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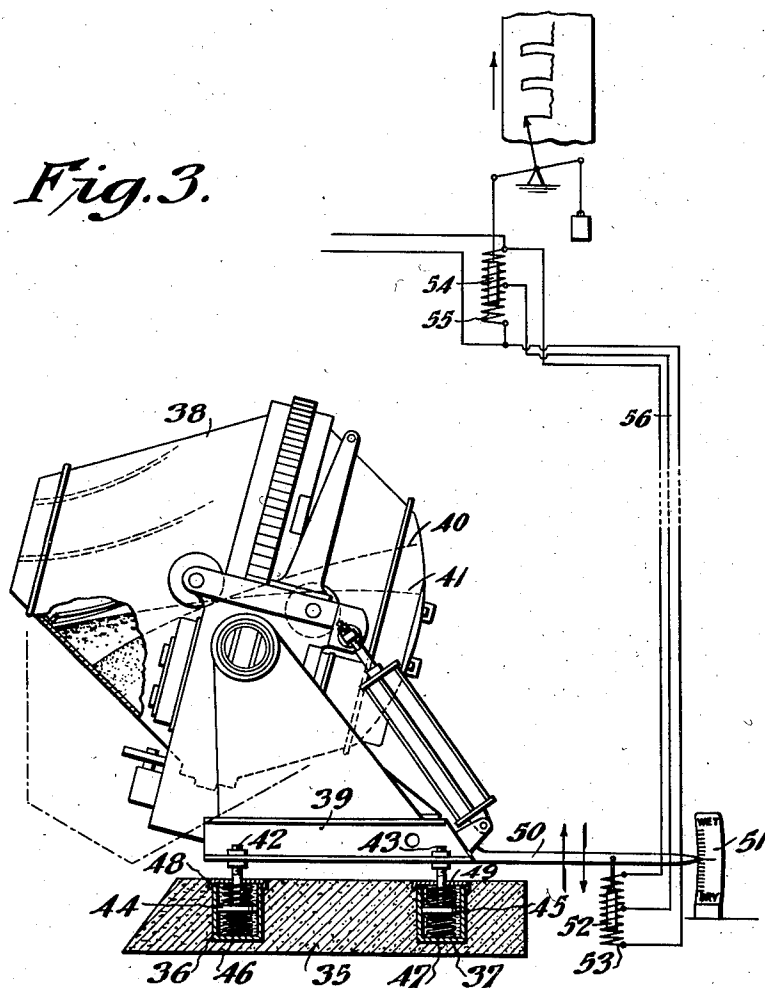
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METHOD OF DETERMINING THE CONSISTENCY OF CONCRETE MIXTURES

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Fig. 3.



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METHOD OF DETERMINING THE CONSISTENCY OF CONCRETE MIXTURES

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2 Claims. (Cl. 265—11)

My invention relates to the method of determining the consistency of a concrete mixture, and particularly to a method intended and adapted to be used commercially for determining the consistency or workability or uniformity or water content of concrete in a mixture, simultaneously with the mixing operation, by measuring or noting changes in the center of gravity of the mix in proportion to its consistency; this application being a division of my co-pending application Serial No. 239,712, filed November 9, 1938, issued into Patent No. 2,273,750, February 17, 1942.

The primary object of this invention is to provide a method of determining the consistency of a concrete mixture which takes cognizance of the fact that the center of gravity of a batch of concrete in a mixer shifts in proportion to the relative consistency or water content, or workability or flowability, of the concrete as altered and influenced by variations in the water content in the ingredients or by changes in the mixing water, or to other variations of the factors affecting consistency changes in the mix.

Another object is to provide a method based upon and taking advantage of the fact that a batch of concrete when charged or placed within a mechanical mixer assumes a certain definite slope with the material tending to pile up and establish a center of gravity influenced by such piling; and, as water is added or the workability or flowability of the concrete mixture is increased or rendered more uniform this slope will flatten out to thus vary and shift the center of gravity, substantially in proportion to the consistency of the mixture, and in a manner that can be determined and measured to indicate or show the consistency of the concrete mixture.

A further object is to provide a method by which the inherent characteristics and the workability and consistency of the concrete mix can be determined and indicated and recorded, through load or strain forces upon the concrete mixer in proportion to the consistency of the mix, from the time the ingredients are placed in the mixer until the finished mass or batch of material is discharged.

With the above and other objects and purposes in view, some of which will be apparent to those skilled in the art and others of which are inherent in the construction and use of the mechanism in carrying out my improved method, this invention includes certain novel features and novel steps and procedures in carrying out the method which will be hereinafter set forth in

connection with the drawings and then pointed out in the claims.

In the drawings:

Figure 1 is a view in elevation, part in section and part schematically shown, illustrating an embodiment of my invention.

Fig. 2 is an enlarged fragmentary sectional and diagrammatic view to better disclose the indicating and recording means.

Fig. 3 is a view similar to Figure 1 illustrating another embodiment.

In carrying out the method of my invention, the embodiment apparatus is in the form of a concrete mixer in which the associated ingredients are manipulated or agitated in predetermined manner tending to pile up the mixture in one location when the water ration is low in parts of the batch or the consistency lacks uniformity, and with the mixture tending to level off as the water ratio or uniformity of consistency increases. With such a concrete mixer, the pounds of force may be determined at one or more locations, and changes in this measured force may be taken as indicating a relative change in the center of gravity of the mix, due to the leveling off. Such force measurements, and changes therein, can and may be taken at various points or locations as reactions upon or from parts of the machine or apparatus or upon its foundation or supporting structure, and innumerable methods of measuring the relative proportions of weight carried at various points to determine and measure the center of gravity of the mix may be resorted to, as conditions and particular installations may demand; the various applications and adaptations differing perhaps primarily in the points or locations at which the forces are measured.

In the embodiment illustrated in Figs. 1 and 2, I have shown my invention in conjunction with a rotary concrete mixer of the tilting dumping type, as now quite commonly used in concrete construction and other projects. The supporting structure 1 is mounted upon a foundation 2, or other suitable base structure, and a revoluble mixer cylinder 3 is carried for swinging or tilting movement on shafts or trunnions 4 mounted in suitable bearings on the supporting structure 1. As such revoluble or rotatable and tiltable concrete mixing drums or cylinders 3 are of common and well known construction in this art, no attempt is here made to fully or particularly illustrate the constructional and mounting and operating features thereof. Rotary concrete mixers are well known in the art, and in the

present embodiment the showing is intended only to illustrate an adaptation and embodiment that may be an example of application to various types and constructions of concrete mixers operating and controlled in various manners.

With the present showing, a dumping and control cylinder 5 is employed to tilt the mixing drum or cylinder 3 to either the position in which the ingredients of the batch are received and are mixed or to a position, as indicated by the dot and dash lines, in which the mixed concrete will be discharged or dumped through the open end 6. Obviously, various hydraulic or pneumatic supply and control means can be employed in connection with the drum tilting cylinder 5, or various mechanical and link and lever means may be suggested therefor, and as such mechanisms are now well known in this art no attempt is here made to show or describe or claim particular mixing apparatus or means.

A bearing member 7 is secured or anchored on the supporting structure 1, or upon the base 2, or is otherwise secured to be substantially stationary, and a swingable member 8 is mounted for swinging movement on the bearing 7, as at 9, and has an offset swinging connection, as at 10, with the dumping cylinder 5, this connection being offset with respect to the line of thrust or force upon the dumping cylinder 5, so that the swinging member 8 is connected at the points 9 and 10 somewhat after the manner of a bell crank, with an extending pointer and indicating arm 11 rocked or oscillated as pulling or thrust force is exerted in a direction substantially coinciding with the axial line of cylinder 5. The pointer or indicating arm 11 may be arranged adjacent to a dial or indicator scale member 12, and thus as the force of thrust or pull is varied through variation in the disposition of the load in the mixing drum or cylinder 3, this pointer 11 will swing adjacent to the markings on the dial or indicator member 12 and will consequently indicate the change in the load and the shifting of the center of gravity of the mix.

The force or weight which the mixer structure may exert upon its foundation, and the thrust and pull upon the cylinder or linkage at 5 must be compensated for and resisted, and this may be accomplished by anchoring a dash pot cylinder 13 in a relation to receive a piston 14 carried by a piston rod 15, which piston rod is in turn pivotally connected at 16 with the swinging member 8. A coil spring 17 can be mounted in the dash pot to counteract or counterbalance the load force of the cylinder or drum 3 when swung to the mixing position, and the dash pot cylinder can be filled with oil or other suitable liquid or fluid to dampen and retard swinging movement of the member 8. I have shown a by-pass 18 establishing connection between the ends of the dash pot cylinder 13 with a valve 19 in this by-pass and, obviously, various forms of spring or dash pot means can be employed to accomplish the desired purpose and end. To positively limit excessive upward swinging movement of the swinging member 8, an anchor bolt 20 may be mounted or secured in the foundation or base structure 2 to extend upwardly through an opening 21 in the swinging end of the member 8, a safety stop 22 being provided at the upper end of this bolt or rod 20. It is perhaps preferable that the bolt or rod 20 be threaded for a sufficient length along its upper end to permit adjustment of the safety stop or nut 22.

Ordinarily, the mixing drum or cylinder 3 will

be provided with mixer blades, as indicated at 23, and when the ingredients constituting the batch of concrete being mixed are placed in this mixing cylinder or drum, and the drum is rotated, two forces will be exerted upon the batch of material. The force of the mixer blades 23 tends to carry or move the concrete mixture up and toward the rear of the drum or cylinder 3, due to its tilt when in the mixing position, so that the material is piled up or accumulated, somewhat as indicated by the line at 24; and, a second force is also present tending toward a natural flow by gravity of the concrete material back down toward the front or mouth 6 of the mixing cylinder or drum 3. As the dry batch is mixed or agitated in the cylinder or drum 3, the mechanical forces will tend to pile up the material substantially after the manner as indicated by the line at 24; and, as the consistency becomes more uniform, due to an increase in uniformity of moisture distribution, the batch being of more workable and flowable consistency will be influenced by gravity forces to level off to assume a surface contour somewhat after the manner indicated by the line at 25. As will be seen by reference to the drawings, this leveling off due to the gravity flow as the batch becomes of more uniform consistency and more workable will cause a considerably different distribution of the material within the mixing cylinder or drum 3, in consequence of which the center of gravity of the batch will be correspondingly shifted. Thus, as water is added to the batch and is mixed in, the workability of the concrete is increased and the material flows so that the slope as the material is accumulated when more dry flattens out, thus shifting the center of gravity from the dry position and permitting the operator to ascertain and determine the condition and consistency and workability or flowability of the particular batch at any and all times during the mixing operation. The spring 17 and the dash pot and associated parts 13 will assume the variations of load and will be responsive to shifting of the center of gravity so that the pointer portion 11 of the swinging member 8 can be read against the dial or scale member 12 to give the operator an indication of the condition of the mixture.

It will of course be understood that the cylinder or drum 3 can be tilted to discharge the mixture therefrom, and that the operation and indications will be accomplished with the cylinder or drum in the mixing position. When the mixer is up in the mixing position but empty, the spring 17 will be partly compressed due to the overbalancing weight of the structural parts. Then, with the addition of a charge of cement and aggregates into the mixer, the spring is compressed to a point corresponding to the position of the center of gravity of the charge. The consistency as thus indicated by the pointer portion 11 may vary due to variations in the mixture of the aggregate ingredients, and as the cylinder or drum 3 is rotated an accurate reading and determination of the mixture content or consistency can be taken. With the addition of water, or other materials affecting the consistency or workability or flowability of the batch, the mass becomes more fluid, and from the approximate piled up relation as indicated at 24, the mass of the batch of material being mixed will flatten out, more after the manner indicated by the line 25, thus shifting the center of gravity of the mass and consequently changing the thrust and forces exerted through the dumping cylinder or link-

age 5 upon the swinging member 8, and thereby altering the deflection of the spring and dash pot system a corresponding amount so that the pointer 11 indicates upon the dial or gauge scale portion a consistency measurement.

It may be necessary or desirable to employ a graphic or recording indicator, and the swinging member 8 adapts itself well to the use of various types of mechanical and electrical graphic and other recorder mechanisms. On the lever or swinging arm or member 8, away from the pivotal or swinging mounting thereof at 9, I connect the core 26 of a transmitting solenoid, and at any suitable point I provide a recording mechanism including a recording solenoid core 27. Suitable circuit wires, generally indicated at 28, connect the transmitting solenoid coil 28 with the recording solenoid coil 29, and this wiring can be connected in any suitable circuit, as at 30, or to receive current from any other suitable source of supply. The recording solenoid core is connected with a swinging arm 31, the solenoid core being preferably counterbalanced by a weight 32 so that this swinging arm 31 will assume a central or normal position. A pen arm 33 extends from and is swingable by this swingable arm 31, and this pen arm 33 works adjacent to and can be equipped to mark upon a recording sheet or tape 34 or upon any other suitable sheet or disc or member. With this recording mechanism, movement of the swinging member or lever arm 8 will move the transmitting solenoid core 26 relative to the transmitting solenoid coil 28, and will thus impart corresponding movement to the recording solenoid core 27 within the recording solenoid coil 29. Consequently, the arm 31 will be swung and the pen arm 32 will be proportionately moved so that as the sheet or tape 34 is moved a graphic record will be indicated and marked and kept thereon.

As graphic indicating and recording means are of many and various constructions and types, and are consequently well known in the art, no attempt is here made to disclose any particular means or mechanism for moving the sheet or tape or record showing member 34, and I do not desire to specify any particular type or construction of recording means. Obviously, employment of any such continuous or traveling graphic recording means will not only give an instant indication of the immediate operating condition, but by lining or otherwise marking the recording member 34 to indicate or denote time or intervals, a graphic record can be made and preserved to show the time of the day, the time or duration of operation of the machine for a particular mix or batch, and the consistency throughout the entire time of operation, and any and all other information or relative information or indication as may be desired.

In the embodiment disclosed in Fig. 3, the foundation or base structure 35 is shown as having openings therein to receive casings 36 and 37, which in the present instance are shown as dash pot casings or cylinders. The mixing drum or cylinder 38 is carried on a supporting structure 39, and as the center of gravity of the load or batch within the mixing cylinder or drum 38 varies, as between the relative positions generally indicated by the lines at 40 and 41, force is exerted upon the supporting structure 39 tending to rock this structure.

Mounting bolts 42 and 43 are connected with the supporting structure 39 at spaced apart points, and in positions to place pistons 44 and

45 thereon for reciprocatory movement in the cylinder-like casings 36 and 37. Springs are provided at 46 and 47 within the casings 36 and 37, below the pistons 44 and 45, so that the load of the concrete mixer carried by the supporting structure 39 is in turn borne upon or by these springs 46 and 47. Stabilizing springs 48 and 49 can be provided within the casings 36 and 37 to bear against the upper sides of the pistons 44 and 45.

In this embodiment, the supporting member or structure 39 constitutes a swinging part influenced by changes in the center of gravity or the distribution of the load within the mixing cylinder or drum 38 and this swinging movement is in turn imparted to a pointer or indicating arm 50, which arm may work adjacent to a dial or gauge 51.

If desired, a transmitting solenoid core 52 can be connected to the arm 50 to be moved within the transmitting solenoid coil 53, and to influence the recording solenoid core 54 movable in recording solenoid coil 55, which parts are embodied in a recording circuit 56. Graphic or other recording means, of any suitable and desired type, and in fact any signal or indicating or recording means, can be actuated from the recording solenoid 54; and, where desired mechanical indicating or recording means can be connected to be operated by movement of the indicator arm 50 or of the supporting member or structure 39.

In the use of this embodiment, as the concrete batch becomes wet it flows toward the mouth of the mixer drum or cylinder faster than the blades can take it up, until an equilibrium point is reached, perhaps somewhat corresponding to the line indicated at 41. Simultaneously with this movement or shifting of the load and center of gravity of the batch, more weight is caused to be concentrated upon the forward mounting bolt, or bolts, 42, accompanied by lessening of the weight carried by the rear supporting bolt or bolts 43. This action somewhat compresses the bottom spring 46 and releases the bottom spring 47, thus causing tilting of the supporting member or structure 39 to correspondingly tilt or move the pointer arm 50 up the scale, thereby indicating the change in the consistency toward the "wet" side.

Conversely, if the ingredients in the batch of concrete being mixed be dry, as for lack of water, the blades will carry the material toward the rear of the mixer faster than it will flow by gravity toward the front, until the equilibrium point is reached somewhat corresponding to the line 40. At this point the center of gravity of the mass will be farther back in the mixer, thus putting greater weight on spring 47 and relieving or lessening the weight on spring 46. This shift will cause the supporting structure or member 39 to be swung and will consequently shift the pointer down the scale or in the "dry" direction. As has been stated, springs 48 and 49 are provided to stabilize the mounting, and to still further stabilize, the casings or cylinders 36 and 37 can be filled with oil or other suitable fluid or liquid. In some instances and adaptations the arrangement of the dash pots or casings 36 and 37 can be changed, as for example so that the load will be carried and shifts in the weight will be indicated, as the load accumulates at one side and recedes or levels off. With this construction, the mounting and the operation are substantially the same as set forth, except for the fact that the changes in weight

or center of gravity are measured from side to side, instead of from front to back. Such an arrangement will permit adaptation of my invention to and will allow applications thereof with a non-tilting type of drum mixer, and to other forms and mixers than the particular tilting type as here principally illustrated.

In the use of my method for determining the consistency of a concrete mixture during the mixing thereof, the operation of the mixer will tend to pile up the material of the batch of concrete mixture, in proportion to its consistency, and as the mixture becomes more uniform the material will flow or level off; and then, by measurement of the forces exerted by the piling up or accumulation due to lack of uniformity of mixture with proportionate leveling off as the mixture becomes more uniform, a very accurate indication is given as to the consistency of the mixture at all times during the mixing operation.

From the foregoing it will be seen that I have provided a method of determining and measuring and indicating and recording the consistency of a concrete mixture by determining the varying forces exerted due to piling up and leveling off or other shifts, of the batch of concrete being mixed, which changes or shifts will in effect indicate and be substantially influenced by variations in the center of gravity and in forces resultant therefrom.

While I have herein shown and described only certain specific embodiments and adaptations for carrying out my invention, and have set forth

only certain steps and operations in carrying out the method, it will be appreciated that many changes and variations can be made in the form and construction and arrangement and mounting and association and use of the parts, as well as in the carrying out of the various steps or procedures of the method or process, without departing from the spirit and scope of my invention.

I claim:

1. The method of determining the consistency of a concrete mixture which includes the steps of continuously agitating combined different fluent aggregate materials of different specific gravities to cause shifting of the center of mass of the materials to create a moving force, and while so agitating said materials measuring the extent of the shifting of the center of mass of the materials by said moving force to indicate the variation in the uniformity of the mixture of said materials.

2. The method of determining the consistency of a concrete mixture which includes the steps of placing solid and liquid aggregates to be admixed in a receptacle, maintaining mixing operation of the receptacle to agitate the aggregates so that the center of gravity of their mass is shifted to create a substantially constant force acting to shift the receptacle, and measuring the shifting movement of the receptacle as effected by said force during the receptacle agitating operation to determine the extent of distribution of the liquid relative to the solid aggregates.

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