

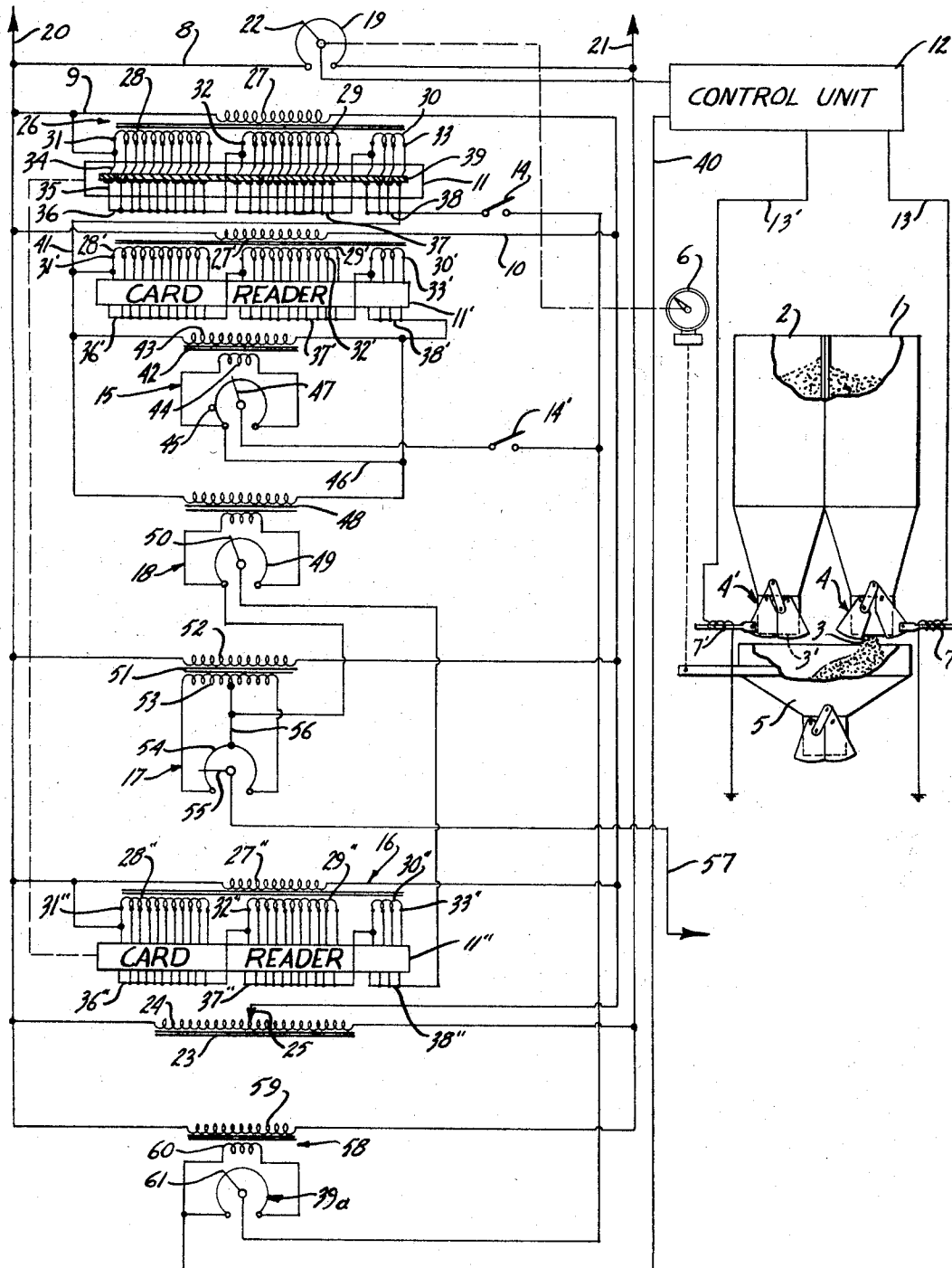
March 25, 1969

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3,434,556

BATCHING CONTROL SYSTEM

Filed March 22, 1965



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3,434,556

BATCHING CONTROL SYSTEM

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Filed Mar. 22, 1965, Ser. No. 441,461

Int. Cl. G01g 19/38

U.S. Cl. 177-70

18 Claims

ABSTRACT OF THE DISCLOSURE

A material batching system having quantity preset transformers for various materials. Each transformer includes a primary winding and an isolated tapped secondary. The primaries are connected in parallel to an adjustable batch size transformer. The secondaries are divided into separate typed sections and selectively connected in an output circuit through a punch code card reader in which the material to be delivered is coded. The alternating current outputs of the several preset transformers are selectively and sequentially inserted into a balancing circuit with the A.C. signals cumulatively connected as successive materials are delivered. Moisture compensating transformers are connected in circuit with the preset transformers to compensate for moisture in the products and further may include a "slump" compensating potentiometer for minor adjustment of water variations in a given batch.

This invention relates to a batching control system and particularly to delivering in a sequential manner predetermined quantities of different materials and the like to form a single mixture.

In product processing and manufacture, it is often necessary to intermix predetermined quantities of material. For example, in the making of concrete, stone, sand, cement and water are mixed in predetermined ratios in accordance with a particular characteristic desired. Automatic feed systems are preferably employed to quickly deliver the several materials into a suitable single receiving means and with a minimum amount of manual operations and calculations. Generally, balancing circuits employing preset voltage signals and weight responsive voltage signals have been suggested and satisfactorily employed in automatic mixing of the ingredients for concrete as well as other processes. The circuit may employ either alternating or direct current signals proportional respectively to preset amounts of the several ingredients which signals are sequentially integrated and compared with weight responsive signals to provide the desired mix. For example, U.S. Patent 3,125,176, which issued to A. G. Bale, Jr., et al., discloses a highly satisfactory circuit for cumulative delivery of material for concrete batching or other processing. The present invention is particularly directed to an improved control circuit employing alternating current signals for automatic and sequential delivery of the several materials in accurately metered or measured amounts to a receiving means.

Generally, in accordance with the present invention, a plurality of quantity preset transformers includes a primary and an isolated secondary. The primaries are energized in parallel from a common source. Tap means are provided for selecting various voltages from the secondaries in accordance with the predetermined amount of the related ingredient to be delivered. The alternating current outputs of the several transformers are selectively and sequentially inserted into a balancing circuit, with the A.C. signals cumulatively connected as successive materials are delivered. In some instances, signals may also be selected individually instead of cumulatively. In order

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to provide for variations in the total batch of the mixed material, the primaries of the preset transformers are energized through an adjustable batch-size transformer such that each of the secondary tap means produces a voltage related to the same proportion of the total batch. By proper setting of the batch-size transformer, the materials are automatically and sequentially intermixed in the predetermined ratio. For example, assuming the capacity of a batch size transformer is 1,000 pounds and it takes 250 pounds of stone at full capacity, the same card for full capacity can be inserted with the batch size transformer set at 500 pounds and only 125 pounds will automatically be delivered.

To fully automate the system, the secondaries of each of the transformers can be divided into completely separate sections, each being related to a weighted number position. For example, employing the decimal system, three secondary windings may be provided to read in hundreds, tens, and units for each ingredient with taps on the secondaries related to the decimal digits 0 through 9. Each tap is connected to a related output line through a suitable card reader or other code device such that the amounts of each material to be delivered can be set up in a punch card or the like for automatically conditioning the circuit to deliver various ratios of the several ingredients.

An additional feature of the present invention provides means to automatically compensate for the moisture content of any one of the ingredients; for example, sand. A moisture compensating transformer is connected in parallel with the preselected segments of the output of the corresponding preset transformer. A step-down transformer is employed to reduce the sensed signal to a selected range. A material moisture compensating potentiometer or other similar device is connected across the secondary of the moisture compensating transformer. The outputs of the potentiometer and the preset transformer are series connected in the balancing network and provide a corresponding percentage compensation by increasing the output signal and increasing the wet weight of the material delivered such that the desired dry weight ratio is maintained. A similar water moisture compensating potentiometer may be connected in series with the water circuit to reduce a preset water circuit and thereby reduce the water input by the amount of moisture. A precalibrated "slump" compensating potentiometer is preferably also connected in the water circuit to permit small manual adjustment of the water delivered. This is desirable in order to avoid the necessity of punching a new card for minor water variations, as more fully developed hereinafter.

The drawing furnished herewith illustrates a concrete batching control disclosing the above features and advantages as well as others which will be clear from the following description.

The drawing is a simplified schematic circuit diagram of a concrete batching control.

A typical application of the invention resides in automatic control and delivery of preselected weights of the stone, sand and water for use in preparation of concrete of either a permanent site or in the instance of highway paving from temporary installations set up near the point of use. The illustrated concrete batching system is shown with a single pair of bins 1 and 2, respectively containing stone and sand for simplicity and clarity of explanation. Each of the bins is similarly constructed and controlled and consequently bin 1 will be described with corresponding elements of bin 2 identified by primed numbers.

The bin 1 includes a lower gravity discharge opening 3 normally held closed through a jaw-type gate 4. A weighing hopper 5 is suitably mounted immediately below both of the discharge openings 3 and 3' and coupled

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to a scale 6 to record the cumulative weights of material fed to the hopper 5 from bins 1 and 2. An electromagnetic or solenoid actuator 7 is shown connected to the jaw-type gate 4 to selectively open and close the opening 3. The solenoid actuator 7 is actuated through a control circuit including a material weight responsive branch 8 which produces alternating current output signals proportional to the scale reading, a preset stone section 9 which produces corresponding alternating current output signals in accordance with the weight of the stone to be delivered from bin 1 and a preset sand section 10 which produces corresponding alternating current output signals in accordance with the weight of the sand to be taken from bin 2. The preset sections 8 and 9 each includes a portion of a card reader 11 for establishing selected ratios of sand and stone. The output signals of sections 8, 9 and 10 are selectively fed to a suitable summing or comparator and control unit 12 having a first output line 13 connected to actuate solenoid actuator 7 and a second output line 13' connected to actuate solenoid actuator 7'. A sequence switching unit, not shown, forming a part of unit 12, for example, as in U.S. Patent 3,125,176, provides the sequential connection of power to lines 13 and 13' and related actuation of switches 14 and 14' in the output of sections 8 and 9.

The control circuit further includes a sand moisture compensating means 15 inserted in the output portion of the preset sand section 10 to compensate for the weight of moisture in the sand and cause sand delivery in accordance with the desired dry weight.

A water preset section 16 including a portion of card reader 11 provides an output signal in accordance with the amount of water to be added to the mixture. A "slump" control means 17 and a water moisture compensating means 18 are inserted in the circuit of the water preset section 16. The "slump" control means permits varying the quantity of water from the amount set in the preset section 16. The water moisture compensating means 18 is similar to the sand moisture compensating means 15 and automatically reduces the preset amount of water by the amount of moisture in the sand to be delivered to hopper 5.

In operation, the preset signal of section 9 is established through the switching mechanism to insert a signal related to the quantity of stone to be discharged from bin 1. Stone is then fed to the hopper 5 and recorded on the scale 6. Section 8 provides a progressively increasing corresponding signal and when a balance is obtained, the output of the unit 12 de-energizes the solenoid actuator 7 to close the gate 3. Switch 14 is also opened and switch 14' closed by the unit 12 and inserts, in a cumulative manner, the signal from the sand preset section 10 which signal corresponds to the sand to be taken from bin 2 to provide the desired ratio of sand and aggregate. Consequently, the unit 12 is again unbalanced and establishes an output signal at line 13' due to the switching action to actuate the solenoid actuator 7' and thereby feed sand into the hopper 5. The scale 6 reflects the increased weight as sand is added and continuously increases the output of the weight responsive section 8 until a new balance is obtained. The moisture compensating means 15 increases the preset signal of section 10 by the moisture content of the sand in bin 2 and consequently increases the total sand delivered to hopper 5 such that the dry weight corresponds to the preset signal of section 10.

The preset water section 16 produces an output signal proportional to the water ratio. The signal is modified by the "slump" means 17 and the water moisture compensating means 18 to produce an output signal which may be employed to automatically deliver the corrected quantity of water to the mixture. The connection and circuitry of the present invention provides a substantial simplification and reliable alternating current output system adapted to employ a card reader or the like, as presently more fully developed.

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In the illustrated embodiment of the invention, the weight responsive section 8 includes a weight responsive potentiometer 19 connected across a set of alternating current (A.C.) power lines 20 and 21. The arm 22 of the weight responsive potentiometer 19 is coupled to the scale 6 in any suitable manner to be positioned from a zero reading position in accordance with the reading of the scale 6 and consequently the weight of the material in the hopper 5. This alternating current signal is compared with a similarly phased A.C. signal from the preset sections 9 and 10. In commercial practice, the transformer employed may produce signals which have phase differences of the order of 2 or 3 degrees. When employed herein, the terminology in or out of phase includes such signals.

In the illustrated embodiment of the invention, the several sections 9 and 10 are energized from a batch size selection transformer 23 connected across the A.C. power lines 20 and 21.

The batch size selection transformer 23 is shown as an autotransformer having a tapped winding 24 connected between the A.C. power lines 20 and 21. A movable tap 25 is selectively connected to the several taps on the winding 24 to provide a corresponding proportional output voltage which is fed simultaneously to the several sections 9, 10 and 16. Although an autotransformer has been illustrated, the present invention or the circuit could be readily modified to use a transformer with a separate primary and secondary if so desired.

Each of the sections 9, 10 and 16 is similarly constructed for purposes of simplicity. Section 9 is described in detail and the corresponding elements of the sections 10 and 16 are identified by similarly primed and double primed numbers, respectively.

The preset stone section 9 includes a transformer 26 having a primary 27 connected between the tap 25 and the power line 20 and therefore in parallel with a corresponding portion of the autotransformer 23.

The present invention, as previously noted, identifies the several weights of the materials in accordance with a decimal identification system. The transformer 26 includes three separate secondary windings; identified respectively as a units winding 28, a tens winding 29 and a hundreds winding 30. The units winding 28 is connected in common with the one side of primary 27 to line 20 and is provided with ten equally spaced taps 31 providing a stepped voltage related respectively to the decimal digits 0 through 9, respectively. The tens winding 29 similarly includes a plurality of ten taps 32 providing a stepped voltage related to the weights 0 through 90 pounds with each tap 32 providing ten times the voltage of the corresponding taps 31. In the illustrated embodiment of the invention, the hundreds winding 30 is shown with three equally spaced taps 33 and is wound to provide a stepped voltage output related to zero to 300 pounds such that the total output may be related to from 0 to 399 pounds of stone.

The taps 31, 32 and 33 are selectively connected in circuit through card reader 11 which is diagrammatically shown including a plurality of spaced reading brushes 34 connected one each to each of the taps 31 through 33. The brushes 34 are aligned with fixed output contacts 35 which are grouped in accordance with windings 28, 29 and 30. The contacts 35 corresponding with taps 28 are connected in common to a units line 36. Similarly, the taps 32 and the taps 33 are connected to a tens line 37 and a hundreds line 38.

The units line 36 is connected directly to the zero tap 32 of the tens secondary winding 29 and the tens line 37 is similarly connected to the zero tap 33 of the hundreds winding 30. A card 39 is cooperatively positioned with respect to the brushes 34 and includes an opening aligned with each set of taps 31, 32 and 33, respectively, to permit completion of the circuit through one of the respective taps and thereby providing a com-

posite output voltage proportional to a selected preset weight. The composite output signal is connected through the stepping switch 14 and a premature cutoff potentiometer 39a to a preset signal line 40 which is connected to the input of the comparator unit 12 for inserting the preset signal therein for comparison with the weight responsive signal from potentiometer 19.

In the initial setting or operation of the circuit, the stepping switch 14 will be closed to insert the output of the stone section 9 into the comparative circuit and thus provide for accurate measurement and metering of stone from bin 1. The purpose and action of potentiometer 39a is described hereinafter. The sand section 10 will at that time be operatively disconnected from the circuit at switch 14'.

As previously noted, the preset sand section 9 generally corresponds to the stone section 9. The zero unit tap 31' of the sand transformer 26' is connected by a line 41 to the common hundreds line 38 of the stone section 9 for subsequent insertion of the signals from the two sections in series through a stepping switch 14'. The sand moisture compensating means 15 is inserted before a stepping switch 14' and is adapted to modify the output signal of the sand transformer as follows.

The sand moisture compensating means 15 includes a transformer 42 having a primary winding 43 connected between the zero units tap 31' of the units winding 28' and the common hundreds line 38' and thereby energized in proportion to the preset output as determined by the sand portion of card 39. A step-down secondary winding 44 is provided to reduce the output voltage in accordance with a preselected moisture compensating percentage. For example, if a range of 10% compensation is desired, a 10:1 transformer is employed. A potentiometer 45 is connected across the secondary and has its zero position connected by a signal line 46 to the hundreds line 38 of section 10. Tap 47 of the potentiometer 45 is connected by the switch 14' to the line 40.

When switch 14' closes, the preset signal is the summation of two in-phase signals from sections 9 and 10 and the in phase signal from the compensating means 15. This unbalances the unit 12 to operate solenoid actuator 7', open gate 4' and feed sand to hopper 5. The increasing weight actuates potentiometer 19 to rebalance the circuit when the desired wet weight of sand has been delivered to hopper 5.

The primaries 27 and 27' of the preset aggregate transformers are energized from the batch size transformer 23 in accordance with a selected batch size. For example, the batch size selection transformer 23 is graduated in single yard steps from 1 to 10 yards. A maximum output voltage is applied to the transformers 26 and 26' to produce a 10 yard batch. To produce a 5-yard batch, one-half the voltage is applied to the transformers.

Additionally, the present invention automatically provides for a correction in the water added to the concrete by modification of the water signal from preset water section 16.

The preset water section 16 generally corresponds to the sections 9 and 10 and no further description is necessary.

The water moisture compensation means is similar to the sand moisture compensation means 15 and includes a water moisture compensating transformer 48 similarly connected in parallel with the sand moisture transformer 42 to the output of the preset sand section 10. A potentiometer 49 is connected across the transformer 48 and includes a tap 50 ganged with tap 47 to provide a corresponding adjustable output signal proportional to the moisture content of the sand. The tap 50 is connected to the hundreds line 38'' of section 16 and decreases the output of the preset water transformer 26'' by a corresponding amount. Thus, the signal at tap 50 is 180° out of phase with the output of the preset water transformer 26''.

Additionally, the illustrated embodiment of the invention provides the "slump" compensation means 17 whereby the operator modifies the water content directly without modification of the card 39. The wetness of the concrete mix is usually described by the slump characteristic of the concrete. During the normal processing, the operator will check the mixed concrete by placement of a sample in a conical form one foot high and immediately remove the form. A moment later, the drop in the height of the concrete mix, called the slump, is determined. If the material is relatively dry, a low "slump" in the order of one or two inches is obtained. If it is quite wet and has perhaps excess water, the mass may drop into a formless mass having a "slump" of six or more inches. Normal "slump" is required to be in the range of two to four inches.

In accordance with the present invention, the means 17 includes a transformer 51 including a primary 52 connected to the A.C. power lines 20 and 21 through the batch size transformer 23 and a center tapped secondary 53. A center tapped potentiometer 54 is connected in parallel with the secondary 53 and includes a movable tap 55. A line 56 joins the center taps of secondary 53 and potentiometer 54 to provide a zero reference point with the phase of the output signal to opposite sides thereof differing by 180 degrees. The tap connection to the potentiometer is not essential but is desirable for use in establishing the zero reference point. The output of the slump compensating means 17 is connected in series with the water moisture compensating potentiometer 49 and the preset water section 16 by connection of the common line 56 to the zero point of potentiometer 49 and by connection of the tap 55 to an output signal lead 57 which may be selectively connected to energize a water feed means, not shown.

The slump control is highly desirable to permit addition or subtraction from the precalibrated amount of water per yard of concrete from that shown in the prepunched cards. If such slump correction is not provided, it will be necessary to repunch a card for minor water variation.

A premature cut-off means is also preferably provided to compensate for the weight in the column between the gate 4 and the hopper 5 which was not of course recorded by the scale 6 until after the feeding stopped. This compensating signal for premature cutoff may be of a circuitry similar to the moisture compensating means and placed in series with and 180° out of phase with the individual preset sections, as shown.

The premature cutoff means includes a transformer 58 having the primary 59 connected directly across the main lines 20 and 21 and a secondary 60. The potentiometer 39a is connected across the secondary 60 and has the tap 61 connected to the common sides of switches 14 and 14' and one side connected to line 40 to provide an out-of-phase signal in series with the preset signal from the several preset sections. The potentiometer tap 61 is preset in accordance with the weight of the free-falling column of material from opening 3.

If desired, separate premature cutoff circuits as described above may be provided for each individual material and sequentially and separately connected in the circuit. This will permit individual setting of the circuit where the weights of the free-falling columns differ significantly.

The operation of the illustrated embodiment of the invention is briefly summarized as follows.

The desired mixes of sand, stone and water are predetermined in accordance with well known formulas or the like and a prepunched card provided. When a particular mix is desired, a proper card is selected and inserted into the card reader 11 to establish proper output voltages at the stone transformer 26, the sand transformer 26' and the water transformer 26'', respectively. The batch size is set in the transformer 23 by proper posi-

tioning of the tap 25. The water content of the sand in bin 2 is readily determined and the water moisture and the sand moisture compensating potentiometers 45 and 49 set to provide the desired percentage compensation. Thus, if the sand includes 5% by weight of moisture, the potentiometers 45 and 49 usually having a common shaft, are set at one-half scale to automatically increase the output signal from preset sand section 10 and correspondingly decrease the output signal of the preset water section 16 in accordance with that proportion of the total weight of sand delivered. If not known, an initial run of the system provides concrete from which a sample of the concrete is taken and the "slump" factor determined. The "slump" control potentiometer 56 is then set to add or to subtract from the water signal a proportional amount as required to produce a desired slump characteristic. The potentiometer 39a is preset to compensate for the weight of the material in the free-fall columns from bins 1 and 2.

Once a card is inserted into the circuits the system is triggered through any suitable on-off device such as a main on-off switch in the power line to supply power to the control circuit including the stepping switch mechanism. Additionally, the stone switch 14 is closed to insert the output of the three secondary windings 28, 29 and 30 of the stone transformer 26 into the circuit of unit 12 to provide a proportionate output signal. As the hopper weight is zero, the output of the weight responsive potentiometer 19 is zero and the unit 12 establishes an output signal at line 13 to the solenoid actuator 7. This opens gate 4 and stone is fed to the hopper 5 causing the scale 6 to progressively and proportionately increase the A.C. signal from potentiometer 19. When the alternating current signals of sections 8 and 9 create a null condition, the output of the unit 12 drops and the solenoid actuator 7 is de-energized to close the gate 4 and immediately stop further feed to the stone.

Once the stone feed is stopped, the nulling of the system may automatically provide for actuation of the stepping switch to open the contacts 14 and close the contacts 14' to connect the sand section to the signal line 40. As previously noted, the output of the stone section 9 is connected to the sand section 10 and the total output signal is the sum of the stone preset signal and the sand preset signal. This again unbalances the input to unit 12 which establishes an output signal proportional thereto and operates the actuator 7' to begin the feed of sand. As sand is fed into the hopper 5 the output of the weight responsive section 8 increases proportionately to again drive the system into balance. The total weight amount of sand delivered to the hopper 5 is greater than that set in card 39 by the amount of moisture in the sand as a result of the moisture compensating potentiometer 45, such that the actual sand delivered is in accordance with the preselected dry weight.

The card 39 actuates section 16 to produce a water signal at line 57 for water to be added to the concrete mix. The amount of water added is reduced by the preset moisture content of the sand as a result of potentiometer 18 and further may be increased or decreased by adjustment of the "slump" potentiometer 54.

In actual practice, a dribble type feed system is preferably used to reduce the feed rate of the aggregates near the terminal portion. This and other compensating modifications will be obvious to those skilled in the art, do not directly modify the concepts of the present invention and are not shown in the interest of clarity.

The present invention thus provides a relatively simple alternating current balancing circuit employing isolating transformers to produce preset signals and modifying or compensating signals for reliable mixing of various batching materials in sequence.

What is claimed is:

1. In an electrically actuated control for controlling the characteristic of a device in a predetermined manner, comprising:

a plurality of alternating current voltage signal means each of which includes a primary winding and a secondary winding,

circuit means connecting said primary windings to a power supply for independently energizing each of said primary windings from a corresponding in-phase alternating current voltage to produce interdependent energizing and corresponding in-phase output signals, means associated one each with each secondary winding to produce a plurality of output signals, means to establish a reference signal, and

output means to selectively summate the output signals and compare the total signal with said reference signal to produce a control signal.

2. In an electrically actuated control for controlling the characteristic of a device in a predetermined manner, comprising:

a plurality of alternating current voltage signal means each of which includes a primary winding and a secondary winding,

circuit means connecting said primary windings to a power supply for independently energizing each of said primary windings from a corresponding in-phase alternating current voltage to produce interdependent energizing and corresponding in-phase output signals,

a punched card reader operatively associated with each winding and including means to connect selected tap points of each winding to a common liner,

means to selectively connect the output voltages appearing at said common lines in series, means to establish a reference signal, and

output means to selectively summate the output signals and compare the total signal with said reference signal to produce a control signal.

3. In an electrically actuated control for batch measuring of a plurality of materials in a predetermined ratio, comprising:

a plurality of alternating current voltage signal means one for each material and each of which includes a primary winding and a plurality of secondary windings,

a batch transformer means independently energizing each of said primary windings and including means to adjust the energization in accordance with the batch size,

source output means associated with each plurality of secondary windings to selectively produce a first composite output signal for each material,

mix responsive means to establish a cumulative signal in accordance with the material delivered, and

output means to selectively summate the composite output signals and compare the total signal with the cumulative signal to produce a control signal.

4. An alternating current control system for measuring a plurality of materials in predetermined ratios and from sources in which a source of a first material includes a predeterminable small amount of a second material,

a plurality of presettable signal source means one for each material and each of which includes a transformer having a primary and a secondary, means selectively connected to the related secondary to produce similar alternating current signals each having an amplitude related to the amount of corresponding material in a predetermined ratio,

a material delivery responsive means producing a correspondingly periodic alternating current output signal in proportion to the progressive and successive cumulative delivery of the materials,

a compensating signal source connected across the output of the signal source means related to said first material for proportionate energization therefrom and having an adjustable output to provide a compensating voltage at a presettable percentage of the energizing voltage, and

circuit means to selectively connect said adjustable output means to the signal source for the first material with the respective signals in-phase.

5. The control system of claim 4 having a second compensating signal source connected in parallel with the first compensating signal source and having an adjustable output means, and

circuit means to selectively connect the adjustable output means of the second compensating signal source to the presettable signal source for the second of said materials with the respective signals 180 degrees out of phase.

6. The control system of claim 4 having a batch control means connecting said primaries of the presettable signal sources to a power supply means and having means to adjust the voltage applied to the sources in accordance with the batch size.

7. An alternating current control system for measuring a plurality of materials in predetermined ratios and from sources in which a source of a first material includes a predeterminable small amount of a second material,

a plurality of presettable signal source means one for each material and selectively producing alternating current signals having an amplitude related to the amount of corresponding material in a predetermined ratio mix of said materials,

a material delivery responsive means producing a corresponding periodic output signal having an amplitude proportional to the progressive and successive cumulative delivery of the materials,

a pair of similar compensating signal sources each comprising a transformer having a primary winding connected across the output of the signal source related to said first material for proportionate energization therefrom and each having a secondary winding, a pair of potentiometer means connected one each across the secondary windings to provide a compensating voltage a presettable percentage of the voltage across the corresponding secondary winding,

circuit means to selectively connect one of said potentiometers to the signal source for the first material with the respective signals in-phase, and

circuit means to selectively connect the other of said potentiometers to the signal source for the second of said materials with the respective signals 180 degrees out of phase.

8. An alternating current control system for measuring a plurality of materials in predetermined ratios and from sources in which a source of a first material includes a predeterminable small amount of a second material,

a plurality of presettable signal source means each of which includes a transformer having a primary winding and a plurality of secondary windings, a card reader means connecting the related secondary windings in a series output circuit for selective additions of one voltage from each winding to produce an alternating current signal having an amplitude related to the amount of material in a predetermined ratio,

a material delivery responsive means producing a correspondingly phased output signal in proportion to the progressive and successive cumulative delivery of the materials,

a pair of similar compensating signal sources each comprising a step-down transformer having a primary winding connected across the output of the signal source related to said first material for proportionate energization therefrom and each having a secondary winding, a pair of potentiometer means connected one each across the secondary windings to provide a compensating voltage at a presettable percentage of the voltage across the corresponding secondary winding,

circuit means to selectively connect one of said poten-

tiometers to the signal source for the first material with the respective signals in-phase, and

circuit means to selectively connect the other in said potentiometers to the signal source for the second of said materials with the respective signals 180 degrees out of phase.

9. An alternating current control system for measuring concrete including wet sand and water, comprising:

a batch-size transformer having an alternating current input means and an adjustable output means,

a preset sand transformer having a primary winding and a secondary winding to produce a signal proportional to a preselected dry weight of sand,

a water moisture compensating transformer having a primary connected in parallel with said secondary winding and having code controlled adjustable secondary windings,

a code means for presetting the output of the secondary winding,

a first adjustable means connected across said last named secondary winding to provide a proportionate voltage,

a preset water transformer having a primary winding connected to the adjustable means and secondary winding to produce a signal proportional to the water weight in the concrete,

a slump compensating transformer having a primary winding and a secondary winding,

a second adjustable means connected across the slump secondary winding, and

circuit means serially connecting preselected portions of the preset water secondary winding in series with first and second adjustable means to provide automatic compensation of the water related signal by the amount of moisture in the sand to permit selective variation in the preset of the water compensating transformer.

10. The system of claim 9 having:

a sand moisture compensating transformer having a primary winding connected in parallel with the secondary of the sand transformer and having a secondary winding, and

a sand compensating adjustable means connected across the last named secondary winding and in series with the sand moisture compensating transformer and providing a presettable output signal in-phase with the sand moisture compensating transformer.

11. An alternating current control system for measuring concrete including a plurality of aggregate and water, comprising:

a batch-size transformer having an alternating current input means and an adjustable output tap means,

a first material preset transformer having a primary winding connected to the adjustable tap means and a plurality of secondary windings, each of which includes a plurality of taps,

a punch card reader selectively connecting a tap from each winding to a corresponding common line, and circuit means to algebraically add the voltages at the common lines.

12. The system of claim 11 having:

a moisture compensating transformer having a primary winding connected in parallel with said circuit means and having a step-down secondary winding, and

a potentiometer means connected across the step-down secondary winding and having output means connected in series with the preset transformer and providing an output signal in-phase with the preset transformer.

13. An alternating current control system for measuring concrete including wet sand and water, comprising:

a batch size transformer having an alternating current input means and an adjustable output means,

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- a preset sand transformer having a primary winding connected to the adjustable means and a plurality of secondary windings, each of which includes a plurality of taps selectively connected to a corresponding common line and circuit means to algebraically add the preset voltages of each winding,
- a sand moisture compensating transformer having a primary winding connected in parallel with said circuit means and having a step-down secondary winding,
- a potentiometer means connected across the step-down secondary winding and having output means connected in series with the sand moisture compensating transformer and providing a presettable output signal in-phase with the sand moisture compensating transformer,
- a water moisture compensating transformer having a primary connected in parallel with said circuit means and having a secondary winding,
- a water potentiometer means connected across said last named secondary winding,
- a preset water transformer having a primary winding connected to the adjustable means and a plurality of secondary windings, each of which includes a plurality of taps selectively connected to a corresponding common line and circuit means to algebraically add the preset voltages of each winding,
- a slump compensating transformer having a primary winding connected to the alternating current power lines and tapped slump secondary multiple windings,
- a slump potentiometer connected across the slump secondary windings and having a common center tap connected to the center of the secondary and the potentiometer, and
- circuit means serially connecting preselected portions of the preset water secondary windings in series with the water potentiometer means and with the slump potentiometer.
14. An alternating current control system for measuring discharge of a material, comprising:
- a preset material transformer having a primary winding and a secondary winding to produce a signal proportional to a preselected quantity of the material,
- a compensating transformer having a primary connected in parallel with said secondary winding and having a secondary winding, and
- an adjustable impedance means connected across the secondary winding of the compensating transformer to provide an output control signal.
15. An alternating current control system for measuring discharge of a material, comprising:
- a preset material transformer having a primary winding and a secondary winding to produce a signal proportional to a preselected quantity of the material,
- a compensating transformer having a primary connected in parallel with said secondary winding having a secondary winding,
- an adjustable impedance means connected across the secondary winding of the compensating transformer to provide an output control signal, and
- a batch-size transformer having an alternating current

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- input means and an adjustable output means connected across the primary windings of the material transformer and the compensating transformer.
16. An alternating control system for measuring discharge of a material, comprising:
- a preset material transformer having a primary winding and a secondary winding to produce a signal proportional to a preselected quantity of the material,
- a compensating transformer having a primary winding connected to said secondary and energized in accordance with the output voltage and having a secondary winding,
- an adjustable impedance means connected across the secondary winding of the compensating transformer, and
- means to serially connect the output of the material transformer and the adjustable impedance means.
17. An alternating control system for measuring discharge of a material, comprising:
- a preset material transformer having a primary winding and a secondary winding to produce a signal proportional to a preselected quantity of the material,
- a batch size transformer having an alternating current input means and an adjustable output means connected across the primary winding of the material transformer,
- a compensating transformer having a primary winding and a secondary winding,
- an adjustable impedance means connected across the secondary winding of the compensating transformer, and
- means to serially connect the output of the material transformer and the adjustable impedance means.
18. In an electrically actuated control for measuring material delivery, comprising:
- an alternating current voltage source for the material and having a primary winding and a plurality of secondary windings,
- a batch size transformer means energizing said primary winding and including means to adjust the energization in accordance with the batch size,
- source output means associated with said secondary windings to selectively produce a first composite output signal for the material,
- quantity responsive means to establish a cumulative signal in accordance with the material delivered, and
- output means to compare the total signal with the cumulative signal to produce a control signal.

References Cited

UNITED STATES PATENTS

2,938,701	5/1960	Thorrson et al.	177—70
3,156,312	11/1964	Heltzel et al.	177—70
3,173,505	3/1965	Thorrson et al.	177—70
3,252,530	5/1966	Bale	177—70 X
3,263,761	8/1966	Boadle et al.	177—70

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,434,556

March 25, 1

Alton G. Bale, Jr.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 67, "providess" should read -- provides --. Column 8, line 29, "liner" should read -- line --. Column 9, line 38, after "voltage" insert -- at --. Column 10, line 3, "in" should read -- of --; line 34, "automatic" should read -- automatic --.

Signed and sealed this 14th day of April 1970.

(SEAL)

Attest:

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Commissioner of Patents