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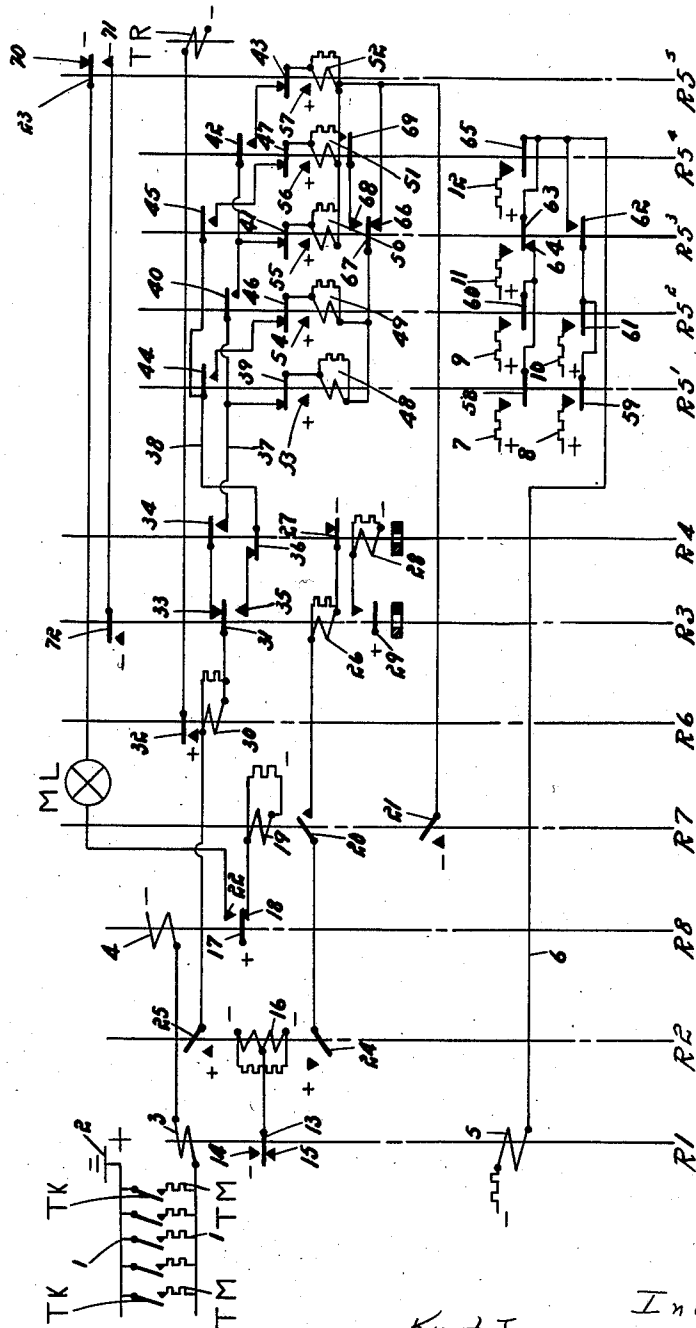
2,790,602

DEVICES FOR COUNTING THREAD BREAKAGES IN TEXTILE MACHINES

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2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

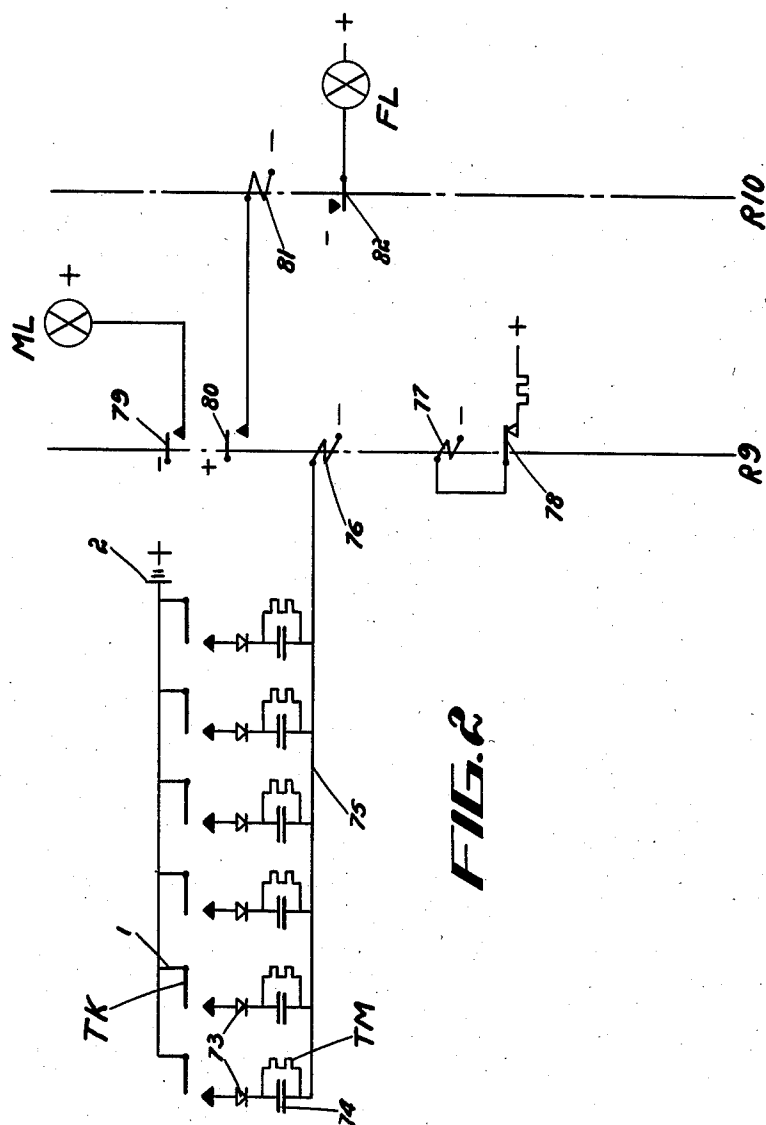


FIG. 2

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DEVICES FOR COUNTING THREAD BREAKAGES IN TEXTILE MACHINES

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6 Claims. (Cl. 235—92)

This invention relates to a device which by means of a counter operable by electric impulses makes it possible automatically to count simultaneously or successively occurring thread breakages in textile machines, in which machines information about the thread breakage frequency is highly important. Drawing frames, spinning machines, twisting machines, winding machines, warping machines, looms and knitting machines can be mentioned as examples of such machines. The invention is applicable to such textile machines which for indicating thread breakages are provided or can be provided with a plurality of thread feelers, each of which is adapted, on breakage of a thread, to close an electric contact, each of said thread feeler contacts being arranged to close one of a number of circuit branches connected in parallel and corresponding to the number of thread feelers. Thread feelers of this type are shown in e. g. U. S. Patent No. 2,569,728.

In such a device for counting thread breakages the thread feeler operated contacts cannot simply be connected with an electric means advancing a counter one count for each current impulse due to closure of one of the thread feeler operated contacts as during the mending of a broken thread the thread feeler operated contact may be closed and opened several times in close succession resulting in a false indication of the counter.

One object of the invention is therefore to provide a device of the character described in which each thread breakage is counted one time only even if the thread feeler operated contact is closed and opened several times during the mending of the broken thread.

Another object of the invention is to provide a device of the character described in which a plurality of thread feeler operated contacts are continuously connected to operate the counter upon occurrence of thread breakages in such a way that in spite of the fact that the counter does not respond to repeated impulses from a thread feeler operated contact during the interval during which the broken thread is mended, the counter is nevertheless during this interval able to respond to an impulse from another thread feeler operated contact upon closure of the latter contact due to breakage of the thread controlling the last-mentioned contact.

Other objects and advantages of the invention will be apparent to those skilled in the art from the following detailed description, reference being had to the accompanying drawings, in which—

Figs. 1 and 2 show circuit diagrams of two embodiments of the invention which have been chosen as examples.

In order to avoid congestion in the drawings positive and negative terminals are indicated in different places in the circuit diagrams and it is to be understood, that all such positive terminals are connected to the positive terminal of an electric source not shown and all such negative terminals are connected to the negative terminal of the electric source.

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In the embodiment shown in Fig. 1, there are seven thread feeler contacts TK which are of prior art construction and each of which is operated by a thread in e. g. a spinning machine (not shown), in such a way that the contacts are closed on breakage of the thread operating the respective contact. Contacts TK are each connected in a branch 1 of a thread feeler circuit, and in each branch 1 the contact TK is connected in series with a thread feeler resistor TM. All resistors TM are of equal size. The thread feeler circuit is arranged to act upon a set of relays to be described in the following and extends from a positive terminal 2 over the branches 1 connected in parallel and provided with the resistors TM and the contacts TK to one terminal of the impulse coil 3 of a balancing relay R1, the other terminal of which is coupled to one terminal of the relay coil 4 of a blocking relay R8, said relay coil having its other terminal connected to a negative terminal, for which reason the coils are connected in series with one another in the thread feeler circuit and with the circuit branches 1 that contain the contacts TK and the resistors TM.

The balancing relay R1 containing the impulse coil 3 has a second relay coil 5 which in the following will be called balancing coil. One terminal of the balancing coil 5 is coupled to a negative terminal of a balancing circuit, while the other terminal of the coil 5 by means of a conduit 6 and relay contacts to be described in the following is connectible to one end of one or more balancing resistors 7—12, the other end of which is connected to the positive terminal of the balancing circuit. Between coils 3 and 5 there is a contact spring 13 which in its inoperative condition rests against a fixed abutment 15 and is swingable to abut an impulse contact 14 connected to a positive terminal. The contact spring 13 is arranged, in the de-energized condition of coils 3 and 5 or in the event of at least equally strong current through the coil 5 as through the coil 3, to occupy the resting position shown in Fig. 1. When the coil 3 is energized and the coil 5 de-energized or the coil 3 is pervaded by a stronger current than the coil 5, the contact spring 13 is swung from the resting position by the coil 3 into electrically conductive contact with the impulse contact 14. The contact spring 13 is connected to the coil 16 in an impulse relay R2 which is of the type that is operated with delay but releases rapidly.

The blocking relay R8 which both responds and releases rapidly has a contact spring 17 which is connected to a positive terminal and in the de-energized condition of the relay coil 4, i. e. when no thread feeler contact TK is closed, abuts a back contact 18 which is connected to one terminal of the coil 19 of a release relay R7, the other coil terminal of which is connected to a negative terminal. The relay R7 both responds and releases with considerable delay—suitably of the order 10 to 12 sec.—and has two break contacts 20 and 21 to be described more closely in the following. As the coil 19 of the relay R7, as appears from the above, is energized when the device is in its resting position, i. e. when no thread feeler contact TK is closed, the relay contacts 20 and 21 consequently are open in this resting position, as is shown in Fig. 1. When one or more thread feeler contacts TK are closed, the coil 4 of the blocking relay R8 is energized and swings the contact spring 17 away from the back contact 18 to abut a front contact 22 which is connected to one terminal of a signal lamp ML, the other terminal of which is connected to a negative terminal by a contact spring 23 to be described more closely in the following.

The impulse relay R2 has two make contacts 24 and 25 which are connected to a positive terminal and adapted to close circuit paths to a ticking relay R3, R4. Thus, the contact 24 is connected to one terminal of the coil 26 of the relay R3 over the break contact 20 of the

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release relay R7, the other terminal of said coil 26 being connected to the break contact 27 in the relay R4, connected to a negative terminal. One terminal of the coil 28 of the relay R4 is connected to a negative terminal, and the other terminal is connected to a make contact 29 in the relay R3 which is connected to a positive terminal. The two relay parts R3 and R4 of the ticking relay are of the type that both responds and releases with delay so that the relays R3 and R4 will alternately be operated and released with overlapping as long as the break contact 20 of the release relay R7 is closed and the coil 16 of the impulse relay R2 is energized so that the make contact 24 is closed.

The make contact 25 of the impulse relay R2 is connected to one terminal of coil 30 of a counting relay R6 whose other coil terminal is connected to a contact spring 31 in the relay R3. Each time the coil 30 of the counting relay R6 is energized, it closes a make contact 32 for closing a circuit through a counter TR which is operable by means of electric impulses so that this counter is advanced one unit each time the relay coil 30 is pervaded by current.

In the de-energized condition of the relay R3, the contact spring 31 abuts a back contact 33 which is the upper one in Fig. 1 and connected to a make contact 34 in the relay R4. On operating the relay R3, the contact spring 31 is swung to abut a front contact 35 which is connected to a break contact 36 in the relay R4. The make contact 34 and the break contact 36 of the relay R4 are each connected to a conduit 37 and 38, respectively, constituting two alternative current paths to a relay group R5¹, R5², R5³, R5⁴ and R5⁵. The conduit 37 is connected to a break contact 39 in the relay R5¹ and a make contact 40 in the relay R5³, which latter contact in turn is connected to a break contact 41 in the relay R5³ and a make contact 42 in the relay R5⁴, which latter contact is connected to a break contact 43 in the relay R5⁵. The conduit 38 is connected to a make contact 44 in the relay R5¹ and a make contact 45 in the relay R5³. The make contact 44 is connected to a break contact 46 in the relay R5², and the make contact 45 is connected to a break contact 47 in the relay R5⁴.

The said break contacts 39, 41, 43, 46 and 47 which, under the circumstances to be described more closely in the following, thus are connected by means of the ticking relay R3, R4 and the coil 30 of the counting relay R6 to the positive terminal connected to the make contact 25 of the impulse relay R2, are connected to one terminal of the coil 48—52 of the respective pertaining relay R5¹—R5⁵, the other terminal of said coil being connectible to a negative terminal by the break contact 21 in the release relay R7 in a manner to be described in the following, the arrangement being such that the terminal of the coil 48—52 in the respective relay R5¹—R5⁵, connected to the break contacts 39, 41, 43, 46 and 47, respectively, on opening of the break contact, is connected to a positive terminal 53—57 for locking the respective relay in the operated position.

Relays R5¹ and R5² each have two make contacts 58, 59, and 60, 61, respectively, and the relay R5³ has a make contact 62 and a contact spring 63 which is connected to the conduit 6 to the coil 5 of the balancing relay R1 and which, in the de-energized condition of the relay R5³, abuts a back contact 64 which is connected to the make contacts 58 and 60 in relays R5¹ and R5², whereas the make contact 62 of the relay R5³ is arranged, on energization of the relay R5³, to connect the conduit 6 with the make contacts 59 and 61 of the relays R5¹ and R5². The relay R5⁴ has a make contact 65 which is directly connected to the conduit 6. Each of the make contacts 58—61 and 65 is arranged, on energization of the respective relays, to close a connection to one of the balancing resistors 7—10 and 12, each of which has the same resistance as one of the mutually equally large thread feeler resistors TM, while the contact spring 63

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is arranged, on energization of the relay R5³, to close a connection between the conduit 6 and the balancing resistor 11 whose resistance is about one third of the resistance of either of the thread feeler resistors TM.

The break contact 21 in the release relay R7, which is connected to a negative terminal is directly connected to the relay coils 50—52 in the relays R5³—R5⁵ and to a back contact 66 in the relay R5³ against which abuts a contact spring 67 in the de-energized condition of the relay R5³. The contact spring 67 is connected to the coils 48 and 49 in the relays R5¹ and R5² and is arranged, on operating of the relay R5³, to abut a front contact 68 which is connectible to the break contact 21 in the release relay R7 over a make contact 69 in the relay R5⁴.

The relay R5⁵ which, for reasons stated in the following, can be termed a maximum capacity relay, is, as distinguished from the relays R5¹—R5⁴, not arranged to operate any contacts for connecting balancing resistors but operates instead the previously mentioned contact spring 23 which, in the de-energized condition of the relay R5⁵, abuts a back contact 70 that is connected to a negative terminal and, on energization of the relay R5⁵, is swung to abut a front contact 71, which is connected to a make contact 72 in the relay R3, which is connected to a negative terminal.

When there is no thread breakage, the parts occupy the positions shown in Fig. 1, in which positions the entire system is de-energized, except for the release relay R7 which carries current. If a thread breakage occurs, the corresponding thread feeler contact TK is closed and the relay coils 3 and 4 are energized over the closed contact TK and the thread feeler resistor TM connected in series therewith. As a result of the current supply to the coil 4, the blocking relay R8 is operated and closes a signal current circuit through the lamp ML over parts 17, 22, 23 and 70 at the same time as the relay R7 is released with considerable delay so that the contacts 20 and 21 are closed. Due to the current supply to the impulse coil 3 the contact spring 13 of the balancing relay R1 rapidly comes into contact with the impulse contact 14 so that the coil 16 of the impulse relay R2 is energized, the current flowing from the positive terminal connected to contact 14 through the contact spring 13 to the middle point of the relay coil 16 the outer ends of which are connected with a negative terminal. Thereby the relay R2 is operated with considerable delay so that the make contacts 24 and 25 are closed. The delay in operating relay R2 and the release of the relay R7 serve to prevent that when the thread feeler contacts TK are closed for such short periods as may possible occur in practice without there having been any thread breakage, such closures be counted as thread breakages by the device. Thus, the device does not respond to closings of the contacts TK for short periods but requires a closing of the contacts TK during at least several seconds to be able to operate relay R2 and release relay R7 so that the counter TK may be advanced as stated in the following. On closing of the make contact 25 in the relay R2, the coil 30 of the counting relay R6 and the contact spring 31 in the relay R3 are connected to the positive terminal, and on closing of the make contact 24 in the relay R2, the coil 26 in the relay R3 is energized over the now closed break contact 20 in the relay R7 and the break contact 27 in the relay R4. During this, the relay R3 is operated with delay, the contact spring 31 connected to the positive terminal coming into contact with the front contact 35, which however remains without any effect since the contacts 44 and 45 are open. On operating of the relay R3 also the make contact 29 is closed so that the coil 28 of the relay R4 is supplied with current and the relay R4 is operated with delay. On operating of the relay R4, the break contact 36 is opened and the make contact 34 is closed, which however remains without any effect for the time being since the contact spring 31 in the operated relay abuts the contact 35. On operating of the relay R4

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also the break contact 27 is opened so that the coil 26 of the relay R3 is de-energised and the relay R3 is released after a certain delay. When the relay R3 is released, the contact spring 31 again comes into contact with the contact 33 and a circuit is closed from the closed make contact 25 of the relay R2 over the coil 30 of the counting relay R6, the contact spring 31, the contact 33, the make contact 34 which is closed on operating of the relay R4, the conduit 37, the closed break contact 39 in the relay R5¹, the coil 48 of this relay, the contact spring 67, the contact 66 and the closed break contact 21. Due to the current passing through the coil 30 of the relay R6 the make contact 32 is closed and transmits a current impulse to the counter TR which is thus advanced one step for counting the occurred thread breakage. Due to the current passing through the coil 48 of the relay R5¹ the relay R5¹ is operated so that the break contact 39 is disconnected from the conduit 37 and instead comes into contact with the contact 53 which is connected to a positive terminal so that a locking circuit for the relay R5¹ is established from the contact 53 through the contact 39, the coil 48, the contact spring 67, the contact 66 and the closed contact 21. On breaking of the connection between the contact 39 and the conduit 37, the relay R6 is de-energised and breaks the circuit through the counter TR by means of the make contact 32. On operating of the relay R5¹ which is kept in the operated position in the manner set forth in the foregoing, the make contacts 44, 58 and 59 are closed. The closing of the contacts 44 and 59 is for the time being without any effect but the closing of the contact 58 brings about supply of current to the balancing coil 5 of the balancing relay R1 over the resistor 7, the contact means 63 and 64 and the conduit 6. As the resistor 7 is as large as the thread feeler resistor TM which has been connected by the counted thread breakage, the coils 3 and 5 of the balancing relay R1 will exert the same influence upon the contact spring 13 which therefore leaves the impulse contact 14 and abuts the abutment 15. When the contact spring 13 leaves the impulse contact 14, the coil 16 of the impulse relay R2 is de-energized so that the make contacts 24 and 25 are disconnected and break the connection of the coil 30 of the counting relay R6 and the coil 26 of the relay R3 with their positive terminals.

On the above-mentioned release of the relay R3 also the make contact 29 is opened so that the coil 28 of the relay R4 is de-energised and the relay R4 is released after the above connection which takes place in conjunction with the operation of the relay R4. During this, the break contact 27 is closed but this does not lead to any supply of current to the coil of the relay R3 since the connection of this coil to the positive terminal has already been broken by the make contact 24 of the relay R2.

On repairing the counted thread breakage, the thread feeler contact TK is opened so that the relay coils 3 and 4 are de-energised. The current break caused by the coil 3 of the relay R1 does not lead to any change in the system while on the other hand the breaking of the current through the coil 4 results in the contact spring 17 of the blocking relay R8 breaking the circuit through the lamp ML by leaving the contact 22 and closing the circuit through the coil 19 of the release relay R7 by abutting the contact 18. In consequence hereof the release relay R7 is operated with considerable delay and the break contact 21 is opened, so that the coil 48 in the relay R5¹ is de-energised and the last-mentioned relay returns to the release position and hereby breaks the current through the coil 5 of the relay R1 by opening the make contact 58. Thus, the system has returned to the resting position shown in the drawing and is ready for counting the next thread breakage.

During the repair of the thread breakage it can happen that the thread feeler contact TK which was closed by the thread breakage is temporarily opened one or more

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times during short intervals but this does not have any disturbing influence upon the system. It is true that on such openings of the thread feeler contact TK for short periods the contact spring 17 of the quickly operating relay R8 will momentarily touch the contact 18 when the coil 4 becomes current-less but the duration of the supply of current to the release relay R7, which is caused hereby, is not so long that, during these opening periods for the contact TK, the relay R7 which operates with great delay manages to respond and open the break contact 21. After each such opening of the thread feeler contact TK for a short period, the system thus returns to the described condition in which the coils 3 and 4 are energized and the relay R5¹ is operated without any incorrect counting of a new thread breakage.

When two thread breakages occur simultaneously (the term "occur simultaneously" is herein used to denote thread breakages that persist simultaneously but have not necessarily the same starting time), the counting of the first thread breakage takes place in the same manner as the one previously described, up to the operation of relays R4 and R5¹. The connecting of the resistor 7 resulting from the operation of the relay R5¹ is however not sufficient to achieve a balance in the relay R1, i. e. return of the contact spring 13 from the contact 14 to the abutment 15 since the two resistors TM which have been connected by the two thread breakages pass a current to the coil 3, which is twice as strong as the one passed on to the coil 5 by the resistor 7. Consequently, the impulse relay R2 is still kept operated so that the contact spring 31 and the coil 26 of the relay R3 are under tension over contacts 24 and 25. If the operated relay R4 is then released, the coil 26 of the relay R3 will therefore be energised over the break contact 27 of the relay R4 so that the relay R3 is operated with delay. Hereby the contact spring 31 which is under tension comes into contact with the front contact 35 so that a circuit is closed from the closed contact 25 through the coil 30 of the counting relay R6, the contact spring 31, the contact 35, the break contact 36, which is now closed, the conduit 38, the make contact 44 which is closed by operating of the relay R5¹ and the break contact 46 to the coil 49 of the relay R5² and from this over the contact spring 67 and the contact 66 to the closed break contact 21. As a result the counting relay R6 is operated and causes advancing of the counter TR by a further unit in the manner described in the foregoing. Besides, the relay R5² is operated with locking, the resistance 9 being connected in parallel with the resistor 7 by the contact 60 in the circuit of the coil 5 so that balance is obtained in the relay R1 and the counting is interrupted by the contact spring 13 taking up its resting position in contact with the abutment 15 and the relay R2 is rapidly released. The restoring of the system takes place in the manner described in the foregoing, and of course the two thread breakages have to be repaired if the coil 4 of the relay R8 is to become current-less so that the relay R7 can restore relays R5¹ and R5² by opening of the contact 21. On the releasing of relay R3 also the relay R4 is operated by means of the make contact 29 but this operating of relay R4 which takes place with relay is without any effect since the relay R2 has already had time to open contacts 24 and 25.

If three thread breakages occur simultaneously, the first two are counted in the manner already described. After counting these breakages, the relay R1 is however still not balanced for which reason the relay R2 is still operated and keeps the contact spring 31 and the coil 26 of the relay R3 under tension. When the relay R3 after counting the first two thread breakages releases after the above-mentioned operation of the relay R4, a circuit will therefore be closed from the closed contact 25 over the coil 30 of the counting relay R6, the contact spring 31, the contacts 33 and 34, the conduit 37, the contact 40 which is closed by the relay R5² on

counting of the second thread breakage, the contact 41 and the coil 50 in the relay R5³ to the contact 21. This causes operation of the relay R6 as well as advance of the counter TR by a further unit in the manner already described. Besides, the relay R5³ is operated with locking and the contact springs 67 and 63 are moved from the position shown in Fig. 1 to abut the contact 68 and the front contact connected with the resistor 11, respectively. At the same time the locking circuits for the relays R5¹ and R5² are opened, which relays return to the released position, and the resistors 7 and 9 are disconnected from the coil 5, whereas the resistor 11 is instead connected to said coil. As the resistor 11 is one third of the size of one of the resistors TM, balance will be obtained in the relay R1 so that the counting operation is interrupted in the same manner as the one described in connection with a single thread breakage. Release after the repairing of the three thread breakages takes place in the manner already described by opening the contact 21 by means of the release relay R7.

Of four simultaneously occurring thread breakages, the first three are counted in the manner described above. After counting of these breakages, the relay R1 is however still not balanced for which reason the relay R2 is still operated and keeps the contact spring 31 and the coil 26 of the relay R3 under tension. On releasing the relay R4 after the counting of the third thread breakage, the relay R3 will already be operated again and consequently the fourth thread breakage is counted in the same manner as the second thread breakage, and just as during the counting of the second thread breakage a current impulse will be sent from the contact spring 31 in the relay R3 over the contact 35, and the break contact 36 to the conduit 38. This current impulse goes past the contact 44 which has been opened on counting of the third thread breakage to the contact 45 that has been closed at the same time by the relay R5³ and over the contact 47 through the coil 51 of the relay R5⁴ to the contact 21. Thus, the relay R5⁴ is operated with locking and connects by means of the make contact 65 the resistor 12 in parallel with the resistor 11 in the balancing circuit through the coil 5 in the relay R1. This produces balance in the relay R1 so that the relay R2 is released and interrupts the counting operation by de-energising the contact spring 31 and the coil 26 in the relay R3. The system is restored to its normal position in the manner already described.

It appears from the description of the mode of operation of the system, for counting as many as four simultaneously occurring thread breakages, that the two parts R3 and R4 of the ticking relay are alternately operated and released as long as the balancing relay R1 has not released the impulse relay R2, and during this operation the counter TR is advanced one unit for each current impulse to the relay group R5¹—R5⁵, these current impulses passing every other time over the conduit 37 and every other time over the conduit 38. The first, third etc. current impulse passes over the conduit 37, and the second, fourth etc. current impulse over the conduit 38.

On five simultaneously existing thread breakages, the current impulse which is transmitted from the ticking relay R3, R4 after the counting of the fourth thread breakage thus passes over the conduit 37 to the relay R5¹ which is operated after the counting of the third thread breakage, said relay R5¹ being operated with locking. The current impulse in the conduit 37 cannot proceed to the closed contact 42 in the relay R5⁴ since the contact 40 of the relay R5² is opened. On operating of the relay R5¹, the make contacts 58 and 59 are closed. The closing of the contact 58 remains without any effect since the contact spring 63 after counting of the third thread breakage has left the contact 64, whereas the closing of the contact 59 has the effect that the resistor 8 in the balancing circuit is connected in parallel with the resistors 11 and 12 that are connected after counting of

the fourth thread breakage, so that balance is obtained in the relay R1 and the counting is discontinued.

When six thread breakages occurs simultaneously the sixth current impulse to the relay group R5¹—R5⁵ from the ticking relay R3, R4 will go over the conduit 38 and the contact 44 which is closed on counting of the fifth thread breakage to the relay R5² which is operated with locking. At the same time the make contacts 60 and 61 are closed. The closing of the contact 60 has no effect because the contact spring 63 on the counting of the third thread breakage has left the contact 64 whereas the closing of the contact 61 causes the resistor 10 to be connected in the balancing circuit in parallel with the resistors 8, 11 and 12 which are connected after the counting of the fifth thread breakage so that balance is obtained in the relay R1 and the counting is discontinued.

With the simultaneous occurrence of seven thread breakages the system that is chosen as an example has reached its maximum capacity, and this is indicated in a special manner to the personnel, so that they notice that the operating conditions in the supervised textile machine have become so unsatisfactory that steps have to be taken immediately to ameliorate the operating conditions. The seventh current impulse from the ticking relay R3, R4 to the relay group R5¹—R5⁵ goes over the conduit 37 and the contacts 40 and 42 which have been closed earlier during the counting to the maximum capacity relay R5⁵ which is operated with locking. On operating relay R5⁵ there is no further resistance connected in the balancing circuit for which reason the relay R1 remains unbalanced and the two parts R3 and R4 of the ticking relay continue to be operated and released alternately as long as not at least one of the thread breakages has been repaired. On operating of relay R5⁵ the contact spring 23 leaves the contact 70 and abuts instead the contact 71 which is connected to the make contact 72 of the relay R3, which contact is connected to a positive terminal. During the function of the ticking relay R3, R4 prior to the repair of at least one of the seven thread breakages, the signal circuit will thus be alternately closed and opened by the relay R3 by means of the contact 72 so that the lamp ML flashes repeatedly and indicates that the maximum capacity of the counting device has been reached. The current impulse operating the relay R5⁵ advances, in the manner previously described, the counter TR a seventh unit but after this seventh current impulse there are no further current impulses to advance the counter although the ticking relay R3, R4 continues to operate because all of the relays R5¹—R5⁵ are operated so that the conduits 37 and 38 have no connection with a negative terminal.

Although it is thus possible to have an optionally large number of thread feeler contacts TK connected to the relay set shown in Fig. 1 this set cannot count more than seven simultaneously occurring thread breakages at the most but it is evident that one can easily enlarge the relay group R5¹—R5⁵ so as to obtain a greater capacity of the counting device. Furthermore, it is evident that instead of connecting the balancing resistors 7—12, one can conceive an equivalent device in which the balancing resistors are disconnected for obtaining a balance in the relay R1.

Fig. 2 shows a considerably simpler embodiment of the invention which is preferred at present. Six thread feeler contacts TK are each connected in a branch 1 of a thread feeler circuit in series with a large thread feeler resistor TM. Besides, there is connected in each branch 1 in series with the contact TK and the resistor TM a means 73 which is current-conductive in one direction only, e. g. a dry rectifier, and in parallel with the resistor TM there is connected a large condenser 74. One terminal of the thread feeler contacts TK is connected to a positive terminal 2 which is common to these contacts, whereas the other terminal is connected to one terminal of the dry rectifier 73. One side of the aggregate which is formed by the resistor TM and the condenser 74 is con-

connected to the other terminal of the dry rectifier 73, while the other side of the aggregate is connected to a conduit 75 that is common to all aggregates and leads to one terminal of the impulse coil 76 of a distributing relay R9, the other terminal of said impulse coil being connected to a negative terminal. The relay R9 has an auxiliary excitation coil 77, one terminal of which is connected to a negative terminal, while its other terminal is connected to a break contact 78 in the relay which is connected to a positive terminal. The relay R9 has two operating positions. In one of these positions two make contacts 79 and 80 are both closed and in the other of these positions only the make contact 79 is closed. The make contact 79 which is connected to a negative terminal is connected to one terminal of a signal lamp ML, the other terminal of which is connected to a positive terminal. The make contact 80 connected to a positive terminal is connected to one terminal of the coil 81 of a counting relay R10, the other terminal of said coil being connected to a negative terminal. The counting relay R10 is arranged directly to advance a counter one unit at each operation and is besides provided with a make contact 82 connected to a negative terminal and to one terminal of an "error"-lamp FL, the other terminal of which is connected to a positive terminal.

The device shown in Fig. 2 operates in the following manner. When a thread breakage occurs, a thread feeler contact TK is closed. This operation first produces a strong current impulse for charging the condenser 74 connected in series with the thread feeler contact. With the aid of the current-pervaded coil 77, this strong impulse operates the relay R9 so forcefully that not only the contact 79 but also the contact 80 is closed, the signal lamp ML being lit and the counter advanced one unit through the operation of the relay R10. After the condenser 74 has been charged, the current from the positive terminal 2 to the relay coil 76 is limited to the small value that is determined by the large resistor TM which is connected in parallel with the condenser. This weak current does not suffice to retain the relay R9 in the original operating position but the relay proceeds to its other operating position, in which the make contact 80 is open and the contact 79 closed and keeps the signal lamp ML lit. The break contact 78 which is opened at the initial operation of the relay R9 is also closed so that the coil 77 is again supplied with current and can partake in operating the relay during subsequent thread breakages. The condenser 74 and the resistor TM are chosen so large, e. g. 100 μ f. and 80,000 ohms, respectively, that the condenser, on opening of the thread feeler contact TK, needs for instance 10-12 sec. to be able to discharge through the resistor TM in a sufficient degree to make it possible that a renewed closing of the pertaining thread feeler contact can be followed by such a large impulse produced by the charging of the condenser, that the contact 80 of the relay R9 is closed and causes counting of a new thread breakage. The openings and closings of the thread feeler contact for short periods which occur during the repair of a thread breakage will therefore not cause any incorrect counting of thread breakages.

In case there are already one or more thread breakages which have not been repaired, one or more thread feeler contacts TK are consequently closed, and the current passing through the resistors TM which are connected in series with these closed contacts, keep the relay R9 in the operating position in which the contacts 78 and 79 are closed but the contact 80 is opened. If a new thread breakage occurs during this period, a further thread feeler contact TK is closed, and the condenser 74 which is connected in series with this contact produces a charging impulse which, owing to its being prevented from passing through the already previously closed thread feeler circuit branches by the means 73 allowing the current to pass in one direction only, increases the current through the coil 76 of the relay R9 in such a degree

that the relay also operates its contact 80, and the counter is advanced one unit by the relay R10.

In the embodiment according to Fig. 2 there are shown six thread feeler contacts TK, and in such a case the relay R9 is so constructed that it takes up its operating position with the contacts 78 and 79 closed but the contact 80 open during a continuous flow of current through as many as five of the resistors TM but closes the contact 80 also if current passes through all six resistors TM so that the counting relay R10 on counting the sixth simultaneous thread breakage remains in the operated position and the "error"-lamp FL is kept lit by closing the make contact 82 of the relay R10 in order to indicate that the maximum capacity of the device has been reached and that so serious errors have occurred that steps must be taken to improve the operating conditions of the supervised machine. Although six thread feeler contacts are shown in Fig. 2, it is of course possible to employ a different number on choosing suitable values for condensers, thread feeler resistors TM and the properties of the relay R9. In practice as many as twelve thread feeler contacts have been employed.

What I claim and desire to secure by Letters Patent is:

1. A device for counting thread breakages in textile machines comprising a plurality of thread feelers, a corresponding number of electric circuit branches being connected in parallel, an electric contact in each of said circuit branches, said contacts being individually operable by said thread feelers to close said circuit branches on breakage of threads supervised by said feelers, a counter operable by electric impulses, control means continuously connected with all of said contacts and with said control means and adapted on closing of any one of said contacts to transmit an impulse to said control means and to render one of said circuit branches inoperative during an interval which comprises the period during which said closed contact remains closed, and besides several seconds after opening of said closed contact so that repeated openings and closures of said closed contact during said interval are ineffective to bring said transmitting means to transmit further impulses to said control means, said control means being adapted to respond to said impulse from said transmitting means by sending an impulse to said counter for advancing said counter one unit and remaining active also during said interval to send further advancing impulses to said counter as a response to further impulses from said transmitting means due to closing of still further ones of said contacts.

2. A device for counting thread breakages in textile machines comprising a plurality of thread feelers, a corresponding number of electric circuit branches being connected in parallel, an electric contact in each of said circuit branches, said contacts being individually operable by said thread feelers to close said circuit branches on breakage of threads supervised by said feelers, a thread feeler resistor connected in series with said contact in each of said circuit branches, said resistors in said circuit branches being equally large, a counter operable by electric impulses, control means connected with said counter, balancing means, a make contact in said balancing means, loading means in said balancing means continuously connected in series with said parallel connected circuit branches and urging, when at least one of said thread feeler operated contacts is closed, said balancing means in a direction to close said make contact, compensating means in said balancing means urging, when energized, said balancing means in a direction to break said make contact to compensate the effect of said loading means on said balancing means, a balancing circuit including said compensating means, pulsing means adapted, when energized, to produce a series of electric pulses, balancing resistors for said balancing circuit, means responding to pulses from said pulsing means for

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altering the current path of said balancing circuit through said balancing resistors stepwise to alter the current flow through said compensating means thereby altering the compensating effect of said compensating means opposing the effect of said loading means on said make contact in said balancing means, said pulsing means being connected with said control means which is adapted to send an impulse to said counter for each pulse received from said pulsing means, energizing means, controlled by said balancing means to energize said pulsing means as long as the effect of said loading means on said make contact in said balancing means preponderates over the effect of said compensating means on said make contact in said balancing means, and restoring means adapted to break said balancing circuit upon opening of all said contacts, said restoring means operating with delay.

3. A device for counting thread breakages in textile machines comprising a plurality of thread feelers, a corresponding number of electric circuit branches, being connected in parallel, an electric contact in each of said circuit branches, said contacts being individually operable by said thread feelers to close said circuit branches on breakage of threads supervised by said feelers, a resistor and a condenser connected in parallel in each of said circuit branches, and having in combination a time constant of several seconds, a counter, and control means continuously connected with said counter and all of said parallel-connected circuit branches and adapted to respond only to the charging current pulse, generated by any one of said condensers upon closing of said contact in the corresponding one of said circuit branches, by advancing said counter one unit.

4. A device according to claim 3 comprising means in each of said circuit branches, which is current conductive in one direction only.

5. A device for counting thread breakages in textile machines comprising a plurality of thread feelers, a corresponding number of electric circuit branches being connected in parallel, an electric thread feeler contact in each of said circuit branches, said contacts being individually operable by said thread feelers, a resistor and a condenser connected in parallel in each of said circuit branches, and

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having in combination a time constant of several seconds, a counter operable by electric impulses, a relay, a make contact in said relay connected to said counter to send an electric impulse to said counter for advancing said counter one unit upon operation of said relay, and a coil in said relay continuously connected in series with all of said parallel connected circuit branches and being able to operate said relay to close said make contact in response to the charging current pulse generated by any one of said condensers upon closing of said thread feeler contact in the corresponding one of said circuit branches but being unable to hold said make contact closed in response to the steady current through said resistor in any one of said circuit branches when the thread feeler contact in the corresponding one of said circuit branches is closed and the charging current pulse through the corresponding one of said condensers has ceased.

6. A device according to claim 5 comprising a second make contact in said relay, said relay coil being able to keep said second make contact closed not only under the influence of the charging current pulse generated by any one of said condensers due to closure of the associated one of said thread feeler contacts but also under the influence of steady current through a plurality of said resistors when the thread feeler contacts associated with said plurality of said resistors are closed and the charging current pulses through said condensers associated with said plurality of said resistors have ceased, and a signalling device, operated by said second make contact.

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