

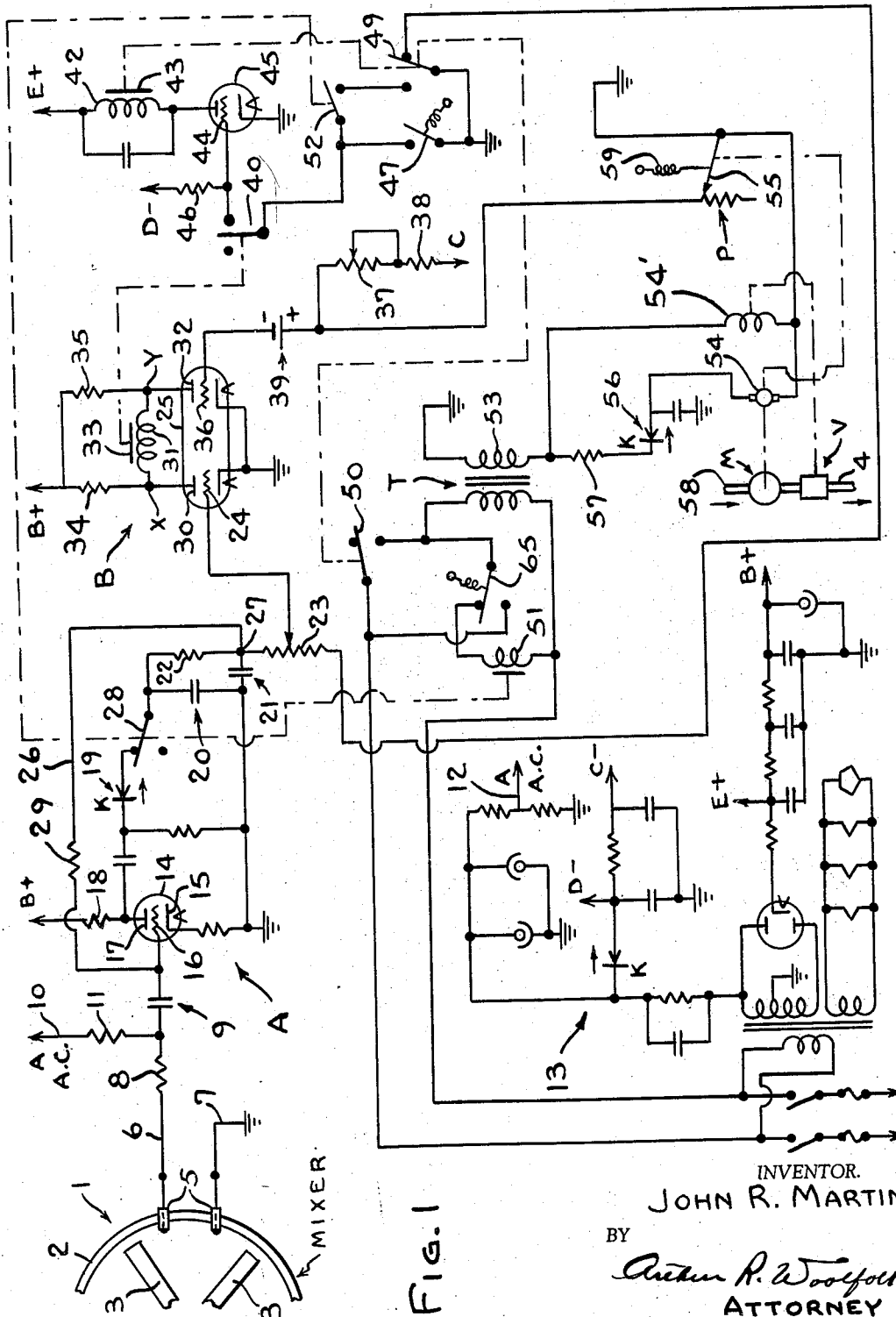
Oct. 21, 1958

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APPARATUS FOR CONTROLLING THE TOTAL LIQUID
CONTENT OF AN AGGREGATE

2,856,948

Filed Sept. 28, 1956

2 Sheets-Sheet 1



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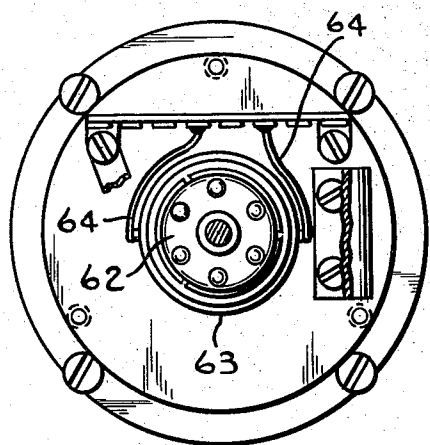
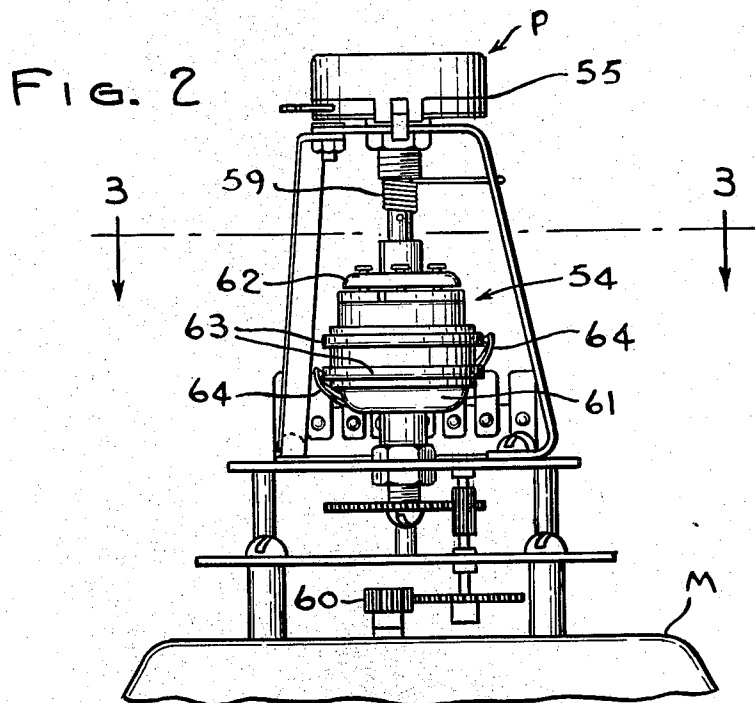


FIG. 3

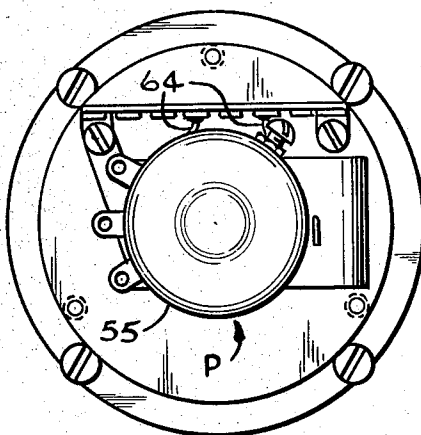


FIG. 4

INVENTOR.
JOHN R. MARTIN

BY

Arthur R. Woolfolk
ATTORNEY

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APPARATUS FOR CONTROLLING THE TOTAL LIQUID CONTENT OF AN AGGREGATE

John R. Martin, Milwaukee, Wis., assignor to Edick Laboratories, Inc., Milwaukee, Wis.

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8 Claims. (Cl. 137—88)

This invention relates to an apparatus for maintaining a certain predetermined total liquid content in an aggregate such as concrete for instance.

For the sake of simplicity in the description and in the claims of this application the term "aggregate" will be replaced by the term "concrete," and the term "liquid" will be replaced by the term "water." It is distinctly understood that this simplification of nomenclature is not to be interpreted in any sense as limiting.

This invention primarily relates to maintaining a certain total water content in a concrete mixture. It nevertheless is applicable to the maintaining of a certain predetermined total liquid content in any aggregate.

For any given batch of concrete, it is desirable that a uniform mixture be maintained, so that the water content in successive charges is identically the same so far as the total water content is concerned in the finished mixture.

In other methods of mixing concrete it has been the usual practice to add a fixed total quantity of water to each individual charge of concrete while it is being mixed. This has not proven satisfactory since even for a large, single batch of concrete the initial water content of each individual charge therefrom varies. For example, in a large batch of concrete which is to be mixed, the outer surface of the mixture may have a very much higher initial water content than the inner portion of the batch. Consequently, if a fixed quantity is added to each charge while it is being mixed, the total quantity of water in the final mixture for each successive charge will vary widely, and the concrete, therefore, will vary in consistency beyond the desired limits or tolerances.

Specifically this invention relates to an apparatus for measuring first the initial water content of the concrete, determining the total water content of the concrete that is desired in the final product, and subtracting the initial water content from the total water content desired, and adding the difference in the water to the mixture while it is being mixed, thereby maintaining for all successive charges from a given batch of concrete, identically the same total water content.

In greater detail, further objects of this invention are to provide an apparatus which is electronically operated and which is wholly automatic, and which obtains the above desirable results without any thought on the part of the operator after the initial setting for the total water content in the finished mixture has been made.

Further specific objects are to provide an apparatus for securing the above desired results, which is so made that it will reset itself for each cycle so that it starts out fresh for each cycle of operations, and will automatically measure the initial water content and add a sufficient quantity of water to obtain a total predetermined water content in the finished mixture for each successive charge from a given batch of concrete.

A further specific object is to provide a novel form of meter which will measure the water flowing into the mixture and which will automatically relay the information

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indicating the quantity of water that has flowed through the meter, and which will cut itself off and stop the water flow when a predetermined amount of water, automatically called for by the apparatus, has been added to the mixture, and which will reset itself for a further operation, all of this being obtained in an automatic manner.

Further objects are to provide a meter for measuring the total quantity of water flowing therethrough, and for providing a means for resetting the meter and cutting off the flow of water when a predetermined quantity has passed through the meter.

Further objects are to provide a novel form of meter which will measure the water flowing therethrough, which is provided with an electromagnetic clutch which disconnects a rheostat operated by the meter from the meter itself, and which returns the rheostat to its zero position when the clutch opens and when the meter ceases to operate, and which simultaneously closes a valve controlling the flow of water through the meter.

Another method that has been tried is to continually measure the moisture content of the mixture while it is being mixed, and while water is being added, and to attempt thereby to get a continuous indication of the moisture content, at least in the zone of the electrodes extending into the mixture. This has not proven satisfactory. If the water is added too rapidly, it is obvious that the mixture is not homogeneous, and consequently the reading is inaccurate, and does not truly represent the moisture content. If the water is added too fast or all at once, it is obvious that the lower portion of the mixture will have all of the water in it, and the upper portion will have very little, and consequently the position of the electrodes themselves has a determining effect on the indicated moisture content of the mixture. It is readily apparent that if the water is added too fast or all at once it will immediately go to the bottom of the mixer, and if the electrodes are in the lower part of the mixer, it will indicate an excessive amount of water long before enough water has been added. On the other hand, if the electrodes were located in a higher point, it will indicate a lesser amount of water than has actually been added to the mixture.

Further objects of this invention are to provide an apparatus which is so arranged as to allow water to be added to mixture at any rate desired without varying the consistency of the final product, that is to say, without varying the value of the water content for successive charges. In other words, a further object is to provide a means whereby the water may be added all at once if desired, or may be added at any rate desired without affecting the consistency of successive charges.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a wiring diagram of the apparatus.

Figure 2 is a side elevation of the water meter.

Figure 3 is a sectional view on the line 3—3 of Figure 2.

Figure 4 is a plan view of the water meter.

Referring to the drawings, particularly Figure 1, it will be seen that the device comprises a memory or measuring portion A, or system, a comparison portion or comparison circuit or system indicated generally by the reference character B, a water meter indicated generally by the reference character M, and a solenoid valve or electromagnetic valve indicated generally by the reference character V.

The concrete mixer is indicated by the reference character 1, and comprises an outer shell 2, or casing or main container, which is stationary, and mixing means, indicated generally by the reference character 3, which rotates within the concrete mixer. Further it is to be understood that in accordance with the usual practice, the dis-

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charge section of the water system indicated by the reference character 4, conveys water into the concrete mixer 1 in the usual way.

A pair of electrodes 5-5 project through the shell or casing of the concrete mixer and are insulated therefrom and are connected to the conductors 6 and 7 respectively, the conductor 7 being grounded.

The conductor 6 leads to the memory portion or measuring portion indicated generally by the reference character A, and is connected thereto through a resistor 8, and a condenser 9. Between the resistor 8 and the condenser 9 alternating current is supplied by the conductor 10 through a resistor 11. The conductor 10 connects with the regulated A. C. supply lead 12 of the power supply system or portion. The power pack or supply portion is indicated generally by the reference character 13.

The portion A is provided with a vacuum tube 14 having a cathode 15, a grid 16, and a plate 17. The plate 17 is connected to the B plus portion of the power supply through a resistor 18. The grid has impressed thereon the alternating current passed through the condenser 9 whose amplitude varies in accordance with the resistance between the electrodes 5 in the concrete mixer, as shown, or between one electrode and the casing of the mixer. The portion A of the system constitutes an alternating current amplifier. The amplitude of the alternating current impressed on the grid 16 of the tube 14 increases as the dryness of the mixture increases and consequently as the resistance between the electrodes 5 increases, and decreases in accordance with the increase in moisture content of the concrete mixture which, as will be readily understood, lowers the resistance between the electrodes 5 as the moisture content increases.

The device thus far described is in reality an alternating current amplifier. The output is rectified by the rectifier 19, and serves to charge the condensers 20 and 21 which are of relatively large capacity, the condenser 20 having the larger capacity and serving additionally to directly by-pass the alternating current or fluctuating component of the amplified current to the ground.

The condensers are bridged by the resistors 22 and 23, resistor 23 constituting a potentiometer so that the voltage impressed on the grid 24 of the comparison or subtracting tube 25 can be adjusted to the desired value. This adjustment is made in the factory and is usually not disturbed. It is made so as to bring the voltage within the range of the first section of the comparison tube 25 of the comparison unit or subtracting unit or portion B.

In each instance where a rectifier, such as the rectifier 19 has been shown, the cathode is indicated by the letter K and the electron flow by the arrow.

There is an additional circuit in the memory system or measuring unit A. This circuit consists of a bridging conductor 26 which starts from the grid side of the tube 14 and extends to the point 27, or end of the potentiometer 23, and serves to renew any charge that has leaked from the condensers, and to thus maintain the memory, or in other words, the condenser charges, at their original point, after this switch 28 has been moved from the closed position shown in the Figure 1 to the open position in the manner hereinafter described. A resistor 29 is placed in the bridging circuit 26. The comparison unit or subtracting unit is provided with two main sections in the tube 25, one of which is controlled by the grid 24 and has its plate connected to one side of the polarized relay 31. The plate 32 of the other tube section is connected to the other side of the polarized relay 31. The armature of such relay is indicated by the reference character 33.

Resistors 34 and 35 are placed in the plate leads between the B supply and the polarized relay 31.

The purpose of the comparison circuit, or unit B or subtracting unit, is to compare the voltage impressed on

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the grid 24 of the first tube section with the voltage impressed on the grid 36 of the second tube section of the comparison or subtracting tube 25. The voltage impressed on the grid 36 is a constant voltage when the potentiometer P, hereinafter described, is at zero. The potentiometer 37 is connected through a protective resistor 38 to the point C of the power supply unit, and thus has a negative potential impressed thereon. The steady voltage or fixed voltage is supplied from any steady voltage source such as the battery 39.

It is to be noted that the polarized relay 31 moves the switch 40 to the right as viewed in Figure 1, when the plus voltage at the point X exceeds the positive voltage at the point Y, and moves the arm 40 to the left as viewed in Figure 1 when the positive voltage at the point Y exceeds the positive voltage at the point X. The polarized relay 31 controls the operation of the electromagnet switch element 42 whose armature is indicated by the reference character 43. It is apparent that the grid 44 of the tube 45 is connected to the point D of the power supply through a resistor 46 so that the tube is paralyzed under normal conditions, or in other words, completely blocked by the high negative voltage normally impressed on its grid, when the switch 40 is in the position shown in full lines in Figure 1.

When the switch 40 is rocked to the left, or in other words, when it is opened, the tube 45 is completely blocked and the electromagnet 42 is not energized. When the switch 40 is closed, a circuit is formed leading to the manually operable starting switch 47, which is biased towards open position as shown. When the switch 47 is moved to the left, or in other words, is closed, the grid 44 of the tube 45 is directly grounded and the tube 45 conducts, and thus energizes the switch element 42 and moves the armature 43 to thereby close the switch 49 and simultaneously close the switch 50 for the purpose hereinafter to appear.

The switch 50 controls the operation of the electromagnet unit 51 which opens the switch 28 previously described, and closes the normally open switch 52. It is obvious that when the switches 49 and 52 are closed that a holding circuit is established for the tube 45 which maintains energization of the electromagnet unit 42 hereinafter described.

When the switch 28 is open the memory unit or measuring unit maintains the memorized information in the form of the negative voltage impressed on the condensers 20 and 21. Any leakage of these condensers is immediately supplied by the bridge circuit 26, so that the memorized signal will not vary, but will be maintained at the automatically selected value.

The setting of the potentiometer 37 determines the total moisture content in the finished concrete mixture. This total moisture content is predetermined by the selection of the operator for the particular batch of cement that is to be mixed in successive charges. It is the purpose of this invention to maintain the total final moisture content of the cement mixture in its finished state exactly the same for all of the successive charges that are placed in the cement mixer.

The closing of the switch 50 also completes the primary circuit of the transformer T, whose secondary 53 supplies alternating current to the electromagnet 54, which controls the electromagnetic valve. The valve, as a unit is indicated generally by the reference character V.

The water meter M starts functioning as soon as the valve V is opened, and this water meter M operates a potentiometer P through a clutch unit indicated generally by the reference character 54. The clutch 54 is an electromagnetic clutch, and is energized by direct current, through the medium of the rectifier 56, and through a protective resistor 57. It is apparent, therefore, that as soon as the switch 50 is closed that the electromagnetic valve V opens and the water passes from the pipe 58 and through the meter M, into the mixer. The operation

of the meter moves the potentiometer member 55 through reduction gearing in accordance with the amount of water which passes through the meter M. Potentiometer or resistor 55 is spring biased, as diagrammatically indicated in the Figure 1 by means of the spring 59, so that it returns to its zero position when the clutch is open, and the electromagnetic valve V is closed. The details of the meter, clutch and potentiometer or resistor unit will be described in detail hereinbelow.

Referring to Figures 2, 3 and 4, it will be seen that the water meter M has its driving pinion 60 connected through gearing to the lower element or unit 61 of the electromagnetic clutch, indicated generally by the reference character 54, the movable portion being indicated by the reference character 62. The potentiometer or resistor unit is indicated generally by the reference character P in Figure 1 and Figure 2, and Figure 4. Slip rings 63 and brushes 64 are provided for conveying direct current to the electromagnetic clutch 54. The electromagnetic clutch is energized whenever the electromagnetic valve is open and the water meter running as previously described.

It is to be understood that the variable resistance unit P may in reality be either a rheostat type or potentiometer type, a rheostat type being shown in Figure 1. Obviously if a potentiometer type is used it could be connected in a bridged circuit to indicate the total water which has flowed through the meter for any given period of operation. This feature forms no portion of the invention. It is merely put in to explain why it might be desirable to use a potentiometer type for the variable resistor P, which is called a potentiometer for the sake of clearness and brevity in this description.

It is preferable to use electrolytic condensers for the condensers 20 and 21, as their resistance, or in other words, their leakage resistance varies as a function of the impressed voltage.

The electric clutch, variable resistor, and water meter form a very important portion of this invention, and the disclosure and description is intended to illustrate a self-restoring unit consisting of the above elements. This unit is so made that the value of this resistor is determined by the length of operation of the meter, or in other words by the amount of water which has passed through the meter. Also it is apparent that the self-restoring feature, hereinabove described, allows the clutch to open upon cessation of water flow through the meter, and thereby allows the unit to reset itself automatically to its zero position, so it is ready to start again on the next cycle of operation.

While a rheostat has been shown as being controlled by the meter, it is to be understood that a potentiometer or other device of this nature could be used in place of a rheostat if it were desired, for example, to indicate on an electric meter the added quantity of water. However, this forms no portion of the specifically claimed invention.

It will be seen that the invention consists of the following named units:

It consists of the measuring unit or memory unit A, which measures the initial water content of the mixture and memorizes the measurement. This is the first element of the device.

The second element is the comparison unit or subtracting unit B which compares the memorized voltage with a fixed predetermined voltage to thereby maintain all of the successive charges at the same final consistency, that is to say, with the same final total water content.

The total final water content is made up of the sum of the initial water content and the added water content. This feature of the apparatus is highly desirable, and produces a very useful result, which has not heretofore been obtained. This result is obtained by measuring and memorizing the initial water content of the original concrete mixture which is recorded as a charge in the condensers.

This initial water content is subtracted from the desired total water content which is determined by the setting of the potentiometer 37. The difference between the total final water content and the initial water content is added by adding that amount of water to the concrete mixture corresponding to the difference between the final total water content and the initial water content.

This device, therefore, does not add a fixed amount of water to each successive charge placed in the concrete mixer. Instead it adds a different quantity for each successive charge of concrete if the successive charges vary in initial water content. This is done automatically by the subtraction hereinabove described, the subtraction itself being automatically electronically obtained. Thus the total water content, or final water content in the finished mixture is maintained exactly the same for each successive charge of concrete. The added water varies for each successive charge wherever there is a variable amount or different amount of water in the initial concrete mixture before any water has been added. This is a very important and novel feature of the device. When the requisite amount of water has been supplied to the mixture in accordance with the subtraction hereinabove described, the polarized relay or switch 31 opens the switch 40 thereby deenergizes the electromagnet element 42, and opens the switch 49, and the switch 50, and deenergizes the electromagnet unit 51 and closes the switch 28, and opens the switch 52, and thus completely resets the device so that the parts stand in the position shown in Figure 1. The electromagnetic water valve closes and the water stops flowing. The water meter resets itself. The device is therefore ready for the next cycle, which is started by temporarily closing the starting switch 47.

Referring to Figure 1 it will be seen that a switch 65 is held by means of a spring in the position shown. This switch forms no portion in the automatic operation of the device. However, when the switch 65 is pressed downwardly, as viewed in Figure 1, it stops the operation and allows the apparatus to reset itself. This is a momentary opening of the switch manually. However, if the switch 65 is pressed all the way down so it contacts the lower contact shown in Figure 1, it will cause water to flow into the mixer by energization of the electromagnetic valve V. This however, is an independent operation, and is merely for the convenience of the operator, and plays no part in the automatic operation of the device.

The expression "electronic" is to be understood as not being limited to vacuum tubes or similar devices, but to include any electrical device responding to electrical energy.

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. In an electrical device for adding liquid to an aggregate while the aggregate is being mixed to secure a predetermined total liquid content for the finished mixture, means for measuring the electrical resistance of the aggregate to determine the initial liquid content of the aggregate, means for registering the initial quantity of liquid in the aggregate, adjustable means for determining the total liquid content in the finished mixed aggregate, a liquid meter, a liquid controlling valve, and automatic means controlling the valve and the meter for supplying the requisite amount of liquid to the aggregate corresponding to the difference between the desired total liquid content and the measured initial liquid content of the aggregate.

2. In a device for maintaining a predetermined total water content in a concrete mixture comprising memory means including electronic means and condenser means and characterized by the fact that its condition corresponds to information supplied the memory means by voltage im-

pressed on the condenser means, and characterized further by the fact that the memory means retains its condition during the entire cycle for one batch of the mixture, means for automatically measuring the water content initially present in the concrete mixture and for automatically supplying this information to the memory means, a water meter, a water valve, means for developing a voltage corresponding to the total desired water content and for maintaining such voltage for a plurality of batches of the mixture, and electronic subtracting means for subtracting the initial water content from the total desired water content by subtracting the first mentioned voltage from the second mentioned voltage and coacting with the meter and the valve to supply to an amount of water corresponding to the difference.

3. In a device for maintaining a predetermined total water content for successive charges of a mixture comprising memory means including electronic means and condenser means and characterized by the fact that its condition corresponds to the initial water content of the mixture, resistance measuring means for measuring the initial resistance of the mixture to determine the initial water content and supplying this information to the memory means by determining the said voltage, a water meter and a cut-off valve, said water meter having adjustable resistance means operated from said meter, adjustable means for determining the total water content by developing a voltage corresponding to the total desired water content, and electronic subtracting means for subtracting the initial water content from the total water content by subtracting the first mentioned voltage from the second mentioned voltage, said subtracting means and said meter and said valve automatically coacting to supply to the mixture the difference in the total water content and the measured initial water content, said meter being self-restoring to its initial position at the end of a cycle.

4. In a device for maintaining a predetermined constant total water content in successive concrete mixtures, electronic means for measuring the initial water content of the mixture, and including a condenser which is charged to a voltage corresponding to the initial water content of the mixture, adjustable means for determining the total water content of the finished mixture, electronic subtracting means for subtracting the voltage corresponding to the initial water content of the mixture from a voltage corresponding to the total water content desired, a self-restoring water meter including adjustable resist-

ance means whose value is controlled by the water meter for determining a voltage corresponding to the amount of water added to the mixture, a water valve, and electrical means for closing the water valve when the voltage corresponding to the adjustable resistance means of the water meter bears a predetermined relation to the voltage supplied from the subtracting means.

5. A self-restoring liquid measuring means comprising a meter, adjustable resistance means having a movable member for varying the resistance; and a clutch interposed between the meter and the movable member of the adjustable resistance means, and means for returning the movable member of the adjustable resistance means to its initial position when the clutch opens.

15 6. A self-restoring liquid measuring means comprising a meter, a variable resistor having a movable member for varying the resistance thereof, reduction mechanism between the movable member and the meter, and an electromagnetic clutch interposed between the meter and the movable member of the variable resistor, and a spring for returning the removable member of the variable resistor to its zero position when such clutch opens.

20 7. A self-restoring liquid measuring means comprising a meter, a variable resistor having a movable member for varying the resistance thereof, reduction mechanism, and an electromagnetic clutch interposed between the movable member of said variable resistor and the meter, and a spring for returning the movable member of the variable resistor to its zero position when said electromagnetic clutch is opened.

30 8. A self-restoring liquid measuring means comprising a meter, reduction gear mechanism driven by said meter, a variable resistor having a movable member for varying the resistance thereof, said movable member being driven from said meter through said reduction gear mechanism, an electromagnetic clutch interposed between the movable member of said variable resistor and said reduction gear mechanism, and a spring for returning the movable member of said variable resistor to its zero position when said electromagnetic clutch is opened.

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