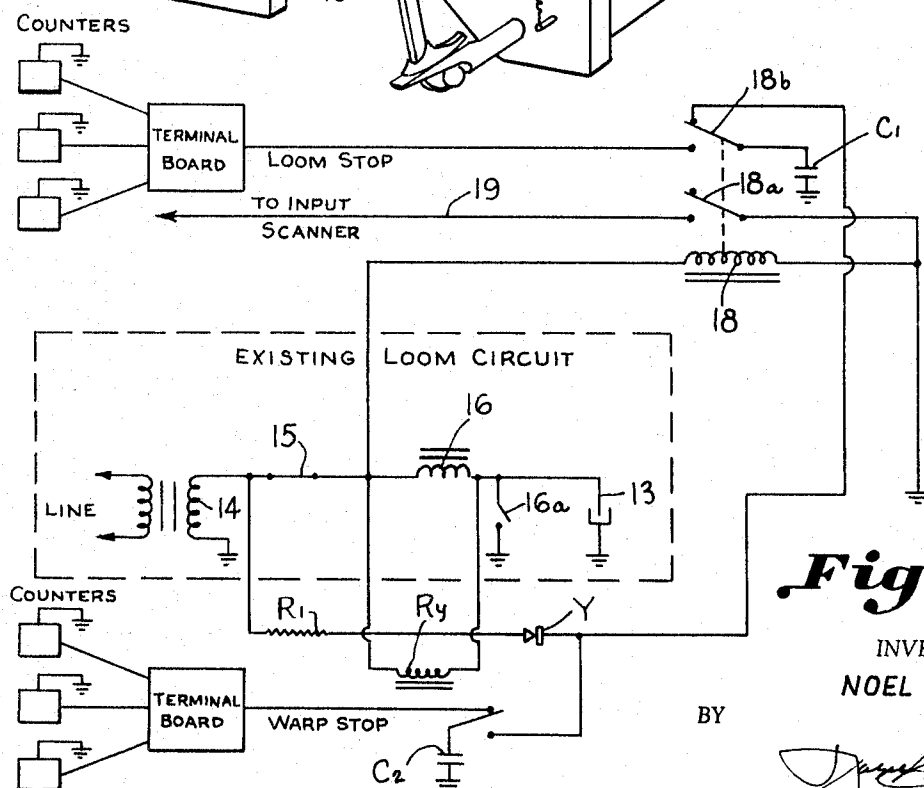
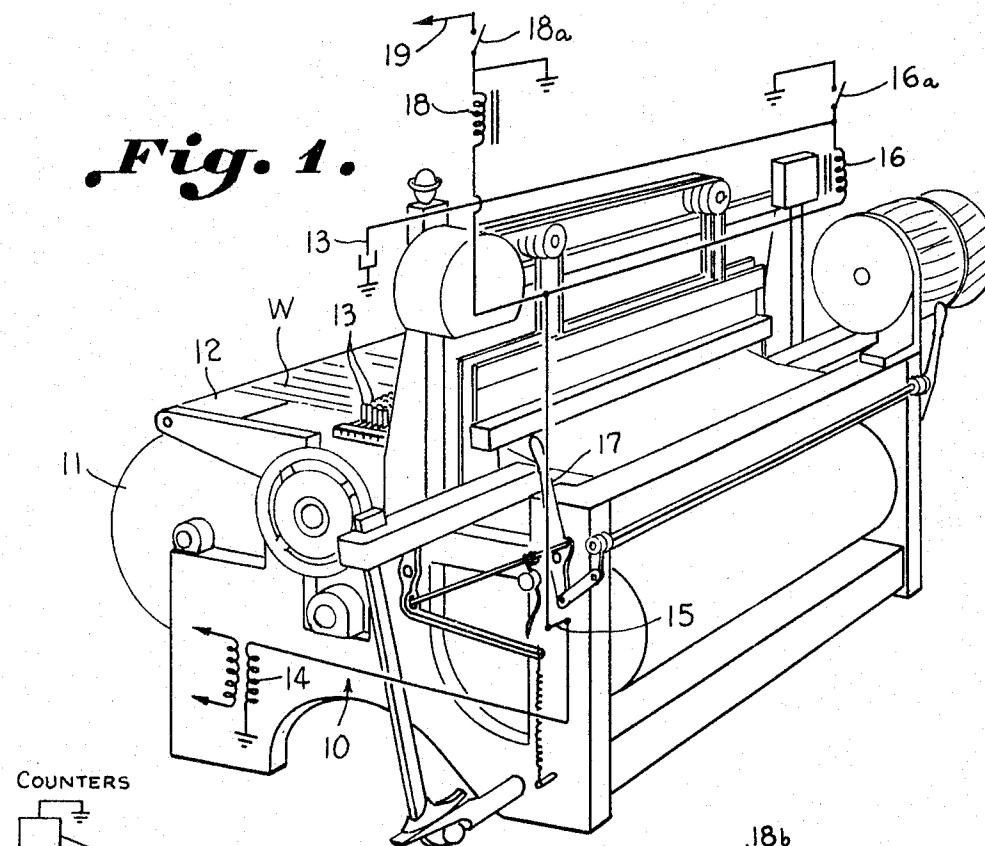


Fig. 2.

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6 Sheets-Sheet 2



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6 Sheets-Sheet 3

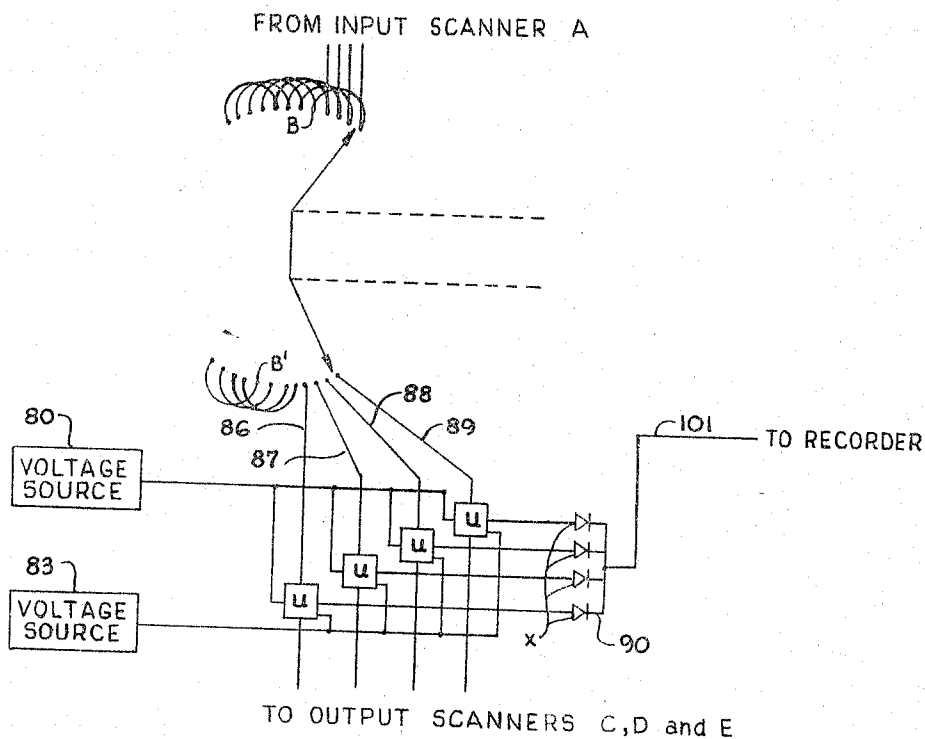


Fig. 3A.

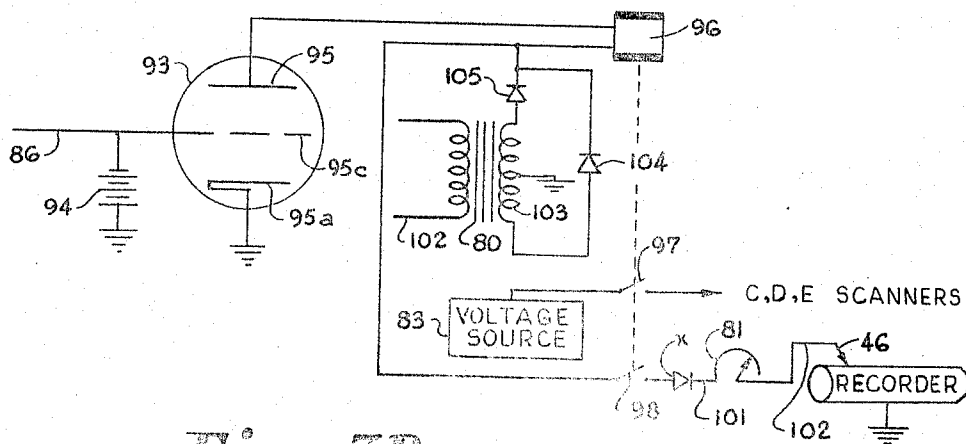


Fig. 3B.

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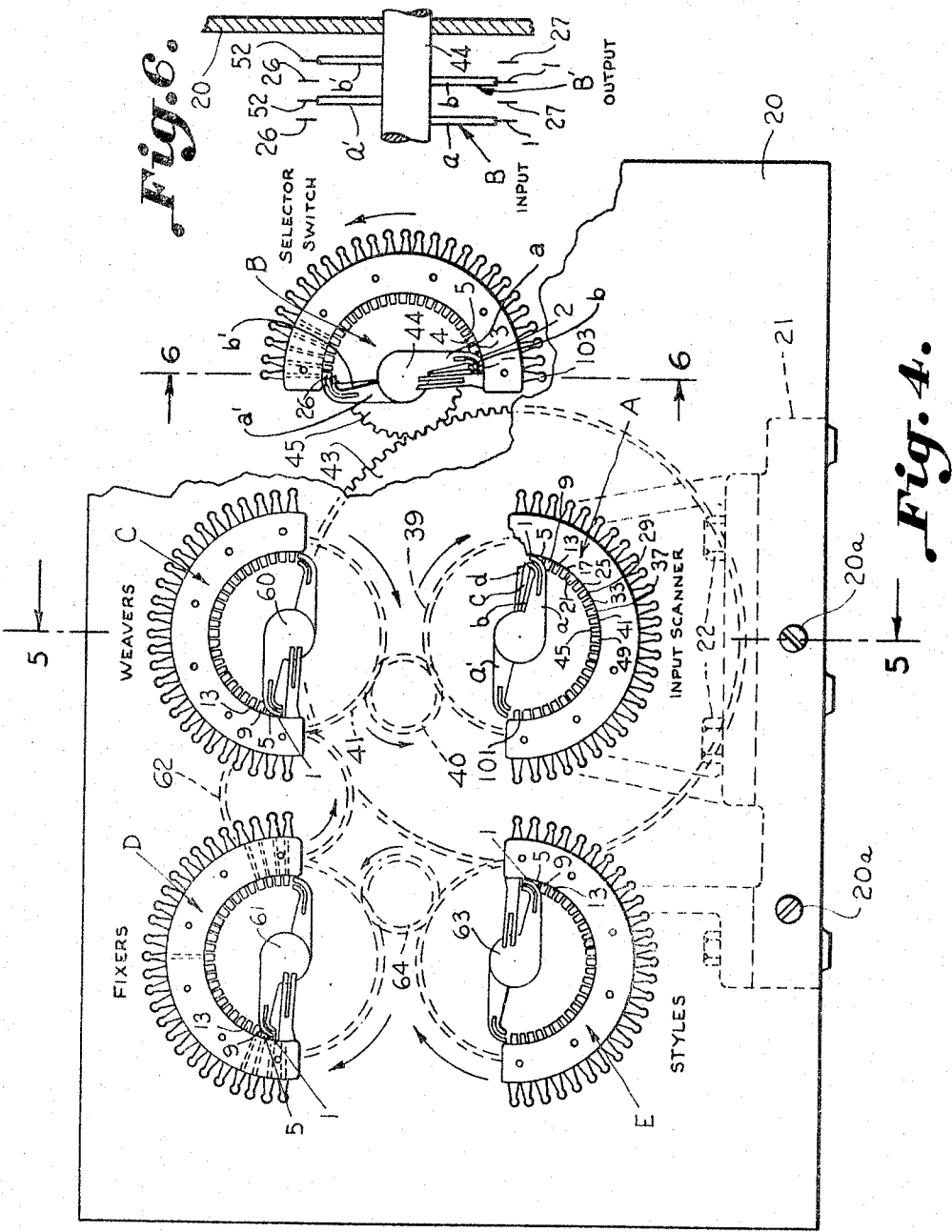
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TEXTILE PRODUCTION CONTROL APPARATUS

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TEXTILE PRODUCTION CONTROL APPARATUS

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6 Sheets-Sheet 5

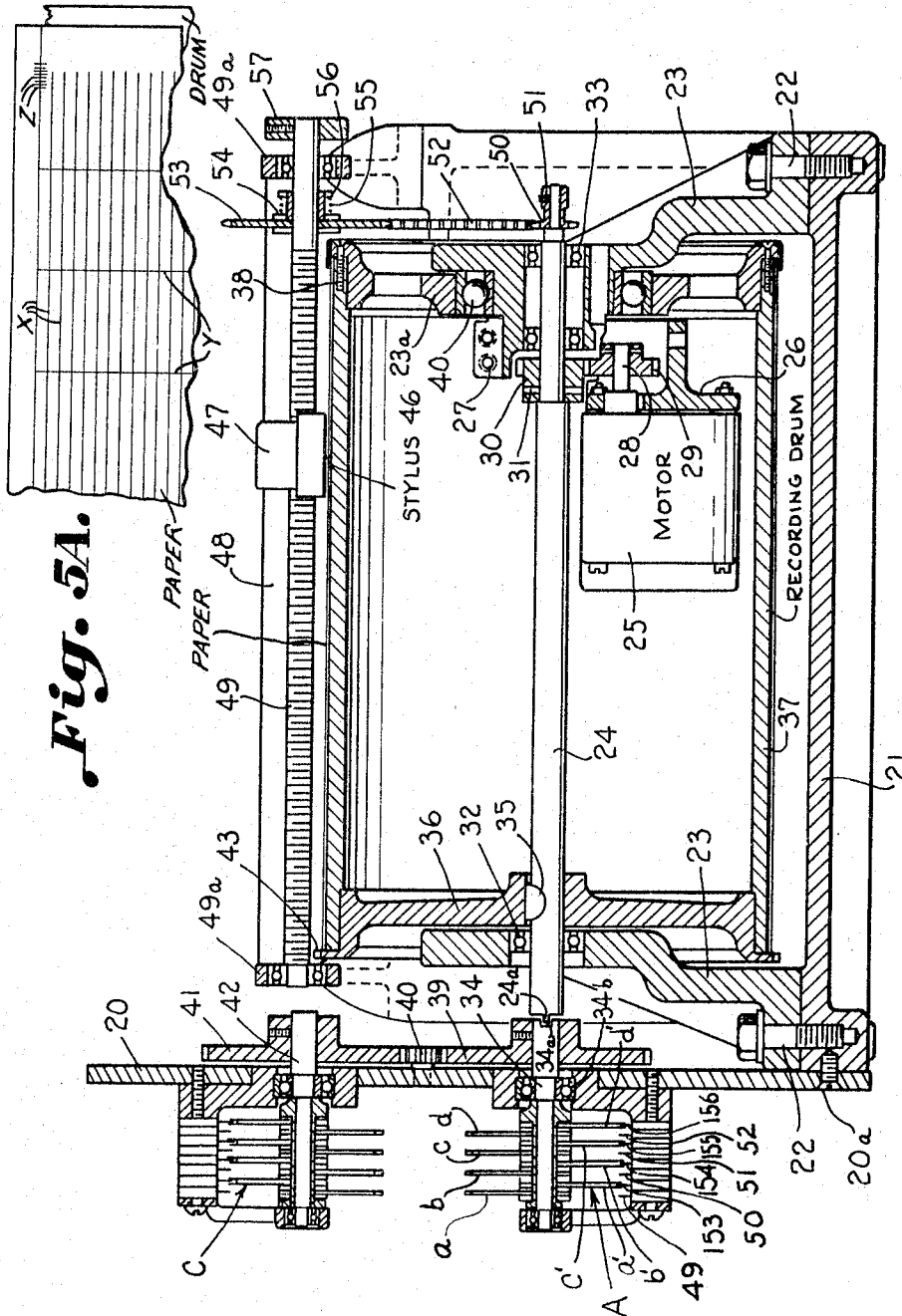


Fig. 5A.

Fig. 5.

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TEXTILE PRODUCTION CONTROL APPARATUS

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6 Sheets-Sheet 6

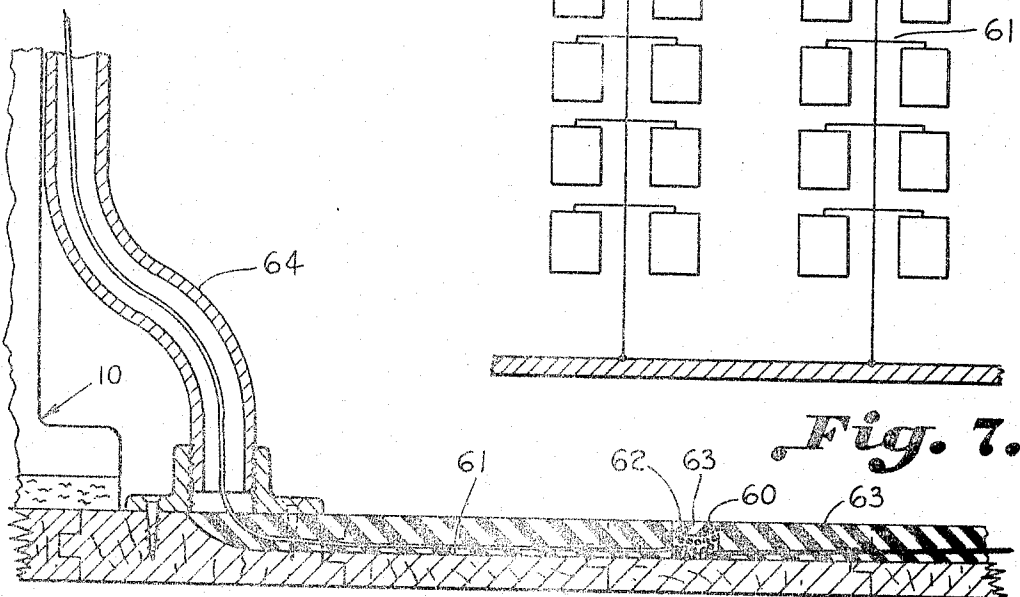
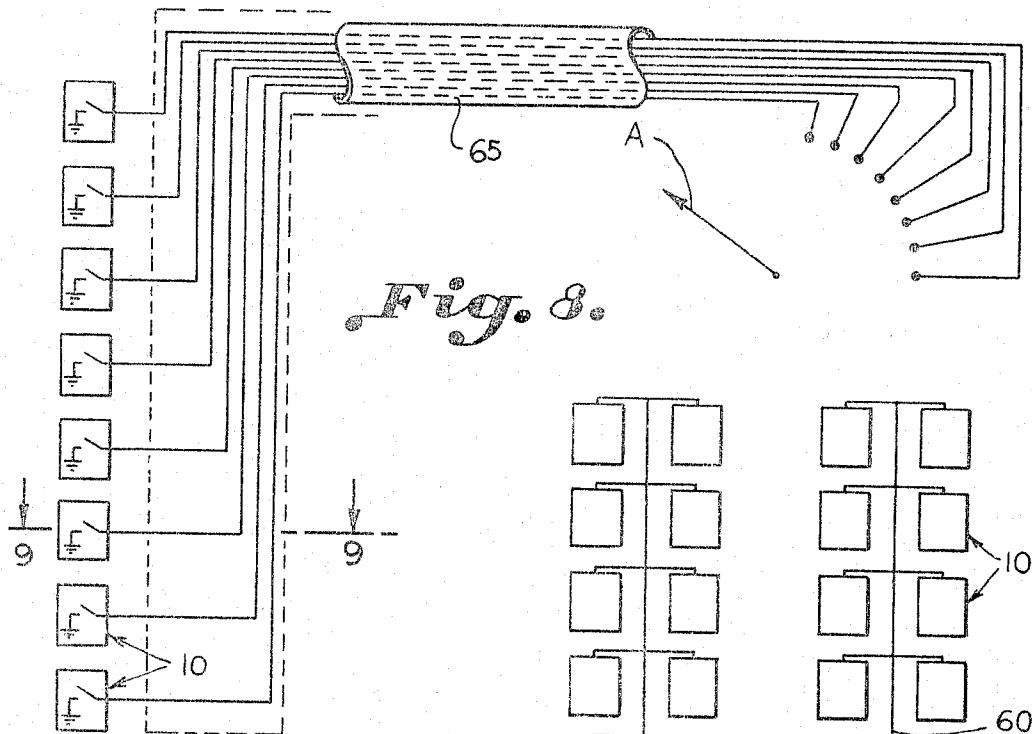


Fig. 9.

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3,319,253

TEXTILE PRODUCTION CONTROL APPARATUS
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Filed Oct. 20, 1965, Ser. No. 498,689

8 Claims. (Cl. 346-34)

This invention relates to textiles and more especially to production control apparatus for recording the duration and time of occurrence of stops of each of a multitude of textile machines such as looms, knitting machines, spinning frames and the like, as well as apparatus for recording the total down time of large groups of textile machines.

This is a modification of copending application Ser. No. 428,009, now Patent No. 3,226,726 entitled, Textile Production Control Apparatus, filed Jan. 8, 1965, and assigned to Adams, Inc.

Devices have been proposed for recording the total operating time of a group of looms for providing a basis on which to compute the wages of operators, however, such devices have either proved unreliable or too expensive to justify their use. Devices commonly used in the textile industry for the purpose of computing wages are individual pick counters, one of which is mounted on each loom. The only information provided by such counters is a measure of cloth production in terms of loom running cycles from the time of last reading. Such devices must be read periodically and the readings totaled according to groups of looms all of which is consuming of time and labor. Other devices have been proposed for computing loom down time due to specific causes such as, down time due to warp breakage or down time due to filling breakage. Such former devices have proved impractical due, to some extent, to the excessive complexity of the switch gear and the difficulty of making proper electrical connections from the large number of looms operated in a single weave room to a central reading station. No former device successfully contemplated the recording of individual loom down time with respect to duration and time of occurrence. While the present invention is thought to have application to textile machines of any type present in large number in a textile mill, the device has special application to looms. Therefore, the preferred embodiment disclosed will be in terms of its relation to looms.

Accordingly, it is an important object of the invention to provide apparatus for recording individual machine down time with respect to duration and time of occurrence.

Another object of this invention is to provide a graph recording of such individual loom down time so that the operation of looms in one or more departments may be observed on a single graph.

Another important object of the invention is to provide operating condition information in numerical form grouped according to operator, shift and the like so that a comparison of operator efficiency may be had.

Still another object of the invention is to provide effective apparatus for totalizing down time for groups of looms.

Another important object of the invention is to provide apparatus for monitoring a single down time signal and distributing this signal to one or more selected recording means according to a desired variety of groupings.

Another object of the invention is to provide simple effective apparatus for connecting a large number of looms, such as in a weave room, to recording apparatus for giving a variety of information on the operation of such looms.

An important object of the invention is to provide scanning means distributing loom stop signals to operate a graphic recording device and redistributing these same signals to one or more recording means each representing a group according to operator, style or shift as desired.

Still another object of the present invention is to provide a coupling means in a production control apparatus for coupling a first voltage source to a recording device and a second voltage source to totalizing means responsive to a predetermined operating condition of the machines being monitored.

Another important object of this invention is to provide a signal responsive to a particular operating condition of the machines being monitored for activating coupling means which energizes a recording device and a totalizing device.

A further object of the present invention is to stagger the brushes of an input selector relative to the brushes of an output selector to provide a more defined break time between incoming signals from the machines being monitored.

Another important object of the invention is to provide a permanent visual history of the activities of operators with relation to time and individual looms.

Another important object of this invention is to increase the reliability of a recording apparatus for giving a variety of information on the operation of a multitude of textile machines by reducing the number of components in said recording apparatus.

Another important object of this invention is to provide a means for rotary switch contacts to carry a current load without requiring the contacts to spark or gap under said current load.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIGURE 1 is a schematic perspective view illustrating a loom and the various electrical connections therefor according to the present invention,

FIGURE 2 is a schematic circuit diagram further illustrating the various electrical connections for a device constructed in accordance with the present invention,

FIGURE 3 is a circuit diagram illustrating apparatus constructed in accordance with the present invention,

FIGURE 3A is a circuit diagram illustrating a modified form of the apparatus illustrated in FIGURE 3,

FIGURE 3B is a schematic diagram of a coupling device used in the circuits illustrated in FIGURES 3 and 3A,

FIGURE 4 is an end elevation of recorder and switching mechanism constructed in accordance with the invention,

FIGURE 5 is a sectional side elevation taken on the line 5-5 in FIGURE 4,

FIGURE 5A is a front elevation illustrating a graph paper upon a device embodying the present invention,

FIGURE 6 is a sectional elevation taken on the line 6-6 in FIGURE 4,

FIGURE 7 is a schematic plan view illustrating machine connections constructed in accordance with the present invention,

FIGURE 8 is a schematic elevation further illustrating electrical connections between machines and the scanning mechanism, and

FIGURE 9 is a sectional view taken on the line 9—9 in FIGURE 8.

In order to achieve certain of the objects of the present invention it is necessary to scan a multitude of circuits. It is desirable to use each circuit in this multitude individually in two different ways. First, it is desirable to record machine stoppage on a chart such that the particular machine involved, the time of occurrence and the duration of the condition may be identified. Second, it is desirable to take the signal from this particular circuit and numerically record it in a desired group of which there may be several. This is accomplished generally by scanning means in the form of circular switching means comprising a multitude of contact points wherein an increased number of contact points by using the circular switch elements are in a stacked or ganged relationship as illustrated at A in FIGURES 3, 4 and 5. The brushes of the circular input scanner switch A will be synchronized with other such elements that the corresponding contacts of each switch element are searched simultaneously as described in greater detail below.

A second scanning means is provided in the form of a separate circular input selector switch B similar to that previously described but running at a higher rate of speed, the multiple of which is determined by the number of ganged sections stacked in switch A. Switch B is used to search the brush assemblies of the switch A and individualize the signals on the brushes of ganged switch A. Selector switch B, which has every fourth terminal commoned as shown in FIGURE 3, is provided to sequentially connect each of the four brush assemblies of scanner switch A to a coupling means U (FIGURE 3) or to an output selector B' (FIGURE 3A). For example, if eight circular switch brushes *a*, *b*, *c* and *d*, and *a'*, *b'*, *c'* and *d'* (FIGURES 3, 3A, 4 and 5) are included in circular switch A for use with eight levels of contacts, the brush *a* of circular switch B would be on its first contact 1 when the brush *a* of switch A is on its contact 1. (See FIGURE 4.) When the brush *a* of switch B is on its second contact 2 it would search switch A, the *b* brush of which would be on contact 2 (not shown) of switch A. Then when the brush *a* of switch B is on its contact 3 it would search switch A, the *c* brush of which would be on contact 3 (not shown) of switch A. The brush *a* of switch B is on its contact 4, while the brush *d* of switch A is on its contact 4 (not shown). When the brush *a* of switch B is on its contact 5 the brush *a* of switch A will be on its contact 5. This type searching is repeated through the revolution of brushes *a* and *a'* of switch B and in this case the brushes of switch B would run at four times the speed of the brushes of switch assembly A. In this manner, the signals available in assembly A are individualized by means of switch B. Since these two switch elements are running at a fixed speed it is important that, the brush *a* in circular switch A slightly lead brush *b*. Brush *b* should slightly lead brush *c*, and brush *c* should slightly lead brush *d*. This is done, as illustrated in FIGURE 4, to be sure that when scanning assembly B senses the appropriate brush in scanning assembly A, this brush definitely will be on contact. Thus, this staggered brush arrangement assures that the proper brush will always be on contact at the right time and for sufficient duration to enable scanning assembly B to pick up for the maximum signal time.

The various contacts are assigned corresponding numbers on FIGURE 4, 5 and 6 to further illustrate the scanning sequence employed. For example, after brush *a* of selector switch B has passed contact 26 of selector switch B, brush *a'* engages contact 27 of the back deck of contacts. At this time brush *c* of input scanner A is on contact 27. When brush *a* of selector switch B leaves contact 26 the drum 37 will have completed one eighth of a cycle. Thus, when any contact is made on scanner switch A during its cycle a corresponding determinable contact is made on selector switch B.

Since scanning assembly B is driven from a rim gear on a drum recorder, it is evident that the switching action which takes place in this rotary switch can be used to indicate on the circumference of the drum, and it is also evident that the signal from any particular circuit in the switching action previously described has a definite location for recordation in relation to the circumference of the drum and can be utilized along the full length of the drum. To use this type arrangement for recording, suitable graph paper such as Teledeltos paper (see FIGURE 5A), sold as Stock L-48 by Western Union Company of Irvington, New Jersey is placed on the drum and an electric stylus is provided to traverse a fixed path in relation to the axis of the drum. This stylus is moved longitudinally in a path parallel to the axis of the drum by a lead screw (49 in FIGURE 5) causing the stylus to be advanced at a fixed relationship to the speed of the drum.

Thus, the switching means reduces a multitude of available signals to one at a time in a definite sequence in order to properly pulse the stylus. Also, it is observed that a numerical counter may be pulsed whenever the stylus is pulsed thereby recording numerically the number of signals acquired over a period of time.

These signals may be redistributed in order to get a total count of stoppages by groups of looms. For example, signals may be assigned to groups which pertain to operators, to maintenance personnel and groups which may be producing the same materials. To accomplish this, the scanning arrangement previously described is inverted so that an output selector switch element B' corresponding to circular switch B is used to systematically complete a circuit to brush assemblies in output scanning switches C, D and E which correspond to brush assemblies *a*, *b*, *c* and *d*, and *a'*, *b'*, *c'* and *d'* in switch assembly A. This means that at one time one circuit in scanning assembly A is scanned by selector assembly B which selects the proper one of the ganged sections or decks of scanning assembly A. In a like manner a corresponding section of scanning assembly B' picks out the proper one of the ganged sections in scanning assemblies C, D and E so that the signal can be processed in the proper manner at each of these three output sections. This results in the information impressed upon each contact of scanner switch A being in the proper timed sequence, being present on the corresponding contacts of paralleled output scanner switches C, D and E.

While reference has been made to the connection between the scanner B and B' and the scanning assemblies C, D and E, it is to be pointed out that such is not a direct connection. A coupling device U is located in the circuit and connects the recording device to a first voltage source 80 and the scanning assemblies C, D and E to a second voltage source 83. The details of the manner in which the coupling circuit or circuits U are connected in the circuit are discussed more fully below.

In the embodiment illustrated in FIGURE 3 the contact time of scanning switch B is shorter than the contact time of scanning switch B'. This assures that the voltage source 83 will be connected to the wiping brushes of switch B' only after the wipers are well on the contacts of switch B' and the voltage source is disconnected from the wiping brushes before the wiping brushes leave the contacts of switch B' preventing destructive arcing when making and breaking contacts under load.

In the embodiment illustrated in FIGURE 3A the brushes of scanning switch B are staggered relative to the brushes of scanning switch B'. The staggering of the brushes of switch B and B' provides a larger "break" or "off" time between signals at the output of switch B'. The details of the staggered brushes are discussed more fully below.

The multitude of contacts which comprise scanning sections C, D and E may be assigned in two ways. First, the contacts on scanning switch C which apply to a par-

ticular category of information sought would be strapped so as to make these points common with each separate readout. Thus, for example, if 104 of the 208 looms were assigned to a particular weaver such 104 contacts could be made common. Second, if it is desirable to have each available circuit of scanning switch C optionally available to several weavers, the contacts on this switch can be wired directly to terminals on a patchboard assembly. Such would have contact points or terminals corresponding in number with those which comprise scanning switch C in each group and as many such groups of contact points as one would choose to make available. By means such as a shorting pin or a jumper wire any terminal which corresponds to a particular contact point on scanning switch C can be made common with any one of the available groups or readouts. In a like manner, the contact points on scanning switch D and E may be arranged in such a manner as to assign each contact to the readout to which it would apply.

Thus, the first operation which takes place is the scanning of a large group of machines through rotary switches A having staggered brush assemblies. These rotary switches are then scanned by a single input selector switch B so that the signals impressed upon the rotary switches are used to mark a chart. These signals are then fed to a coupling device U (FIGURE 3) which connects a first voltage source to a recorder which produces a mark indicative of a predetermined operable condition of a machine. As a result of the coupling device receiving a signal a second voltage source is coupled to an output selector scanner B' which distributes a voltage from the second source to a number of other rotary switches C, D and E, which apply such through corresponding contacts to desired groups of sub-totalizing means. The graphic totalization of a very large group of signals is thus accomplished with the capability of redistributing these same signals to desired indicating means.

Referring to FIGURE 1 a loom is broadly designated at 10 and includes warp yarn W coming off of the loom beam 11 and being fed over the usual whip roll 12. The warp yarn is then fed through the usual drop wires 13. Electrical connection is made from the secondary 14 of the loom transformer through a switch 15. The transformer illustrated is a standard part of the loom control circuitry, whose function it is to provide a control voltage in the proper range from its secondary 14. The switch 15 is normally closed when the loom is in operation and is mechanically attached to the shipper rod 17 which opens same upon loom stoppage. The switch 15 and the solenoid 16 operate a shunt switch contact 16a responsive to connections made as a result of the action of the drop wires 13 when they fall to indicate a faulty end of warp yarn. These are all normal parts of the loom stop circuitry and are enclosed in dotted lines in FIGURE 2 to indicate this.

Upon the occurrence of a faulty warp yarn, one of the drop wires 13 falls to a shorting position causing the solenoid 16 to energize. The solenoid 16 pulls in its shunt contact 16a thus relieving the drop wire 13 of further responsibility. The solenoid 16 operates mechanical means to stop the loom. When the loom stops the switch 15 is mechanically opened by the shipper rod 17 to de-energize the circuit. Upon restarting the loom the switch 15 is closed responsive to movement of the shipper rod 17 to operating position. The scanning mechanism requires a connection to ground in order to monitor loom stops and for this purpose relay 18 was added to the circuit. The relay 18 is normally energized, when the loom is running, holding open its contact 18a. When the loom stops the relay 18 is de-energized and its contact 18a closes to signal input scanning means A through a conductor 19 (see FIGURE 2). In the event no electrical automatic stop device is used on the machine, a switch similar to switch 15 in FIGURE 1 would be used. Switch 15 is mechanically actuated by movement of the control

lever and in this arrangement is mounted so that the sensing contacts are open when the control handle is in the on position and closed when the control handle is in the off position, thereby completing the sensing circuit to ground. Switch 15 would thus replace the action of contact 18a which closes the circuit 19 to ground during machine stoppage.

If it is desirable to count the total number of loom stops, another set of contacts 18b may be ganged with contacts 18a and be operated by the coil 18 as double throw contacts as indicated schematically in FIGURE 2. A diode Y is connected through a resistor R1 to the high potential side of the secondary 14 and furnishes a D.C. voltage for the purpose of charging a capacitor C1 while the loom is running. When the loom stops for any reason the accumulated charge on the capacitor C1 is pulsed through the contacts 18b. This pulse is fed to a loom stop terminal board (see FIGURE 2) where it is routed to a counter. The counters may be arranged so as to totalize the down time of desired groups of looms.

If it is desirable to count the total number of stops due to faulty warp yarn a relay Ry is added in parallel with the loom solenoid 16. Every time the loom solenoid 16 is energized by a faulty warp the relay Ry will be energized. This will cause its movable contact to move from the position shown in FIGURE 2 to close a circuit to ground and charge the capacitor C2 through the diode Y. Since it is the function of the solenoid 16 to stop the loom resulting in the opening of switch 15, the relay Ry will be de-energized and its contacts will be returned to normal position. The charge on the capacitor C2 will be delivered to the warp stop terminal board from whence it is selectively routed to a desired counter.

Referring now to FIGURES 4 and 5 it will be observed that various switch components are supported on a vertical plate 20, and that the entire drum unit is securely fastened to a rugged baseplate 21 by means of bolts 22. The plate 20 is fastened to the base 21 as by screws 20a. As will be noted the end bells 23 support a shaft 24 for rotation axially of the assembly. The motor 25 is supported by a specially prepared bracket 26 that is clamped to the end bell 23. The holes 27 receive the necessary screws (not shown) to tighten the bracket 26. A gear 29 is attached to the shaft 28 of motor 25 and is meshed with gear 30. In turn, gear 30 is fastened to the shaft 24 by pin 31. The net result is that the motor 25 drives the shaft 24. The leads (not shown) of the motor 25 are dressed out through a suitable port in the wall of end bell 23.

Since the shaft 24 must extend through the end bells 23, the bearings 32 and 33 are provided. The shaft 24 has a spade 24a on one end to drive the shaft 34 by receiving same in a slot 34a. The shaft 34 is mounted for rotation in the bearing 34b carried by the plate 20. Also, attached to shaft 24 by means of a key 35 is a wheel 36. The wheel 36 is attached to a drum 37 as by screws 38. The other end of the drum is supported by a wheel 23a which turns on a bearing 40 supported by the adjacent end plate 23. The motor 25 drives the shaft 24 which in turn drives both the shaft 34 and the drum 37 in synchronization. Now referring again to the shaft 34 it should be observed that a gear 39 is fastened securely thereto. This gear 39 is in mesh with an idler gear 40 which is in mesh with gear 41. The gear 41 is fastened to shaft 42 which rotates the brush assembly of switch C at the same speed as the brush assembly of switch A. As shown in FIGURE 4, a gear 41 drives the idler 62 which in turn drives a gear to which is fastened the shaft of scanner D and this gear drives idler 64 which in turn drives a gear fastened to the shaft of switch assembly E. This gear train results in having the rotor shafts of all switches A, C, D and E moving at the same speed and relationship to each other. Further, the brush a of scanning switch A finds contact 1 of the switch A at the same time that brush a of switch B finds contact 1 of switch B. At the same time brush b of switch B' will cause this same informa-

tion to be distributed to contact 1 of switch assembly C and switch assembly E, and the above mentioned gear train will cause the brushes on the rotors of these corresponding switches to be in the proper position to distribute these signals to desired indicators such as set forth below.

As pointed out above, switches B and B' are rotated by the shaft 44 at the same speed and the two switches have corresponding contacts. The individual contacts 1 through 52 of the selector switch B and the corresponding contacts 1 through 52 of the selector switch B' form, in effect, two terminals of a normally open switch. When, for example, the brush *a* of selector switch B is in contact with one of the terminals or contacts of switch B, the brush *b* of selector switch B is in contact with a corresponding terminal or contact of switch B'. Thus, close circuits are made between a contact of switch B and a corresponding contact of switch B' as the brushes *a* and *b* scan the contacts of switches B and B'.

The duration of circuit continuity through each of the switch circuits 1—1, 2—2, 3—3, etc., between switch B and B' may be reduced during the scanning operation by offsetting or staggering the brushes of switch B relative to the brushes of switch B'. The switch circuits 1—1, 2—2, etc. represent a circuit including such a numbered contact of the scanner B and a corresponding numbered contact of the scanner B'. By staggering the brushes the "break" or "off" time between signals at the output of switch B' can be increased. Such provides a more defined space between marks when the signals are recorded. The increased break time also provides more time for the electromechanical counting devices to reset between counting impulses. FIGURE 4 of the drawings illustrates the brushes *a* and *a'* of switch B being staggered relative to the brushes *b* and *b'* of switch B'.

The motor 25, drives a shaft 24, to which is coupled a switch assembly A and the drum 37. A gear train (see FIGURES 4 and 5) increases the shaft speed of a secondary or auxiliary switch assembly B which scans the main switch assembly A. It should be noted that for this purpose the shaft 24 drives a gear 43 carried by the drum 37. The gear 43 drives the selector switch shaft 44 through the gear 45. By increasing the speed of the selector scanner B to a proper ratio with respect to the switch A, each brush on the selector scanner assembly B produces a single output. This is accomplished by making the contacts of the scanner B common with the proper brushes on switch A. In short, the selector scanner is the means by which the multitude of information received by the main scanning assembly is considered individually and in an orderly fashion.

Now since the drum 37 turns in timed sequence with the scanner brushes and because scanning assembly B and scanning assembly A are similar except for speed and number of decks, then it follows that points on the perimeter of the drum will agree with scanner contacts. Thus, if a piece of recording paper is stretched tightly around the drum 37, it may be ruled or lined as at X to agree with the scanner contacts as discussed above. In the embodiment shown, the specially prepared paper discussed above may be wrapped around the drum for this purpose. This paper is sensitive to electric currents so that when the recording stylus 46 (FIGURE 5) which is connected to a high voltage source through a coupling device U, is energized, a trace Z (see FIGURE 5A) is burned on the paper.

The burning stylus 46 is mounted on a carriage 47 which has a guide 48 and is driven longitudinally across the drum by the lead screw 49. The lead screw 49 is in turn driven from shaft 24 by means of a sprocket 50, securely attached thereto by a set screw 51, providing power through a sprocket chain 52 to the sprocket 53. The sprocket 53 is attached to shaft 49 by means of a friction clutch 54, against which rests a compressed spring 55 held in place by stop 56. The pressure exerted by the clutch 54 is so adjusted that the drive from shaft 24 will

remain positive under normal operating conditions. However, it is possible to turn the knurled nut 57 by hand and override the drive from shaft 24 in either direction, thus enabling preliminary adjustments at start up or at the operator's discretion. The lead screw 49 is supported by bearings 49a at both ends.

Should the stylus become energized at any particular moment, it will mark a trace Z at a specific point on the paper. This point is always in agreement with the contact segments of the scanning assembly to identify the source and with the progression of the stylus along the longitudinal surface of the drum to determine the time of the occurrence since the switch assembly, the stylus drive and the drum are synchronized. The paper is prelined and prepositioned (see FIGURE 5A) on the drum so that any markings Z on the paper will be readily identified as to the source as at X and time of receipt of such intelligence as at Y. Duration of the occurrence resulting in the markings or traces Z may be visually observed by observing elapsed time for successive markings.

The problem of placing the circuit which must connect the individual machines with a central station will now be considered. If the mill floor is built on grade, conduits would have to be laid beneath the flooring in main channels and in connecting spurs to each machine area before putting down the flooring and before installing the machines. This type application would be expensive and virtually impossible in existing factories. The conduit to individual machines might be suspended from the ceiling and dropped down to each machine location. This arrangement is unsightly and expensive.

If the mill floor is not built on grade and space were available beneath it, the necessary wiring could be run through the floor and routed along the underside of the sub-floor. The under-floor area may consist of merely crawl space or it may comprise another production area similar to the floor above, possibly having an 18 foot ceiling. In either case, communications between workmen from one floor to the other would be restricted and, if scaffolding were needed, this would add to the inconvenience of properly harnessing and forming the main arteries of wire along the ceiling. This type application would be expensive, time-consuming and potentially dangerous.

FIGURE 7 shows a multitude of looms 10 arranged in parallel rows with the main wiring channels 60 situated beneath each parallel pair with cross access channels 61 to opposite machines. FIGURE 8 illustrates a number of looms 10 with normally opening sensing circuits from which sensing leads are provided. These leads are eventually attached to individual contacts of the scanning switch A so that they can be checked at regular intervals to determine if the appropriate machine sensing device is actuated. Whenever a machine sensing device has been actuated, a circuit is completed to a counter or other recording device. From the individual looms to a point where a conduit can be used, the wire is embedded in the floor and protected with floor surfacing materials. FIGURE 9 shows a cross-section of the floor between two rows of machines 10. In one of the boards a channel has been cut partly through the board of sufficient width to house a large number of wires. These wires are held near the bottom of the channel 60 by spring clips 62 which are slightly longer than the width of the channel so that when pressed into the channel, they will grip the walls and at the same time force the wire downward. Once these wires are in place, the channel is filled with a suitable industrial type floor surfacing material 63. This material should be of a type having high penetration characteristics so that once it has cured, it becomes extremely tough and durable. If the factory floor be concrete, the appropriate channel can be sawed in a similar manner to that shown and filled with the appropriate floor surfacing material. It will be noted that a conduit 64 is provided for housing the lead to the individual looms

while a conduit 65 is provided for carrying the leads to the switch A.

It is to be understood that an arrangement of this type would probably not suffice where the wires being embedded are intended to carry high voltage current under heavy load. However, in this case it is only necessary that individual sensing leads be made available at a large number of locations and the voltage and load requirements are extremely low. With this type arrangement there would be no fire or other safety hazards involved should two or more leads become damaged. The main concern here is to conveniently house, and within reason, protect the circuitry from abuse. While a direct connection is made between the switches on the machines and the contacts of switch A in the preferred embodiment, other means may be used to transfer the signals from the machines to the production control apparatus. One alternative method may comprise a transmitter mounted on the machines and a receiver associated with the scanning apparatus.

The electrical circuit may best be understood by referring to FIGURE 3. For sake of illustration, a complete circuit through the unit will be traced. A terminal board is illustrated in the upper left-hand corner serving 208 circuits plus a common ground. Assuming that loom No. 1 is down and it is connected through lead 19 to terminal No. 1 on this board the circuit is ground to the common terminals 209 and 210. The scanner A searches this point periodically so that the grounded circuit will be connected through scanner A, and through scanner B. Since the scanner B is rotating four times as fast as the scanner A, the signals received at the output of scanner B are in sequence. These signals are fed into a coupling device U. The coupling device U is described in detail in the description of FIGURE 3B. The coupling device connects, by lead 101, a D.C. voltage from a first voltage source 80 to the recorder input on the control chassis A. The D.C. voltage 80 is connected to terminal 5 on the control chassis A to terminal 5 on the control chassis B through a variable resistor 81 (FIGURE 3B), which is useful to adjust the trace intensity of the stylus. From terminal 6 on the control chassis B this circuit is returned to terminal 6 on the control chassis A. Then from terminal 7 on the control chassis A, the signal is routed through lead 102 to the electric stylus 46. Current from the stylus will conduct through the paper to the drum surface causing a mark Z (FIGURE 5A) to appear on the paper. The drum is grounded to complete the back leg of the supply circuit. It will be noted that each time the scanner finds such a grounded circuit, a resultant mark Z will appear on the chart.

Referring again to the point where the output of scanner B is connected to the coupling device U. A ground potential signal from switch B also causes the coupling device U to connect a second voltage source 83 to the brush arms of selector switch B'.

Assuming that loom No. 1 is down, at the time the graphic recorder writes, there will also be a circuit completed through B' and scanners C, D and E. While only three output scanners are shown, any number may be used. There must be an output scanner for each individual category of readout required. This is to prevent cross circuits between the different situations. Furthermore, since two contacts are usually made at any one time on any scanner C, D or E, due to the staggering of the brushes, diodes Y' may be used in series with all brush arms of the output scanners to prevent cross circuits. Further inquiry into circuit No. 1 will lead from the output scanners to a central patchboard. The prime purpose of the patchboard is to subtotalize the readouts, for example, information concerning the activity of weavers, fixers or styles. In this case output scanner C (weavers) has six sub-totals A through F, output scanner D (fixers) has four sub-totals G through J, and output scanner E (styles) has ten-totals K through T. By

variation in design of the patchboard, any number of sub-totals may be assigned to any category of readout. Thus, for example, a given weaver may be assigned the looms of sub-totals A and B or if this constitutes too heavy a work load he may be assigned the looms of sub-total A only. Thus, the performance of that particular weaver may be recorded in terms of down time for his group of looms. The sub-totals are chosen at the discretion of the mill supervisors, by arrangements of shorting pins. Once a job load is set up on the patchboard, all incoming intelligence from this group is routed to control chassis A.

While any suitable switch gear may be used to actuate the stylus and to distribute the signals from the patchboard and actuate the counter panel responsive thereto, an arrangement found to be desirable is set forth below. Control chassis A includes a power supply and a shift change switch. Control chassis B houses the necessary control switches (not shown) and indicator lights. The power supply is conventional and prepares suitable voltages for the counters and the shift change relay.

The control chassis A must operate shift change mechanism since many textile mills operate on a twenty-four hours basis using three shifts. Each sub-total or group assigned to a job must be changed at shift time. A standard rotary switch of the telephone variety is used to accomplish this. There must be enough points to accommodate the number of shifts. The rotary switch is usually pulsed by a set of contacts located in the time-clock mechanism that activates the shift change signal, but for convenience, a hand operated switch is located in the switching section of the control chassis B so that the shift may be changed manually if desired.

From the shift change switch, the intelligence is routed through a cable 104 to a panel which houses sufficient counters for the tally. The counter panel in FIGURE 3 would need 40 counters, 10 for styles, 18 for weavers (6 for each of 3 shifts) and 12 for fixers (4 for each of 3 shifts).

Referring further to FIGURE 3, a numbering system for inter-connecting cables has been established. The letters A through T appear on the output of the patchboard, and indicate groupings of machines. The machine groups A through F are connected by lead 85 to the shift change so that each sub-total or group assigned to a job can be changed at shift time. It is noted that each of the 208 machines being monitored are in one of the groups A through F. The machine groups G through J (fixers and K through T (styles) are connected directly to the counter panel through the trunk line 104.

A similar numbering system using the numerals 1 to 24 has also been established to show connections from the control chassis B to their respective terminations. As previously stated, control chassis B houses all control switches and indicator lamps necessary for the operation of the device illustrated. To illustrate the various functions, the available power source is brought to control chassis B by way of terminals 1 and 2 so that it can be connected across a manual switch and connected to output terminals 3 and 4. From these points it is connected to chassis A at terminals 3 and 4 for use within this chassis. Also, terminal 5 connects the stylus voltage from control chassis A to control chassis B. This is because a variable potentiometer is located on control chassis B to vary the voltage, and thus control the intensity of the stylus trace on the graph paper. Terminal 6 returns the controlled voltage back to the control chassis A, and thence through 7 on control chassis A to the stylus. Terminals 7 and 8 on chassis B deliver voltage (after suitable switching not shown) to interior lighting which makes the chart more readable during the recording operation.

Terminal 9 receives the negative lead of the stylus voltage, and can be switched to interrupt the voltage. It is desirable to open the stylus circuit while the operator is

changing paper on the drum. Terminal 10 on chassis A and terminals 10 and 17 on chassis B are system grounds. All ground leads are brought to the control chassis B for central grounding, thus preventing circulating currents in the ground system. Terminal 11 furnishes the connections for a ground lead from the shift change relay which has been placed across a manually operated switch. This switch allows the operator to shift-change the mechanism device manually whenever automatic means are not used. Terminals 12 and 13 are used to bring filament voltage from the control chassis A to control chassis B to power the small indicator lamps located on control chassis B. Terminals 14, 15 and 16 are not used but are available for future use if necessary.

The remaining points 17 to 24 serve to help align a fresh sheet of Teledeltos paper upon the recording drum. When a fresh sheet of recording paper is put on the recording drum, it is desirable to check to make certain that the paper is properly aligned on the drum. It is often inconvenient to walk several hundred feet to the location of loom No. 1 and stop it in order to record loom No. 1 as being stopped. Also, the mill supervisors object to the lost production which would result from such a procedure. To overcome these difficulties, a suitable relay is installed in control chassis B so that when a suitable switch (not shown) is operated, the relay is energized. One set of contacts (between 17 and 18) shorts out the circuit to No. 1 loom, and alignment of the stylus marking can be determined. At the same time it is desirable to disengage any numerical counters that would otherwise be actuated as a result of this action. Therefore, terminals 19 and 20, terminals 21 and 22, and terminals 23 and 24 are connected to contacts across which the counting circuits of the styles, fixers and weavers counters are opened.

FIGURE 3A illustrates a modified form of the invention. Instead of using a single coupling device U between the B switch and the B' switch, as illustrated in FIGURE 3, four coupling devices U are used in the output circuit connected to scanner B'. As previously mentioned the contacts of the B' scanner are grouped into four groups. Lead lines 86, 87, 88, and 89 connect each of the groups to a coupling device U. When a ground potential signal is received by the coupling device U connected to lead 86, for example, the coupling device connects a first voltage source 80 to lead 101 through lead 90 and diode X. The voltage source 80 causes the recorder to record the signal in the same manner as illustrated in the description of FIGURE 3. The coupling device also connects a second voltage source 83 to the scanning switches C, D and E. Thus, it can be seen that the coupling devices U connect a first voltage to the recorder responsive to a ground potential signal and a second and lower voltage to the scanning switches C, D and E. The diodes X connected between the coupling devices U and the lead 101 prevents cross voltages between the circuits. The circuit in which the modified form of the invention illustrated in FIGURE 3A is identical to that of FIGURE 3 save the location of the coupling devices U in the circuit.

FIGURE 3B is a schematic diagram of a coupling device U used in the circuits illustrated in FIGURES 3 and 3A. The coupling device is described as being connected in the circuit illustrated in FIGURE 3A.

The coupling device U includes a triode 93 which is normally non-conductive due to a negative grid bias voltage supplied by voltage source 94. The plate 95 of the diode is connected to a high voltage source 80 through a winding on a relay 96. The cathode 95a of the triode is grounded. When a ground potential is supplied to the grid 95c of the tube by lead 86, which is connected to the output of switch B', the bias voltage on the grid is overcome causing the tube to conduct. The current flowing from the high voltage source 80 through the winding of relay 96 causes the relay to close switches 97 and 98. The closing of switch 98 connects the voltage source 80

to the recorder through lead 101 and diode X. Thus, the ground signal received at the grid of tube 93 is recorded on the recording device. As previously mentioned, a potentiometer 81 is connected to lead 101 to regulate the voltage being supplied to the recorder.

The closing of switch 97 causes a low voltage source 83 to be connected to the output scanners C, D and E. This low voltage is in turn connected to the counters (FIGURE 3) to record the total number of signals received.

The voltage source 80 consists of a transformer having primary winding 102 and a grounded center tapped secondary winding 103. An A.C. voltage is applied to the primary winding 102 of the transformer which steps up the voltage. Diodes 104 and 105 are connected to the secondary winding to rectify the A.C. voltage received by the secondary winding to provide a D.C. voltage to the plate 95 of the tube and to activate relay 96 when the tube conducts.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A production control apparatus for a large group of machines including, switch means producing a signal responsive to a given operating condition upon each machine, a rotatably mounted shaft, power operated means driving said shaft uniformly, a first rotary switch having an output terminal and a plurality of spaced contacts each connected to a switch means, a positive drive for driving said first rotary switch from said shaft for scanning each of said switch means in predetermined timed cycles, a first graphic recorder means, a positive drive for moving said first graphic recorder means from said shaft, a second graphic recorder means driven progressively across said first graphic recorder means in a predetermined timed sequence, coupling means coupled to the output terminal of said first rotary switch for connecting a first voltage source to one of said graphic recorder means responsive to a signal on said output terminal of said first rotary switch for graphically recording such operating condition on each scanning cycle during which such operating condition obtains, thus recording duration of such operating condition with respect to each individual identifiable machine and with respect to time of occurrence thereof, a second rotary switch having a plurality of spaced contacts each corresponding to a contact of said first rotary switch, a positive drive for driving said second rotary switch from said shaft for scanning each of said contacts of said first rotary switch in predetermined timed cycles, said coupling means connecting a second voltage source to said second rotary switch responsive to a signal on said output terminal of said first rotary switch, a plurality of totalizing means, and means selectively connecting the contacts of said second rotary switch to a selected totalizing means, whereby the total time of such operating condition of selected machine groupings may be recorded.

2. A production control apparatus for a large group of machines including, switch means operable responsive to a given operating condition upon each machine, a rotatably mounted shaft, power operated means driving said shaft uniformly, a first rotary switch having a plurality of spaced contacts each connected to a switch means, a positive drive for driving said first rotary switch from said shaft for scanning each of said switch means in predetermined timed cycles, a second rotary switch having a plurality of spaced contacts, a positive drive for driving said second rotary switch from said shaft for scanning each of said contacts of said first rotary switch in predetermined timed cycles, a first graphic recorder means, a positive drive for moving said first graphic recorder means from said shaft, a second graphic recorder means driven progressively across said first graphic recorder means in

a predetermined timed sequence, coupling means coupled to the contacts of said second rotary switch for connecting a first voltage source to one of said graphic recorder means responsive to said second rotary switch for graphically recording such operating condition on each scanning cycle during which such operating condition obtains, thus recording duration of such operating condition with respect to each individual identifiable machine and with respect to time of occurrence thereof, totalizing means, said coupling means connecting a second voltage source to said totalizing means, whereby the total time of such operating condition of selected machine groupings may be recorded.

3. The device set forth in claim 2 wherein said rotary switches each have contacts and contact actuating means, said contact actuating means being ganged and said contacts being stacked, the contact actuating means and the contacts of each rotary switch being staggered with respect to each other so that as a contact actuating means of a rotary switch leaves a respective contact a corresponding contact actuating means of the other rotary switch is in physical contact with a corresponding contact.

4. A production control apparatus for a large group of machines including, switch means producing a signal responsive to a given operating condition upon each machine, a rotatably mounted shaft, power operated means driving said shaft uniformly, a rotary switch having a plurality of spaced contacts for receiving signals from said switch means, a positive drive for driving said rotary switch from said shaft for scanning each of said switch means in predetermined timed cycles, a first graphic recorder means, a positive drive for moving said first graphic recorder means from said shaft, a second graphic recorder means driven progressively across said first graphic recorder means in predetermined timed sequence, a coupling means for connecting a first voltage source to one of said graphic recorder means responsive to a signal being supplied to said rotary switch for graphically recording such operating condition on each scanning cycle during which such operating condition obtains, a totalizing means, said coupling means connecting a second voltage source to said totalizing means, whereby total time of such operating condition is recorded with respect to each individual identifiable machine and with respect to time of occurrence thereof and the total time of such operating condition of selected machine groupings may be recorded.

5. A production control apparatus for a large group of machines including, switch means producing a signal responsive to a given operating condition upon each machine, a rotatably mounted shaft, power operated means driving said shaft uniformly, a first rotary switch having a plurality of spaced contacts for receiving signals from said switch means, a positive drive means for driving said first rotary switch from said shaft for scanning each of said switch means in predetermined timed cycles, a second rotary switch having a plurality of spaced contacts, a positive drive means for driving said second rotary switch from said shaft for scanning each of said contacts of said first rotary switch in predetermined timed cycles, a first graphic recorder means, a positive drive means for moving said first graphic recorder means from said shaft, a second graphic recorder means driven progressively across said first graphic recorder means in predetermined timed sequence, coupling means coupled to the contacts of said second rotary switch for connecting a first voltage source to one of said graphic recorder means respon-

sive to a signal on the contacts of said second rotary switch, a selector means, said coupling means connecting a second voltage source to said selector means responsive to a signal on the contacts of said second rotary switch, and a plurality of totalizing means, said selector means connecting the second voltage source to a selected totalizing means, whereby the total time of such operating condition of selected machine groupings may be recorded.

6. In a production control device for a large group of machines including, switch means operable responsive to a given operating condition upon each machine, scanning means monitoring said switch means in predetermined timed cycles, said scanning means having an output terminal, recording means for recording the operating condition of each machine during a time cycle, coupling means connected to the output terminal of said scanning means for coupling said recording means to a first voltage source each time one of said switch means is operable responsive to a given operating condition during a time cycle, and a plurality of totalizing means, said coupling means coupling said totalizing means to a second voltage source responsive to a given operating condition during one of said time cycles, whereby the total time of such operating condition of selected machine groupings may be recorded.

7. The device as set forth in claim 1, wherein the contacts of said first rotary switch are smaller than the contacts of said second rotary switch so that the contact time of said first rotary switch with a particular contact is shorter than the contact time of said second rotary switch with a corresponding contact.

8. A production control apparatus for a large group of machines including, switch means producing a signal responsive to a given operating condition upon each machine, a rotatably mounted shaft, power operated means driving said shaft uniformly, a first rotary scanning switch having a plurality of spaced contacts for receiving signals from said switch means, a positive drive means for driving said first rotary scanning switch from said shaft for scanning each of said switch means in predetermined timed cycles, a rotary secondary switch for selecting and spacing the signals from the first rotary scanning switch, a positive means for driving said rotary secondary switch from said shaft, an output rotary scanning switch having a plurality of spaced contacts, a positive means for driving said output rotary scanning switch from said shaft, a first graphic recorder means, a positive means for moving said first graphic recorder means from said shaft, a second graphic recorder means driven progressively across said first graphic recorder means in predetermined timed sequence, coupling means coupled to the contacts of said rotary secondary switch for connecting a first voltage source to one of said graphic recorder means responsive to a signal on the contacts of said rotary secondary switch, said coupling means connecting a second voltage source to said output rotary switch responsive to a signal on the contacts of said rotary secondary switch, a plurality of totalizing means, and means selectively connecting the contacts of said output rotary switch to a selected totalizing means, whereby the total time of such operating condition of selected machine groupings may be recorded.

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