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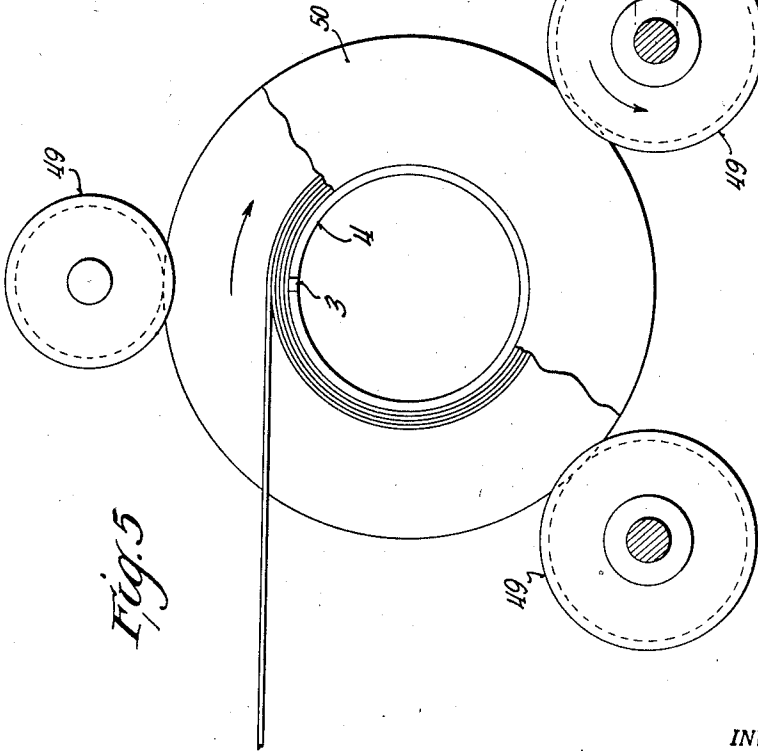
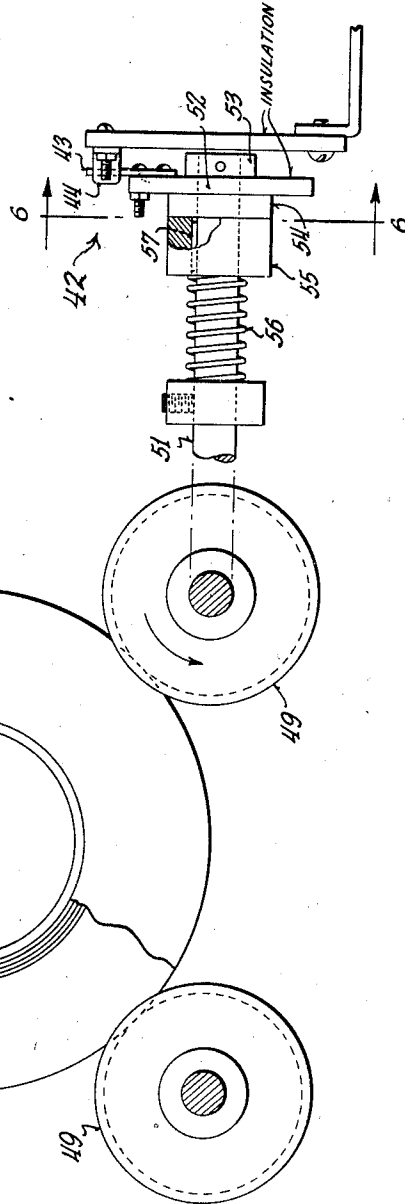
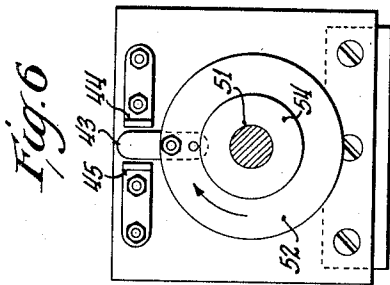
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2,420,590

COUNTING DEVICE

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2 Sheets-Sheet 2



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COUNTING DEVICE

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This invention relates to a counting device and is particularly directed to a device for counting the number of turns of wire being wound on a coil, such as the coil assembly of a transformer or other magnet coil.

Objects of this invention are to provide a counting device which will record the number of turns of wire being wound on a coil and which is so made that it will either subtract any turns which are unwound from the coil, if such unwinding should be necessary, or else will record both the number of turns wound on the coil and the number of turns unwound from the coil.

Further objects are to provide a counter having the characteristics set forth above which combines a selector switch responsive to the direction of rotation of the coil with an electronic counting system which is so made that it is controlled from a beam of light related to the coil in such a manner that a pulse is transmitted through the electronic counter for each revolution of the coil, without requiring contact with the coil.

In greater detail, further objects are to provide the combination of a light source, an electronic counter, an electromagnet recorder, and selector means to secure positive and negative operations of the electromagnet recorder corresponding to the winding of wire on the coil or the unwinding of wire from the coil.

Further objects are to provide a counting device for any desired use in which a thyatron is employed and controlled by vacuum tubes and in which switch means are provided for interrupting the plate current of the thyatron only after a complete operation of an electromagnet recorder, to thus positively insure completion of the operation of the recorder for each pulse passing to the thyatron.

Further objects are to provide a counting device which is controlled directly from a unitary part of the coil assembly or coil structure, so that if slipping of the coil assembly or coil structure with reference to the winding machine occurs, no false counting will take place.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is a diagrammatic view showing the electrical system employed in one form of counter.

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Figure 2 is a face view of one form of magnetic register.

Figure 3 is a face view of a further form of magnetic register.

5 Figure 4 is a fragmentary view of a modified form that the counter may take.

Figure 5 is a fragmentary view showing a portion of a winding machine with the selector switch operatively coupled thereto.

10 Figure 6 is a sectional view on the line 6—6 of Figure 5.

Referring to Figure 1, it will be seen that the counter is so arranged that a source of light indicated by the reference character 1 is adapted to concentrate, by means of a lens 2, a beam of light on a narrow reflecting strip 3 placed on the end edge of a shell or sleeve 4 on which a magnetic coil is being wound. The reflecting strip may be a narrow strip of silver paper cemented on the end edge of the sleeve 4, as shown in Fig. 5, or may be of any other suitable material. The beam of reflected light is concentrated by means of a lens 5 onto a photoelectric cell 6. The photoelectric cell has an anode 7 and a light sensitive cathode 8 or may be of any of the usual types.

25 The photoelectric cell is adapted to control the first vacuum tube 9 in the system. This vacuum tube is preferably a sharp cut-off type of tube and is provided with an indirectly heated cathode 10, a control grid 11, a screen grid 12, a suppressor grid 13, and a plate 14. The plate is supplied from any suitable source of direct current through a resistor 15. The positive terminal of the source of high voltage direct current is indicated by the reference character 16, the negative terminal by the reference character 17. A suitable source of current is supplied the filament 18 of the vacuum tube. The positive and negative terminals of the high voltage source of supply are connected by means of a potentiometer arrangement indicated generally by the reference character 19 so that suitable voltages may be impressed upon the screen grid 12 and the anode 7 of the photoelectric cell 6. The cathode 10 of the tube 9 is preferably connected at such a point as to produce a negative bias on the control grid 11 provided there is no energization of the photoelectric cell 6 to thus provide for either substantially reducing the current flowing in the plate circuit or else completely stopping such current

flow. An amplifier tube 23 has its control grid 21 connected to the plate 14 of the tube 9 by means of a blocking condenser 22, a grid leak resistor 23 and a cathode resistor 24 being connected to the negative terminal 17. The cathode and the plate of the amplifier tube 23 are respectively indicated by the reference characters 25 and 26. The plate 26 of the amplifier tube 23 is connected through a resistor 27 with the positive terminal 16.

A thyatron is controlled from the amplifier tube and is indicated at 28. Its control grid 29 is connected by means of a blocking condenser 30 with the plate 26 of the tube 23, a suitable grid leak resistor 31 being connected between the grid 29 and the negative terminal 32. The thyatron is preferably supplied from a separate high voltage source of current, the negative terminal 32 of which is preferably connected to the negative terminal 17 of the first source of high voltage current. The positive terminal of such second high voltage source is indicated by the reference character 33. The cathode 34 of the thyatron is connected at a suitable point to the potentiometer 35 connected between the terminals 32 and 33 so as to provide a suitable negative voltage for the control grid 29.

The terminal 33 is connected through a resistor 36 with one side of each of the two coils 37 and 38 of an electromagnetic counter or register indicated generally by the reference character 39. This electromagnetic counter is adapted to operate one or the other of a pair of armatures so that one armature records a plus count and the other armature subtracts from this plus count, depending on which of the two coils 37 or 38 is energized. This type of register is indicated at 39' in Figure 2.

If desired the register may take the form indicated at 39'' in Figure 3 and may have a positive scale 40 and a negative scale 41 for respectively registering the number of positive or negative counts. As stated, any suitable type of electromagnetic register can be employed.

The means for determining which of the two coils 37 or 38 shall be energized may take the form of the selector switch indicated generally by the reference character 42 in Figure 1. This selector switch consists of a movable switch arm 43 which is adapted to engage either the stationary contact 44 or the stationary contact 45, depending on whether the coil is rotated in a positive direction to wind wire thereon or in a negative direction to unwind wire therefrom. If it is assumed, for instance, that the positive direction of rotation of the coil is as indicated by the arrow at the left-hand side of Figure 1, it may be assumed that the direction of rotation of the selector switch arm 43 is in the direction indicated by the arrow at the right-hand side of Figure 1. The selector switch is so arranged that it is held in engagement with the stationary contact 44 as long as the coil is rotating in a direction to wind wire thereon. Consequently the magnet coil 33 of the registering counter will be the one energized whenever the thyatron 23 fires as the selector switch arm 43 will maintain the magnet coil 33 in electrical connection with the plate 46 of the thyatron 23. On the other hand, if the wire is unwound from the coil, that is to say, if the shell 4 is rotated in the reverse direction from that shown by the arrow in Figure 1, the selector switch is so made that it will move into and remain in engagement with the stationary contact 45 and the subtracting magnet coil

37 will then be in electrical connection with the plate 46 of the thyatron 23 so that each time the thyatron fires, one count will be subtracted from the counter 39' or register on the negative scale of the counter 39''.

The filament 47 of the amplifier tube 23 and the filament 13 of the first tube 9 may be heated from the same source if desired. It is preferable to have a separate source for heating the filament 48 of the thyatron 28.

Any suitable type of coil winding machine can be employed, for instance that shown in Patent No. 2,305,999 of December 22, 1942, issued to A. G. Steinmayer et al. for Method and machine for winding coils. This coil winding machine may be arranged to rotate the shell or sleeve 4 in the manner set forth in the above noted patent, suitable rollers 49 being provided for carrying the flange 50 of the shell. From some rotating portion of this machine, for example from one of the rollers 49, a shaft 51 may project. This shaft is operatively coupled by means of a friction device with the selector switch arm 43. This friction device may comprise an insulating disk 52 loosely mounted on the shaft 51 and in contact with the collar 53 rigid on such shaft. The disk 52 may have rigidly attached thereto a wear plate 54 against which a friction member 55 is urged by means of the spring 56. The friction member 55 is loosely splined as indicated at 57 to the shaft 51 so that it rotates with such shaft. It is apparent, therefore, that when the shaft rotates in the direction indicated for the positive winding of wire on the shell 4, the switch arm 43 will be moved to the right as viewed in Figure 6 and held in engagement with the stationary contact 44 as long as wire is being wound on the shell 4. However, if the direction rotation of the shell is reversed, the selector switch arm 43 will move over into contact with the stationary contact 45.

The operation of the apparatus is as follows: Assuming that the shell 4 is being rotated in a positive direction to wind wire thereon, it is apparent that as the reflecting spot or strip 3 passes the position shown in Figure 1, a beam of light will be thrown onto the photoelectric cell 6 and will cause current to flow in the plate circuit of the tube 9. This will cause a negative pulse to be imparted to the control grid 21 of the amplifier tube 23, thus reducing the current flow in the plate circuit of such amplifier tube and causing a positive pulse to be transmitted to the control grid 29 of the thyatron 23. This will cause the thyatron 23 to fire and consequently will cause energization of the positive counting magnet coil 38. The magnetic register or counter 39 is so arranged that when the coil 33 is energized, it closes the switch indicated by the reference character 58 and this switch is arranged to connect the plate 46 of the thyatron with one side of a condenser 59, the other side of the condenser being connected to the cathode 34 of the thyatron. In view of the fact that a dropping resistor 36 is in the plate circuit of the thyatron 23, it is clear that the voltage between the plate and the cathode 34 will momentarily drop to approximately a zero value as the condenser 59 begins charging. This will interrupt the plate flow through the thyatron, though the thyatron is supplied with direct current. The thyatron will not restrike as the effect of the initiating pulse on its grid has ceased. The positive counting magnet coil 38 will thus be deenergized and no further current flow will

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occur in the plate circuit of the thyatron. A suitable leak resistor 60 is bridged around the condenser 59. The time constant of the circuit consisting of the condenser 59 and resistor 60 is sufficiently small so as to allow the requisite rapidity of operation of the system, that is to say, the time constant of the resistor and condenser combination is much less than the period for one revolution of the shell 4. A switch 58', similar to the switch 58, is provided for the coil 37.

It is apparent, as has been previously described, that if wire is unwound from the coil 4, the selector switch will connect the negative counting magnet coil 37 in the plate circuit of the thyatron 28 and this will either cause a subtracting in the total count for the electromagnetic counter indicated in Figure 2 or the registering of the negative count on the scale 41 of the electromagnetic counter shown in Figure 3.

The invention may take other forms. For instance, the thyatron indicated at 61 may be substituted for the thyatron 28. In this system the same selector switch arrangement is employed as that previously described. However, a resistor 62 is connected between the high voltage terminal 33 and the selector switch arm 43. The stationary contact 44 is connected to one side of the positive counting magnet coil 63 and the stationary contact 45 is connected to one side of the negative counting magnet coil 64. The switches 65 and 66 associated with the magnet coils 63 and 64 are normally closed and are temporarily opened whenever their respective magnet coils are energized. The switch 65 or the switch 66, depending on which coil is being energized, is arranged to open the plate circuit of the thyatron 61 and thus interrupt current flow through the thyatron so that the thyatron will come back to its initial condition ready for the next impulse.

Obviously any suitable type of thyatron could be employed in either form of the invention. In the form shown in Figure 4 a screen grid type of thyatron is shown, the screen grid being indicated by the reference character 68 and the control grid by the reference character 69. The screen grid in the form shown in Figure 4 may be connected to the cathode 70 as indicated or may be connected at any suitable point between the positive and negative terminals 33 and 32, depending upon the conditions of operation desired.

It will be seen that a novel form of counter has been provided which is of extremely simple construction, which utilizes a thyatron to control the magnet coils of an electromagnetic counter, and which though employing direct current in the plate circuit of the thyatron nevertheless is so constructed that it mechanically stops the flow of current in the plate circuit of the thyatron after firing of the thyatron has once been initiated but only after the electromagnetic counter has executed one complete operation. This invention, therefore, secures a sufficient length of time for the current flow from the last tube to insure operation of the electromagnetic counter and also enables the relatively heavy current carrying thyatron to be used although direct current is supplied its plate circuit.

It will be seen further that the counter can be operated at very rapid rates with assurance of an accurate count.

It is to be noted also that by the combining of the selector switch with the electromagnetic portion of the counting system a positive and a negative count can be had to thus allow the opera-

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tor to unwind turns from the magnet coil being formed on the winding machine with assurance that the counter will accurately register the total number of remaining turns or will indicate the total number of positive turns and the total number of turns to be subtracted therefrom.

Although the counting device has been described and illustrated as applied to the counting of the number of turns of wire wound on a coil, it could be used for other purposes and is not to be limited solely to a coil counter except when so limited in the claims.

If it is desired to have the counting occur on the interruption of a light beam instead of on the initiation of the light beam as shown, this could easily be accomplished by adding an amplifying tube like the tube 20 of Figure 1 and connecting it in cascade to the tube 20 by blocking condensers and resistances as has been shown for the tube 20.

Also, it is obvious if the desirable features of the thyatron were not desired a suitable grid controlled vacuum tube could be substituted for the thyatron. In this case the switches 58 and 58' of Figure 1, 65 and 66 of Figure 2, would be omitted. However, the selector switch 42 would still be employed.

The use of the thyatron is preferred, for the thyatron's plate current is arranged to continue flowing until it is stopped by the completion of the operation of the electromagnetic counter. This insures a complete and positive operation of the electromagnetic counter even at a very high rate of counting.

It will be seen further that a counting system has been provided by this invention which has a powerful effect sufficient to operate any of the usual electromagnetic registering counting devices although the system employs only a small number of tubes.

It is to be understood that although thyatrons have been specifically described that they are to be regarded as merely one of any suitable form of trigger type space discharge device.

The expression "light" is intended to cover either visible or invisible light, and the reflecting member 3 is merely one example of means for controlling the beam of light.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. An electronic counting device comprising a revoluble member, initiating means for initiating electrical impulses in accordance with the revolutions of said revoluble member, electronic means controlled from said impulse initiating means, electromagnetic means controlled from said electronic means and arranged to selectively count in a positive or negative sense, and selector switch means responsive to the direction of rotation of said revoluble member and arranged to determine the sense in which the electromagnetic counting means will count, said impulse initiating means and said selector switch means being separate means.

2. An electronic counting device comprising a revoluble member, initiating means for initiating electrical impulses in accordance with the revolutions of said revoluble member, electronic means controlled from said impulse initiating means, electromagnetic means controlled from said electronic means and having a positive and

a negative counting portion and arranged to selectively count in a positive or negative sense, and selector switch means responsive to the direction of rotation of said revoluble member arranged to selectively direct the impulses to said positive or negative counting portion of said electromagnetic means and arranged to determine the sense in which the electromagnetic counting means will count, said impulse initiating means and said selector switch means being separate means.

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