

Aug. 13, 1957

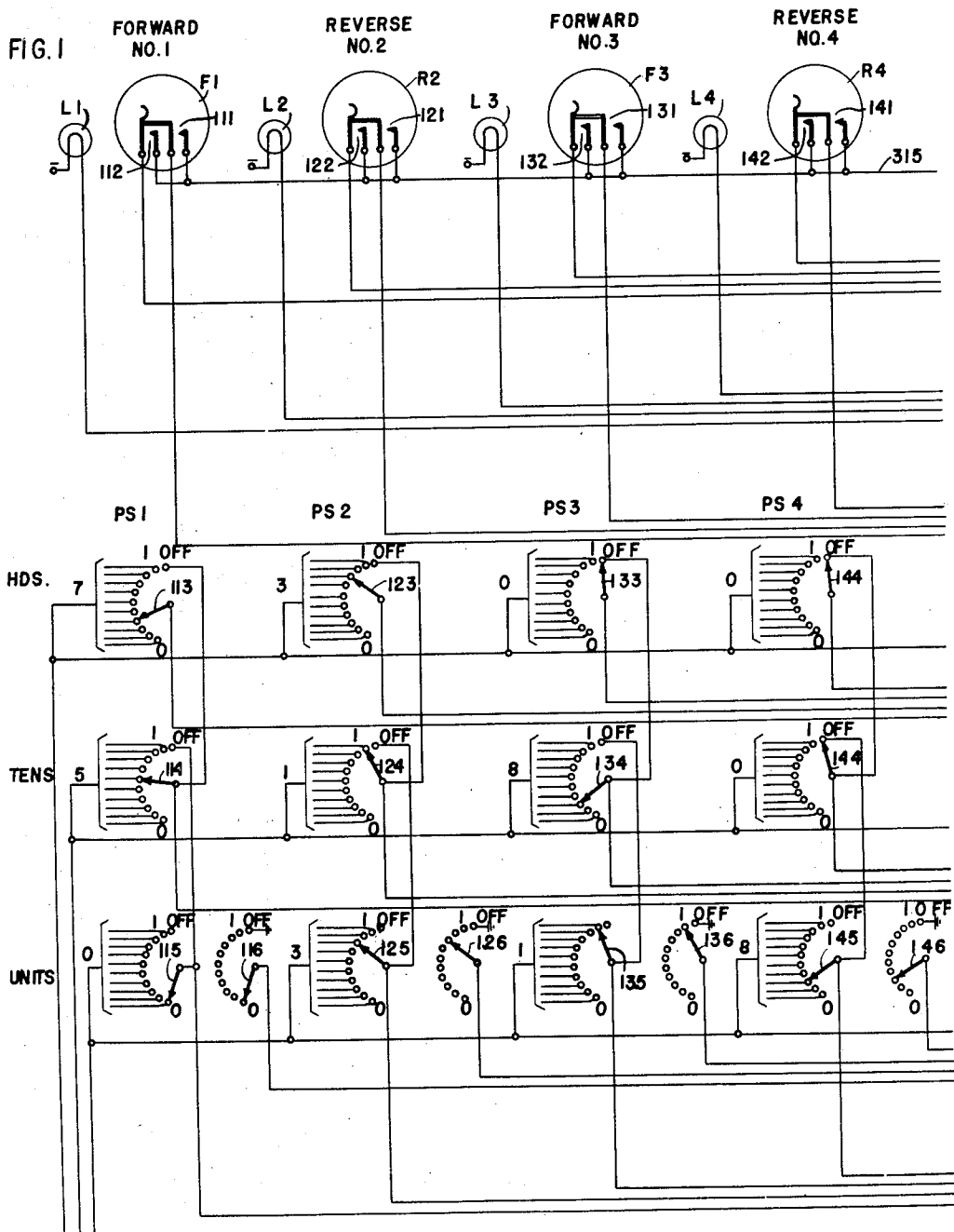
L. F. CRABTREE

2,802,627

PRESET COUNTER FOR WEAVING MACHINE

Filed Dec. 31, 1954

6 Sheets-Sheet 1



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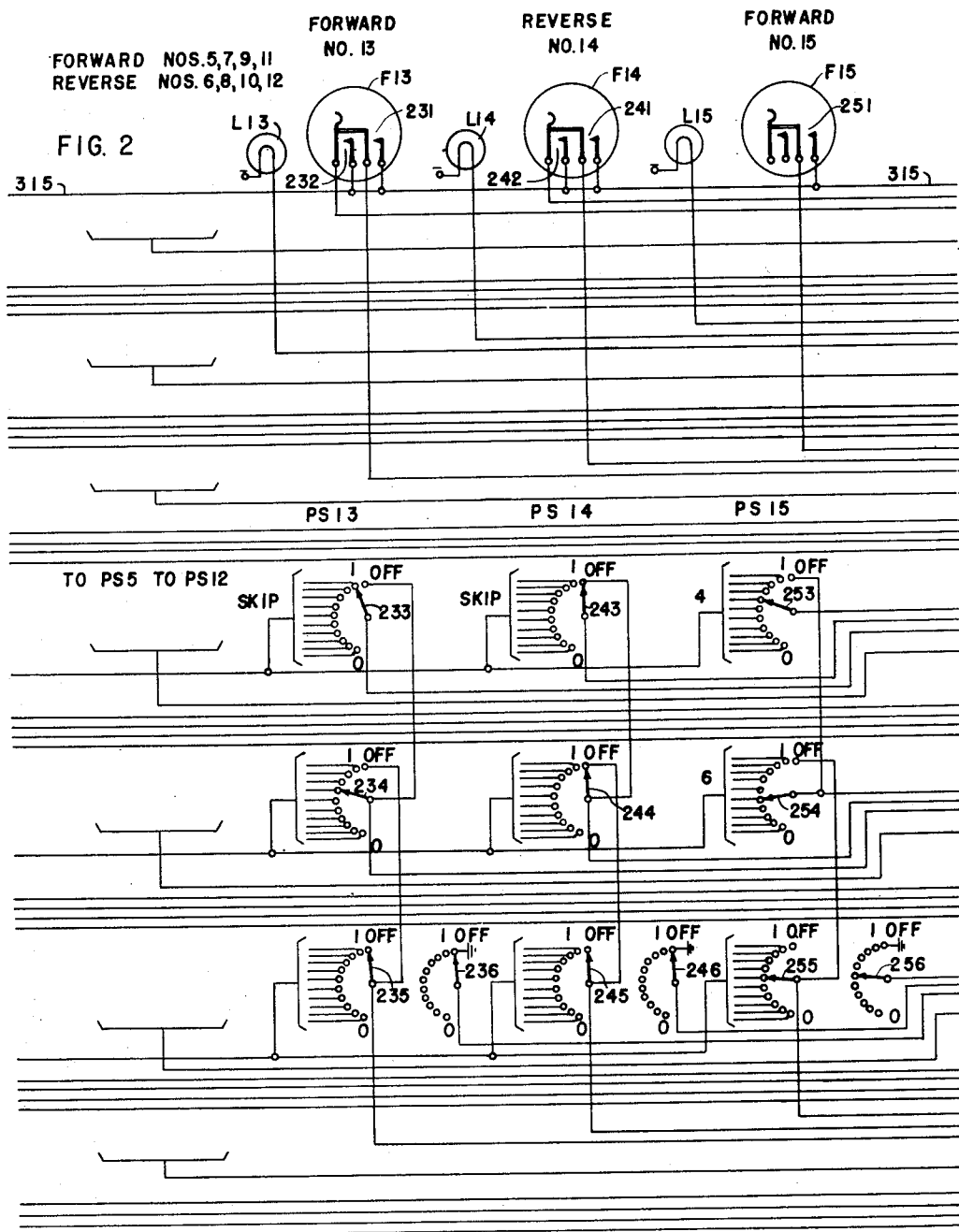
PRESET COUNTER FOR WEAVING MACHINE

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FORWARD NOS. 5, 7, 9, 11
REVERSE NOS. 6, 8, 10, 12

FIG. 2



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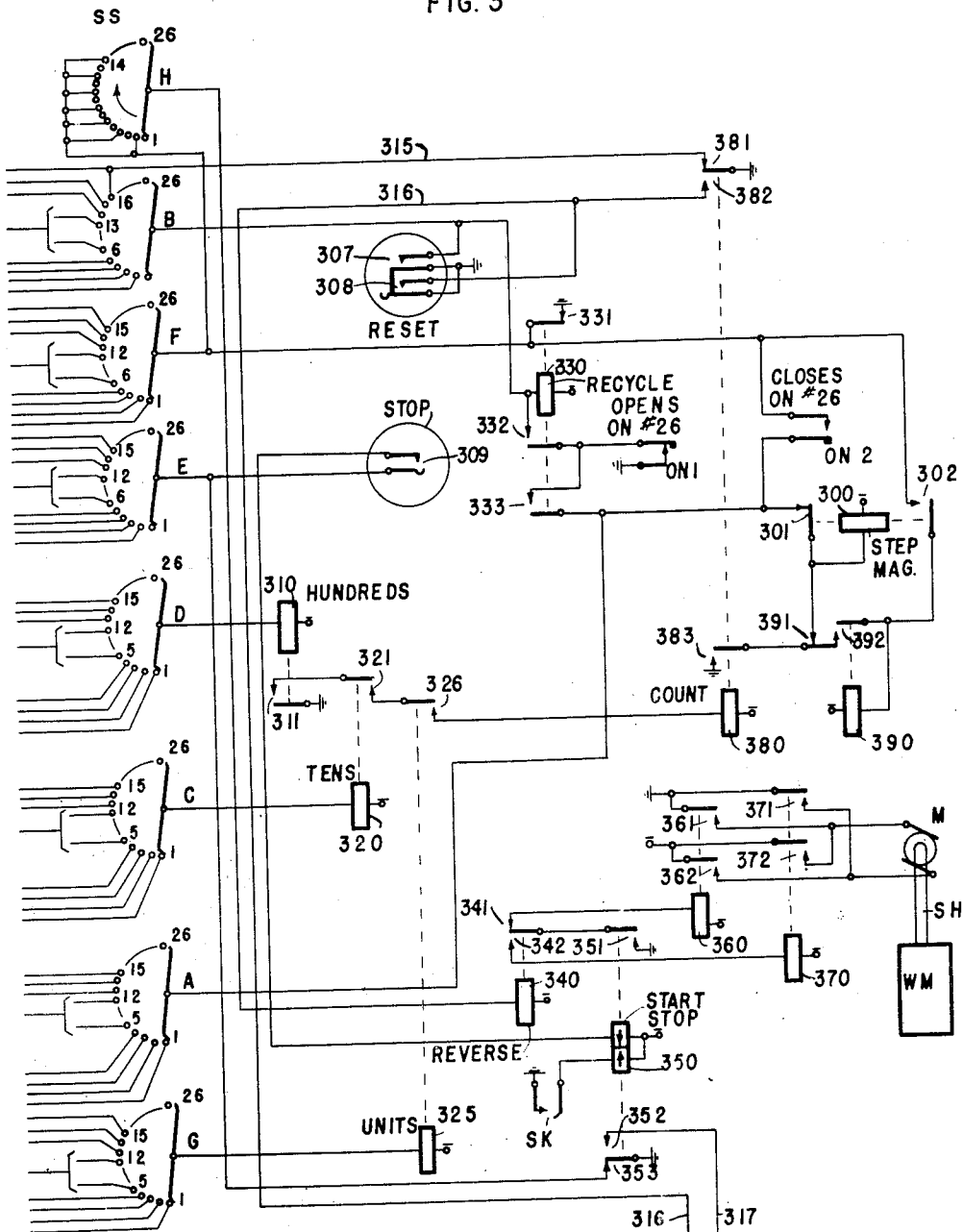
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PRESET COUNTER FOR WEAVING MACHINE

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6 Sheets-Sheet 3

FIG. 3



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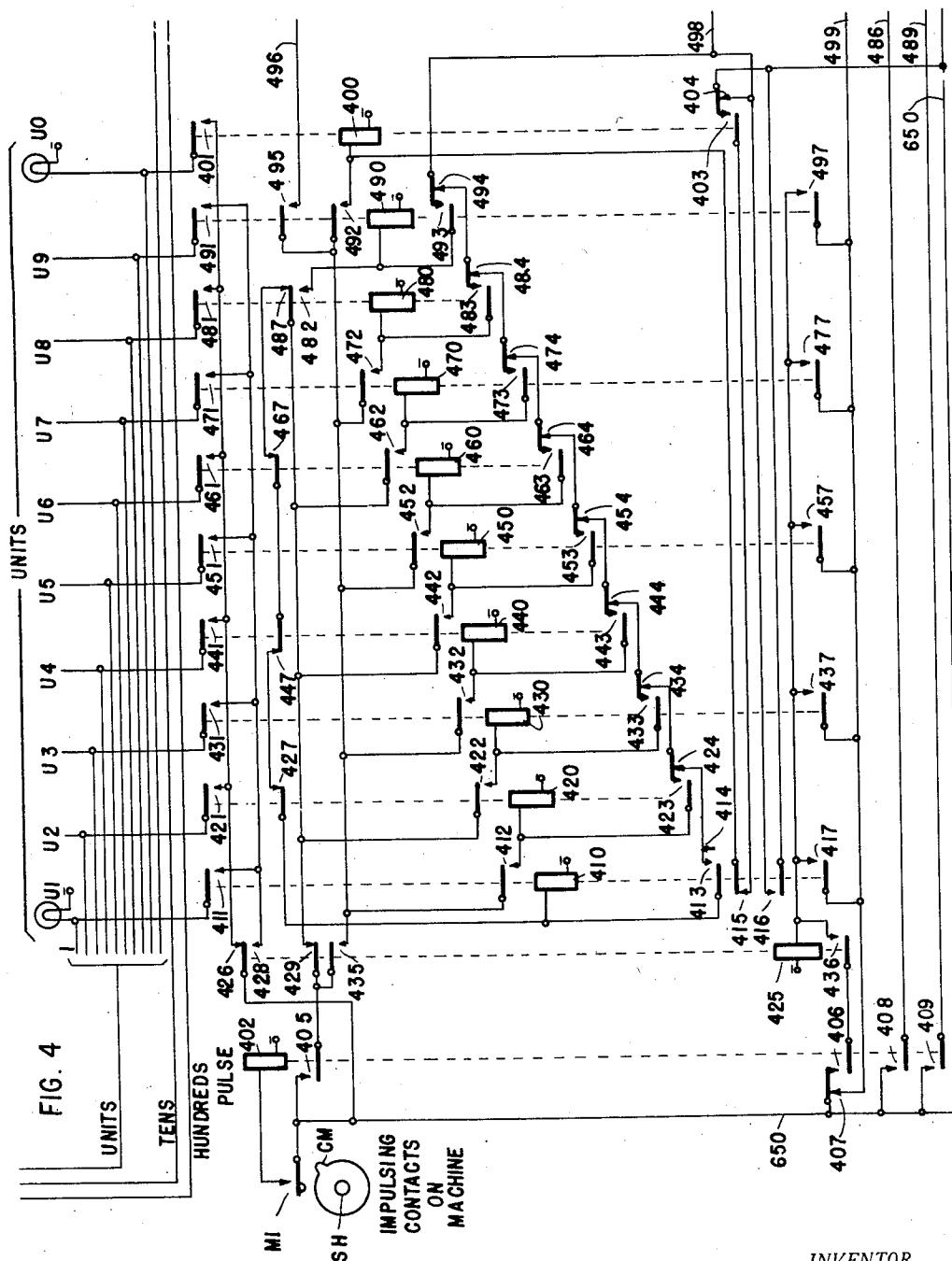
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6 Sheets-Sheet 4



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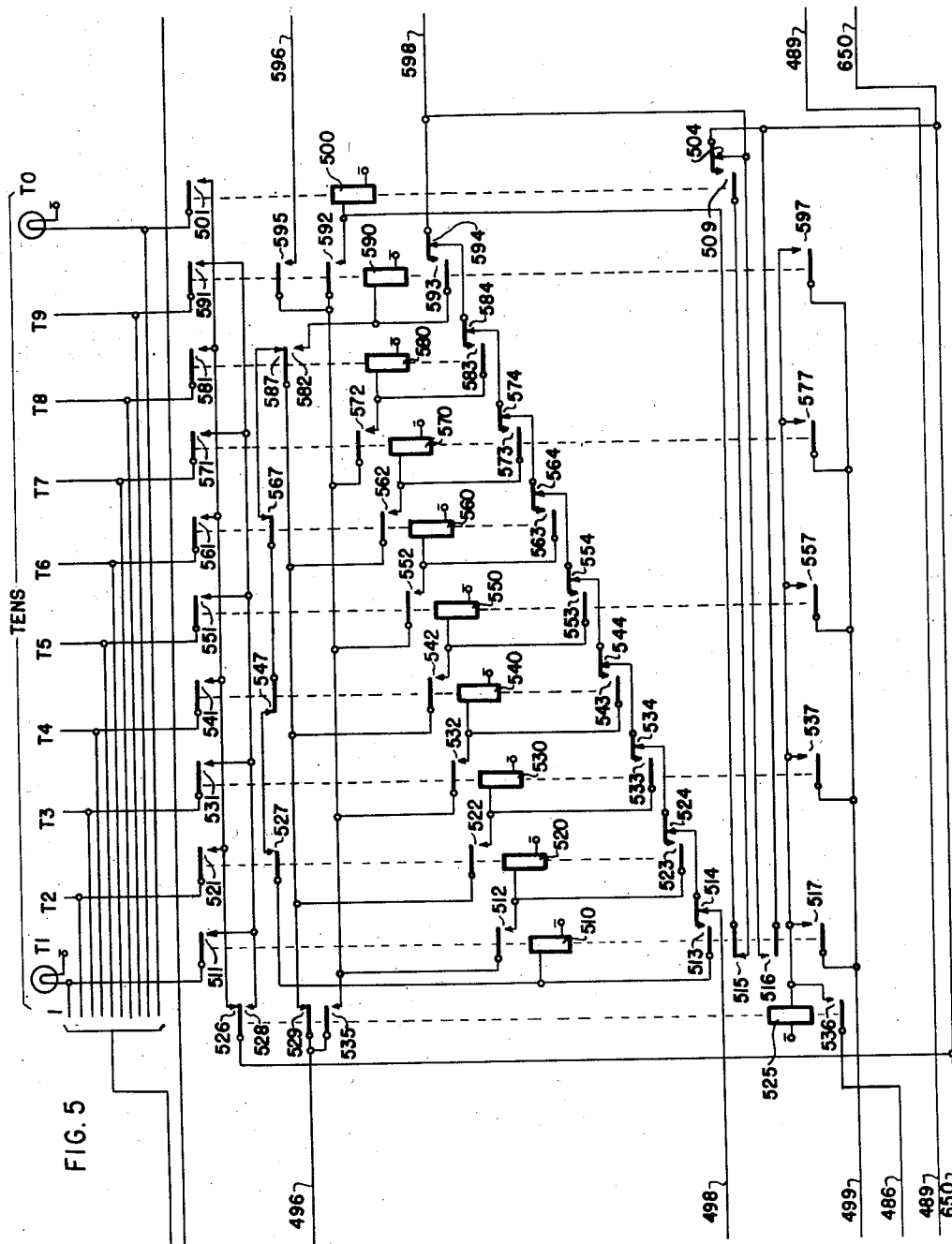
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PRESET COUNTER FOR WEAVING MACHINE

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6 Sheets-Sheet 5



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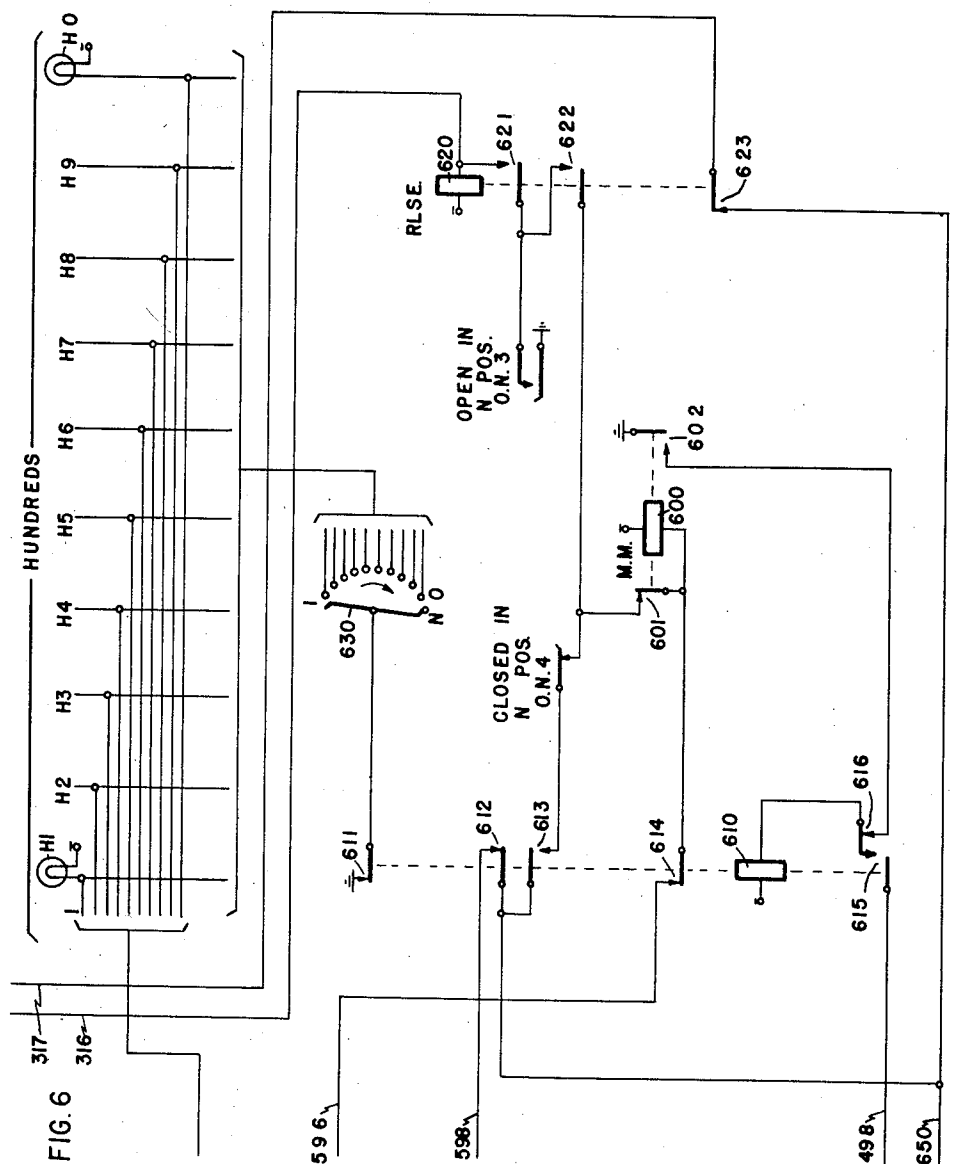
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PRESET COUNTER FOR WEAVING MACHINE

Filed Dec. 31, 1954

6 Sheets-Sheet 6



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2,802,627

PRESET COUNTER FOR WEAVING MACHINE

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Application December 31, 1954, Serial No. 479,927

6 Claims. (Cl. 235—132)

The present invention relates in general to preset counters and control means for dividing the operations of a weaving machine into successive groups of machine operations for weaving predetermined designs.

The main object of the present invention relates to improved control means whereby the weaving machine is continuously and automatically operated through successive cycle operations under control of a selector which automatically selects successive group positions for each group machine operation and a common counting means which counts the number of machine operations in each group machine operation; there being a set of preset switches for predetermining the number of machine operations for each group of position.

A feature of the invention relates to recycling means whereby only a selected, or predetermined, number of said group positions may be utilized in the automatic successive recycling operations.

Another feature relates to skipping means for automatically controlling the selector to skip any desired ones of the group positions so that the counting operations normally performed at these positions are skipped whereby a following group position, not set in skip position, thereafter control the counting operation of the succeeding machine group operation.

A further feature relates to the means whereby the direction of operation of the weaving machine in its forward or reverse movements is controlled by the occupied position of the selector during the counting operations for the respective group positions.

An additional feature relates to the means for automatically stopping the machine operations at a predetermined preselected one of said group positions in response to the completion of the preceding counting operations for the preceding group positions up to and including such preselected group position and for automatically resetting the control and counting means to normal to prepare for another series of group machine operations starting from the first group position.

Other features of the invention will be apparent from the following description of the drawings, comprising Figs. 1 to 6, inclusive which illustrate in schematic diagram the preferred embodiment of the invention.

Figs. 1 and 2 show the preset means for predetermining the successive group weaving operations of the weaving machine.

Fig. 3 shows the selector switch SS and control means for controlling the groups of weaving machine operations in accordance with the setting of the preset means of Figs. 1 and 2.

Fig. 4 shows a pulse relay controlled by the weaving machine and a units counter controlled by the pulse relay.

Fig. 5 shows the tens counter controlled from the units counter of Fig. 4.

Fig. 6 shows the hundreds counter and releasing apparatus for restoring the counters to normal.

The preset apparatus shown in Figs. 1 and 2 are pro-

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vided, in the present invention, to control fifteen different successive group weaving operations of the weaving machine, and comprises a manually operative recycle key and hundreds, tens and units manually operative tap switches for determining the number of weaving operations in each group operation of the machine. The forward recycle key F1, the lamp L1, and the tap switches PS1 are provided for the first group operation while the reverse recycle key R2, lamp L2 and tap switches PS2 are provided for the second group operation of the machine. Similar keys, lamps and tap switches are provided for controlling the remaining group operations of the machine. The successive recycle keys are connected to corresponding successive positions in the bank of the selector SS of Fig. 3 for controlling the recycling operations of the machine. The tap switches each comprise a wiper, such as wiper 113, manually operative to engage one of eleven bank contacts numbered "off" and 1 to 0 inclusive. The units tap switches each comprise two wipers, such as wipers 115 and 116, which are simultaneously set to corresponding positions, the wiper 116 being provided to cause a skip operation when set in "off" position. The hundreds tap switches have their bank contacts connected to the hundreds counter shown in Fig. 6, the tens tap switches have their bank contacts connected to the tens counter of Fig. 5 and the units tap switches have their first set of bank contacts connected to the units counter of Fig. 4 as shown. The wipers of the tap switches are respectively connected in successive order in the banks of the selector switch SS of Fig. 3.

The selector switch of Fig. 3 is of the well-known ratchet-type rotary step-by-step switch having 8 wipers and corresponding sets of bank contacts and a stepping magnet 300 which operates the stepping pawl to step the wipers one step on each deenergization. The selector also has off-normal contacts ON1 which open when the wipers of the selector engage their twenty-sixth bank contacts, and off-normal ON2 which close when the wipers engage their twenty-sixth bank contacts. Fig. 3 also shows a reset key for resetting the control and counting means to normal, a start key SK for operating the start-stop relay 350, and a stop key for restoring the start-stop differential relay 350. Relays 360 and 370 are controlled by the start-stop relay 350 and reverse relay 340 to operate the motor M in its forward or reverse directions to control the weaving machine WM by means of shaft SH. A recycle relay 330 is provided to control the operation of the selector to automatically recycle the group machine operations. The hundreds relay 310, the tens relay 320 and the units relay 325, are controlled over the selector wipers at successive selector positions when the hundreds, tens, and units counters have counted to the number preset on the tap switches at the time engaged by the selector wipers. The simultaneous operations of the hundreds, tens and units relay operates a count relay 380 which causes the selector SS to step to the next position and to release the counting means to normal.

The units counter shown in Fig. 4 comprises a chain of counting relays including a drive relay 425 for counting the number of shaft rotations of the weaving machine under control of the pulse relay 402 which is operated by contacts M1 controlled by cam CM on shaft SH of the weaving machine.

The tens counter of Fig. 5 is similar to the units counter and comprises counting relays which are operated each time the units counter counts ten.

The hundreds counter of Fig. 6 comprises an eleven point rotary step-by-step switch similar in construction to the selector SS of Fig. 3 and has a motor magnet MM for stepping wiper 630 on deenergization. Off-normal contacts ON3 open when the wiper 630 is in normal position and are closed in all other positions. Off-nor-

mal contacts ON4 close in normal position and are open in all other positions to enable this counter to be used if it is later desired to count over a thousand. A release relay 620 and another relay 610 are provided to control the restoration of the counters to normal after counting to a preset number.

Before describing the detail operations it is believed advisable to explain that battery and ground symbols shown on the drawings are in effect negative and positive potentials obtained by rectified alternating current in any well-known manner. For example, a start key is operated at the same time start key SK of Fig. 3 is operated to connect 110 volt A. C. to one winding of a transformer, the other winding being connected to a full-wave rectifier to produce the desired negative and positive potentials and thereby connect such potentials to the points indicated by battery and ground symbols.

In order to describe the detail operations it will be assumed that a weaving design has been made which requires a predetermined number of forward and reverse group operations of the machine and in which each of said group operations requires a predetermined number of individual weaving operations to weaving a pattern according to the desired design. A plurality of group positions are provided for controlling or dividing the weaving operations into group operations and such positions each include tap switches which may be numerically set by hand to register the number of weaving, or machine, operations desired for that particular group position. For example, the first group position, as indicated in Fig. 1, has its tap switches PS1 set to register 750 to thereby cause the machine to take 750 weaving machine operations in a forward direction for the first group position, the second group position has its tap switches PS2 set to register 313 weaving machine operations in a reverse direction, the third group position tap switches PS3 registers 81 weaving operations for the next forward direction, and the fourth group position tap switches PS4 registers 8 weaving operations for the next reverse direction. The tap switches for the succeeding group positions are manually set to register the desired number of weaving operations for their respective group positions. Group positions 5 to 12 are diagrammatically illustrated but not shown since such positions are similar to group positions 1 to 4 inclusive. The units tap switches PS13 and PS14 for the thirteenth and fourteenth group positions are set in skip position with the wipers 236 and 246 engaging their "off" contacts which are grounded to thereby cause these group positions to be skipped as will be described hereinafter. The fifteenth group position tap switches PS15 are set to register 465 forward weaving operations for this position. In accordance with the preset tap switches PS the weaving machine will make thirteen different group machine operations each group containing a predetermined number of weaving operations preferable in alternate forward and reverse directions after which the cycle is repeated until the machine is stopped.

After manually presetting the tap switches the start key (not shown) is operated to connect battery and ground potentials to the apparatus at the points indicated by the battery and ground symbols. The operations of the start key SK (Fig. 3) completes an obvious circuit for operating the start-stop relay 350 over its lower winding. At contacts 351 relay 350 completes a circuit over contacts 341 for operating relay 360 and at contacts 352 grounds conductor 317 and conductor 650 by way of contacts 623 to thereby supply operating ground for the pulse and counting relays of Figs. 4 and 5. Relay 360 at contacts 361 and 362 completes a circuit for operating the weaving machine motor M in a forward direction. Lamp L1 associated with the first group position is now illuminated over the following circuit: ground contacts 331, F wiper of selector SS in engagement with its first bank contact, and lamp L1 to battery to indicate that

the machine is operating to control the group operation in accordance with the preset tap switches PS1 for the first group position. Similar lamps are shown at each group position and are similarly operated for such group operations.

Each revolution of the machine shaft SH causes the cam CM (Fig. 4) to close contacts M1 and complete a circuit from grounded conductor 650 to operate pulse relay 402. The first operation of pulse relay 402 completes a circuit for operating the first units counting relay 410 as follows: grounded conductor 650, contacts 405, 429, 487, 467, 447, 427 and winding of relay 410 to battery. Relay 410 at contacts 411 prepares a circuit for grounding units conductor I and units counting lamp U1, at contacts 412 prepares the circuit to the second counting relay 420, at contacts 413 completes a locking circuit for itself; at contacts 415 opens a point in the locking circuit for the tenth units counting relay 400; at contacts 415 completes a circuit for maintaining conductor 498 grounded when relay 400 is operated, and at contacts 417 prepares a circuit for operating drive relay 425. The locking circuit for relay 410 may be traced as follows: grounded conductor 650, contacts 404, 494, 484, 474, 464, 454, 444, 434, 424, and 413 and the winding of relay 410 to battery.

When cam CM opens contacts M1 pulse relay 402 restores and at contacts 407 completes a circuit for operating drive relay 425 as follows: grounded conductor 650, contacts 407 and 417 and winding of relay 425 to battery. Relay 425 at contacts 428 connects grounded conductor 650 by way of contacts 411 to the units 1 conductor and lights units lamp U1, at contacts 429 opens a point in the original energizing circuit of relay 410, at contacts 435 prepares another point in the circuit for operating the second counting relay 420, and at contacts 436 prepares a locking circuit for itself which is effective during the operation of pulse relay 402.

When cam CM closes contacts M1 a second time pulse relay 402 again reoperates and since drive relay 425 is operated completes a circuit for operating the second counting relay 420 from grounded conductor 650 over contacts 405, 435, and 412. Pulse relay 402 closes contacts 406 before contacts 407 open to maintain drive relay 425 operated until the pulse relay restores. Second counting relay 420 at contacts 421 prepares a circuit for connecting grounded conductor 650 to units conductor 2 and to units lamp U2, at contacts 427 opens another point in the original energizing circuit of the first counting relay 410, at contacts 422 prepares the circuit for the third counting relay 430, at contacts 423 completes its own locking circuit and at contacts 424 opens the locking circuit to the first counting relay 410 which now restores. The locking circuit for relay 420 extends from grounded conductor 650 over the break contacts of the succeeding counting relays as previously described for the first counting relay and by way of contacts 423 to relay 420 and battery. Relay 410, upon restoring, at contacts 411 disconnects ground from lamp U1 and units conductor 1, at contacts 412 opens the original energizing circuit to relay 420, at contacts 415 prepares a locking circuit for relay 400, and at contacts 417 opens the original circuit of drive relay 425 which is locked energized over contacts 436 as long as pulse relay 402 is operated.

When cam CM opens contacts M1 for the second time pulse relay 402 again restores and at contacts 406 opens the locking circuit to drive relay 425 which also restores. At 426 relay 425 completes a circuit by way of grounded conductor 650 and contacts 421 for grounding the number 2 units conductor and for lighting units lamp U2, and at contacts 429 prepares the circuit for operating the third units counting relay 430.

Pulse relay 402 is operated a third time by the cam CM closing contacts M1 on its third revolution and completes a circuit for the third counting relay 430 by way of contacts 405, 429, and 422. Relay 430 locks over

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contacts 433 and the break contacts of the succeeding counting relays, at contacts 432 prepares at circuit for relay 440, at contacts 437 prepares a circuit for drive relay 425, and at contacts 434 opens the locking circuit of the second counting relay 420 which now restores to extinguish lamp U2 and remove ground from the number 2 units conductor. When the pulse relay 402 restores it completes a circuit by way of contacts 407 and 437 for reoperating drive relay 425 and the latter relay at contacts 428 completes a circuit by way of contacts 431 for grounding the number 3 units conductor and for lighting units lamp U3.

When the pulse relay 402 is operated a fourth time it completes the circuit for the fourth counting relay 440 which locks and causes the preceding counting relay 430 to restore and disconnect ground from lamp U3 and number 3 units conductor and when the pulse relay 402 is restored it opens the locking circuit of the drive relay 425 which restores to prepare the circuit for the fifth counting relay 450 and to ground lamp U4 and the number 4 units conductor all in manner similar to that previously described. The succeeding counting relays are successively operated by successive operations of the pulse relay in a similar manner to successively ground the corresponding units conductors. The drive relay 425 is operated after each odd operation of the pulse relay and restores after each even operation of the pulse relay to control the succeeding odd and even counting relays and to ground the successive units conductors.

When the ninth counting relay 490 is operated by the ninth operation of pulse relay 402, relay 490 at contacts 495 prepares a circuit for operating the first tens counting relay 510 and for simultaneously operating the tenth units counting relay 400. In response to the tenth operation of pulse relay 402 relays 400 and 510 are operated over the following circuit: grounded conductor 650, contacts 405, 435 and one branch over 492 to relay 400 and the other branch over 495 and conductor 496, contacts 529, 587, 567, 547, 527 and relays 510 to battery. Relay 400 at contacts 401 prepares a circuit for grounding 0 units conductor and lighting units lamp U0, at contacts 403 locks itself by way of contacts 415, and at contacts 404 opens the locking circuit of relay 490 which restores.

Since the tens counter of Fig. 5 is identical to the units counter of Fig. 4, the first tens counting relay 510 at contacts 511 prepares a circuit for grounding the tens conductor 1 and for lighting the tens lamp T1, at contacts 512 prepares a circuit for the second tens counting relay 520, at contacts 513 completes a locking circuit for itself and at contacts 517 prepares a circuit for the tens drive relay 525 which is completed when the pulse relay 402 restores and closes contacts 407. Drive relay 525 operates at the end of the pulse to complete a circuit for lighting the lamp T1 and grounding tens conductor 1, at contacts 536 completes a locking circuit for itself over conductor 486 and contacts 408 while the pulse relay is in operated position. The drive relay 525 is maintained in this operated position over its original energizing circuit including contacts 407 and 517 during the time pulse relay 402 is in restored position. The tens counter remains in this position until the units counter again counts up to ten.

In response to the 11th operation of pulse relay 402, the first counting relay 410 is again operated, but this time at contacts 415 opens the locking circuit of relay 400 which restores. The locking circuit for units counting relay 410, during the time relay 400 is operated, may be traced as follows: grounded conductor 650, contacts 416, back through the break contacts of the counting relays to contacts 413 and the winding relay 410 to battery. When relay 400 restores contacts 404 short circuits the contacts 416 to thereby establish a new locking for relay 410. The drive relay 425 and the succeeding units counting relays operate in the same manner as previously described. In an obvious manner from the foregoing description and in response to the 20th pulse, conductor 496

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is grounded to operate the second tens counting relay 520. Each succeeding 10th pulse operates the next tens counting relay and when the 100th pulse is received motor magnet 600 of the hundreds counter is operated over the following circuit at the same time that the tens counting relay 500 is operated. This circuit may be traced as follows: from grounded conductor 650, contacts 405, 435, 495, 535, 595, 614 and through the winding of motor magnet 600 to battery. Motor magnet 600 at contacts 602 completes a circuit by way of contacts 616 for energizing relay 610. Relay 610 at contacts 615 completes a locking circuit for itself over conductor 489 and contacts 409, at contacts 611 disconnects ground from wiper 630, at contacts 612 disconnects one of the multiple grounds from conductor 598, and at contacts 614 opens the original energizing circuit of motor magnet 600. Motor magnet 600 restores and advances wiper 630 one step into engagement with the bank contacts terminating the first hundreds conductor 1 and at contacts 602 opens the original energizing circuit of relay 610. In response to the hundreds counter moving off-normal the off-normal contacts ON3 close and the off-normal contacts ON4 open. When the pulse is terminated relay 610 restores and at contacts 611 grounds wiper 630 and hundreds conductor 1 and also completes a circuit for lighting the hundreds lamp H1.

The above described sequence of the counting operation continues until the hundreds counter has operated to its 7th bank contact to ground the 7 hundreds conductor to cause the operation of the hundreds relay 310 over the hundreds preset switch PS1 as follows: ground, contacts 611, wiper 630 and 7th bank contacts, the 7 hundreds conductor terminating in the 7th position bank contact engaged by wiper 113, the first bank contact engaged by wiper 113, the first bank contact engaged by wiper D of selector switch SS and through the winding of the hundreds relay 310 to battery. The counting operation continues until the tens counter grounds the tens conductor 5 to complete the following circuit for the tens relay 320 as follows: from grounded conductor 650, contacts 528 and 551, tens conductor 5, 5th bank contact and wiper 114 of the tens preset switch, first bank contact and wiper C of selector SS and through the winding of the tens relay 320 to battery. The units counter also completes a circuit for the units relay 325 as follows: from grounded conductor 650, contacts 426 and 401, the units conductor 0, wiper 115 of the units preset switch, first bank contact and wiper G of the selector switch SS and through the winding of relay 325 to battery. The simultaneous operation of the hundreds relay 310, the tens relay 320 and the units relay 325 completes a circuit by way of contacts 311, 321 and 326 for operating count relay 380.

Count relay 380 at contacts 383 completes a circuit by way of contact 391 for energizing the stepping magnet 300 and at contacts 382 completes a circuit by way of conductor 316 for energizing the release relay 620. Stepping magnet 300 operates and closes its contact 302 to complete the circuit for operating relay 390 from grounded contacts 331. At contacts 392 relay 390 completes locking circuit for itself during the time count relay 380 is operated, and at contact 391 opens the circuit to magnet 300. Magnet 300 restores to step the selector wipers to their second position bank contacts to control the second group operation. Wiper H of selector switch SS, in engagement with its second bank contact, completes a circuit from grounded contacts 331 for operating reverse relay 340. Relay 340 at contact 341 opens the circuit of relay 360 which restores and at contacts 342 operates relay 370. Relay 370 at contacts 371 and 372 completes an obvious circuit for operating motor M in the reverse direction to initiate the reverse group operation of the weaving machine WM.

Release relay 620, upon energizing, at contacts 621

completes a locking circuit for itself from operated off-normal contacts ON3, at contacts 623 disconnects ground from conductor 650 to thereby restore any operated counting relays; and at contacts 622 completes a circuit for restoring the hundreds counter to normal. In response to the removal of ground from conductor 650, all of the operated counting relays including the hundreds relay 310, the tens relay 320 and the units relay 325 restore to cause count relay 380 to also restore. The following circuit is completed for motor magnet 600 of the hundreds counter when release relay 620 is operated: ground, ON3 contacts, contacts 622, interrupter contacts 601 and through the winding of motor magnet 600 to battery. Magnet 600 at contacts 602 completes a circuit over contacts 616 for operating relay 610 and at interrupter contacts 601 interrupts its own circuit to thereby deenergize magnet 600 and step wiper 630 a step. Interrupter contacts 601 close to again operate motor magnet 600 to open contacts 601 to thereby again restore magnet 600 to step wiper 630 another step. Magnet 600 is intermittently operated and restored over the above traced circuit until wiper 630 is stepped to its normal position at which time the ON3 contacts open this stepping circuit. The operation of relay 610 at contacts 611 disconnects ground from wiper 630 during the restoring operation of the hundreds counter. All of the above described restoring operations take place very rapidly before the weaving machine WM sends the next pulse in its reverse operation.

In response to the reverse operation of weaving machine WM the counting apparatus functions the same as previously described until it has counted to the preset number set up on the present tap switches PS2 associated with the second group position. Since the preset switches PS2 are preset to register 313, the counting apparatus upon counting to this preset number operates relays 310, 320 and 325 over the second position bank contacts of the selector SS in a manner obvious from the foregoing description. Count relay 380 is again operated by these three relays to cause the selector SS to step to its third position and to cause release relay 620 to operate and restore all counting apparatus to normal as previously described. Selector SS at wiper H opens the circuit to the reverse relay 340 which restores and operates relay 360. Relay 360 now operates motor M in a forward direction for the next, or third, group operation of the weaving machine WM. In a manner obvious from the foregoing description successive group operations of the weaving machine are controlled by the preset switches PS and the stepping of the selector SS to corresponding positions to alternately divide the machine operations into alternate forward and reverse directions of operations in accordance with the numbers set upon the preset tap switches PS for each group position.

In order to skip any desired group position, the units tap switches PS may be in "off" position as shown by the units tap switches PS13 and PS14 in Fig. 2 in which the wipers 236 and 246 are connected to ground at their "off" positions. The selector SS is operated to engage its thirteenth bank contacts after having counted the preset number of the tap switches associated with the twelfth group position. The units tap switches wiper 236 of the thirteenth group position is grounded with the result that since wiper A of selector SS engages this thirteenth bank contact stepping magnet 300 is immediately operated over its interrupter contacts 301. The stepping magnet 300 near the end of this stroke opens interrupter contacts 301 to thereby restore stepping magnet 300 and advance the selector wipers another step into engagement with their fourteenth bank contacts. Since the 14th position units tap switch wiper 246 is in skip position and is grounded stepping magnet 300 is again operated, this time from the fourteenth bank contact and wiper A to cause the selector wipers to advance to their fifteenth position to control the next group operation of the weaving machine

WM in accordance with the number set up on the preset tap switches PS15.

When the count for the fifteenth position is completed the selector SS, in the same manner as previously described, steps to its sixteenth position to cause the recycling of the previous group operations. The recycle relay 330 is operated in response to the selector SS being advanced to its sixteenth position by way of ground at contacts 381 after the count relay restores, over the sixteenth bank contact and the wiper B. Recycle relay 330 at contacts 332 completes a locking circuit for itself over off-normal contacts ON1 and at contacts 333 closes a circuit to automatically advancing the wipers of selector SS to the twenty-sixth position. This circuit may be traced from ground at ON1 contacts, contacts 333, interrupter contacts 301 and the winding of magnet 300 to battery. Interrupter contacts 301 interrupts the circuit to the stepping magnet 300 to cause the stepping magnet to intermittently operate and restore, and advance the wipers of selector SS step-by-step until the off-normal contacts ON1 open when the wipers reach their twenty-sixth bank contacts. The opening of contacts ON1 opens the locking circuit of recycle relay 330 which now restores. At contacts 331 recycle relay 330 completes a circuit by way of off-normal contacts ON2, which close only in the twenty-sixth position of selector SS, and by way of interrupter contacts 301 to the winding of stepping magnet 300 to cause the selector wipers to advance to engage their first bank contacts. Contacts ON2 are now open to prevent further operation of the selector wipers and the apparatus now is conditioned to re-operate in another cycle of the group counting operations as determined by the preset tap switches for the different group positions in the manner previously described.

This recycling of the successive group operations is continued until it is desired to stop the machine after any desired group operation. For example, after the last desired recycling operation is started the recycle key, such as key R4 is operated if it is desired to stop the machine after counting the 4th group operation and in addition the stop key Stop (Fig. 3) is also operated. It will be remembered that after the counting operation for the fourth group position is completed the selector SS is automatically advanced to its fifth position in which position the circuit is completed when the count relay 380 restores to restore the start-stop differentially wound relay 350. Recycle relay 330 is also operated through the operated recycle key at the same time relay 350 is restored. The circuit for energizing the upper winding of the start-stop relay 350 may be traced as follows: ground, contacts 381, conductor 315, operated contacts 141 of recycle key R4, fifth bank contact and wiper E, closed contacts 309 of Stop key and through the upper winding of relay 350 to battery. Since the lower winding of differential relay 350 is also energized at this time from start key SK relay 350 is operated to its restored position. At contacts 351 relay 350 releases either relay 360 or 370 to stop the motor M, at contacts 352 disconnect ground from conductor 317 and conductor 650 to restore any operated counting relays, and at contacts 353 completes a circuit through the Stop key for maintaining relay 330 in restored position. The circuit for operating recycle relay 330 may be traced as follows: ground contacts 381, conductor 315, key contact 142 of the operated recycle key R4, fifth bank contact and wiper B of selector SS, the winding of recycle relay 330 to battery. At contacts 332 relay 330 again completes its own locking circuit and at contacts 333 again completes a self-restoring circuit to stepping magnet 300 to cause the selector wipers to advance to their twenty-sixth position. ON1 contacts open in the twenty-sixth position of selector SS to restore relay 330 and to open the self-restoring circuit of the stepping magnet. Recycle relay 330, upon restoring, completes the previously traced circuit by way of contacts 331 and ON2 for advancing the selector wipers into

engagement with their first set of bank contacts. The selector switch SS is now in position to start a new recycling operation and the counting apparatus is restored to normal. In order to re-start the operations of the weaving machine WM the stop key must be restored to normal to open the circuit through the upper winding of relay 350 and thereby render the circuit through the lower winding effective to operate relay 350 to its operated position.

While the successive group operations of the machine are normally alternate forward and reverse movements under the control of the H wiper of selector SS and its alternate bank contacts, the machine can make successive forward group movements by setting the units tap switches at the alternate reverse positions to their skip positions. For example, assuming that the units tap switches PS2 and PS4 are set to their skip positions by moving wipers 126 and 146 to their "off" or grounded positions, then these positions are skipped as previously described resulting in three successive forward group operations under control of the preset switches PS1, PS3 and PS5. In a similar manner successive reverse operations may be made similarly positioning the units tap switches to skip positions for certain group positions.

It is also possible to control the recycling of the group machine operations for only certain desired ones of the group positions. That is, assuming that it is desired to continuously recycle the group machine operations for only the first four group positions then the recycle key R4 after the completion of the counting operation for the fourth position. Assuming now, that the recycle key R4 is the first recycle key in operated position and when the counting operation for the 4th group position is completed the selector switch steps to engage its fifth bank contact. Now when the count relay 380 restores and grounds conductor 315 at contacts 381 a circuit is completed over contacts 142, fifth bank contact and wiper B for operating recycle relay 330. The operation of recycle relay 330 causes the selector SS to automatically advance to engage its first set of bank contacts in the same manner as previously described. When the selector SS arrived in its first position the counting operation for the first group position is automatically restored to start a new cycle of group machine operations for the first four group positions.

A Reset key is also provided to enable restoration of the counting apparatus to normal and to restore the selector SS to its 1st position at any time during any counting operation for any position. When the Reset key is operated, a circuit is completed from contacts 307 for operating the recycle relay 330, and a circuit is completed from contacts 308 and over conductor 316 for operating release relay 620. The recycle relay 330 restores the selector SS to its first position and the release relay 620 restores the counters to normal in the same manner as previously described.

What is claimed is:

1. In a preset counter for controlling a plurality of groups of weaving operations of a weaving machine comprising a plurality of sets of switches each set representing a group of weaving machine operations, each said set being manually preset in accordance with a predetermined plural digit number to predetermine the number of weaving machine operations for that set of switches, a selector for successively selecting and engaging successive sets of said preset switches, counting means for counting the number of operations of said machine, control means operated when said counting means has counted a number of machine operations corresponding to a plural digit number preset on a selected set of said preset switches for operating said selector to select and engage the next set of said preset switches and for restoring said counting means to normal, said control means again operated in response to said counting means counting the number of machine operations corresponding to the plural digit

number on said next set of preset switches for again operating said selector to engage a subsequent set of preset switches and for again restoring said counting means to normal to thereby again recondition said control means and said counting means to count further machine operations, whereby group machine operations are automatically and sequentially counted in groups in accordance with the successive sets of said preset switches automatically selected and engaged by said selector, common stop means, stop means individual to each said set of switches and manually movable to its stop position, and stopping means effective when said selector has engaged one of its successive sets of switches having its individual stop means placed in its stop position, and only in case said common stop means is placed in its stop position, for stopping further operations of said machine.

2. A preset counter as claimed in claim 1, including circuit means connected to said selector for operating said stopping means only after the counting operation has been completed for the said one group position having its individual stop means placed in its stop position.

3. In a preset counter for controlling a plurality of groups of weaving operations of a weaving machine comprising a plurality of sets of switches each set representing a group of weaving machine operations, each said set being manually preset in accordance with a predetermined plural digit number to predetermine the number of weaving machine operations for that set of switches, a selector for successively selecting and engaging successive sets of said preset switches, counting means for counting the number of operations of said machine, control means operated when said counting means has counted a number of machine operations corresponding to a plural digit number preset on a selected set of said preset switches for operating said selector to select and engage the next set of said preset switches and for restoring said counting means to normal, said control means again operated in response to said counting means counting the number of machine operations corresponding to the plural digit number on said next set of preset switches for again operating said selector to engage a subsequent set of preset switches and for again restoring said counting means to normal to thereby again recondition said control means and said counting means to count further machine operations, whereby group machine operations are automatically and sequentially counted in groups in accordance with the successive sets of said preset switches automatically selected and engaged by said selector, and means for automatically causing said machine to be alternately driven in a forward or a reverse direction, bank contacts in said selector corresponding to said sets of switches, a wiper in said selector having access to said bank contacts, said last means including a reversing relay connected to said wiper, connections to alternate ones of said bank contacts, means for operating said reversing relay over said connections in response to said wiper engaging any one of said alternate bank contacts, and means controlled by the operation of said relay for operating said driving means to operate said machine in said reverse direction.

4. In a preset counter for controlling a plurality of groups of weaving operations of a weaving machine comprising a plurality of sets of switches each set representing a group of weaving machine operations, each said set being manually preset in accordance with a predetermined plural digit number to predetermine the number of weaving machine operations for that set of switches, a selector for successively selecting and engaging successive sets of said preset switches, counting means for counting the number of operations of said machine, control means operated when said counting means has counted a number of machine operations corresponding to a plural digit number preset on a selected set of said preset switches for operating said selector to select and engage the next set of said preset switches and for restoring said counting means to normal, said control

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means again operated in response to said counting means counting the number of machine operations corresponding to the plural digit number on said next set of preset switches for again operating said selector to engage a subsequent set of preset switches and for again restoring said counting means to normal to thereby again recondition said control means and said counting means to count further machine operations, whereby group machine operations are automatically and sequentially counted in groups in accordance with the successive sets of said preset switches automatically selected and engaged by said selector, and individual manually operative recycle means associated with each position to cause a recycling operation of the counter when operated.

5. In a preset counter for controlling a plurality of groups of weaving operations of a weaving machine comprising a plurality of sets of switches each set representing a group of weaving machine operations, each said set being manually preset in accordance with a predetermined plural digit number to predetermine the number of weaving machine operations for that set of switches, a selector for successively selecting and engaging successive sets of said preset switches, counting means for counting the number of operation of said machine, control means operated when said counting means has counted a number of machine operations corresponding to a plural digit number preset on a selected set of said preset switches for operating said selector to select and engage the next set of said preset switches and for restoring said counting means to normal, said control means again operated in response to said counting means counting the number of machine operations corresponding to the plural digit number on said next set of preset switches

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for again operating said selector to engage a subsequent set of preset switches and for again restoring said counting means to normal to thereby again recondition said control means and said counting means to count further machine operations, whereby group machine operations are automatically and sequentially counted in groups in accordance with the successive sets of said preset switches automatically selected and engaged by said selector, manually operative recycle means associated with each position and individually accessible to said selector, a recycle relay connected to said selector and successively connected to said recycle means on successive operations of said selector, means for operating said recycle relay in response to said selector engaging an operated recycle means at one of said positions on one of said successive selector operations, and means responsive to the operation of said recycle relay for automatically operating said selector to recycle the counting operations for all positions successively engaged by said selector preceding the operation of said recycle relay.

6. A preset counter as claimed in claim 5, wherein said manually operative recycle means for each said group position is connected to said selector in the next succeeding selector position to thereby cause the recycling operation to be effective immediately after the counting operation for the group position having an operated recycle means.

References Cited in the file of this patent

30 "Electro-Mechanical Programme Controller," Journal of Scientific Instruments, vol. No. 30, issue No. 9, pages 324-326, September 1953, by A. F. Watson.