

March 10, 1953

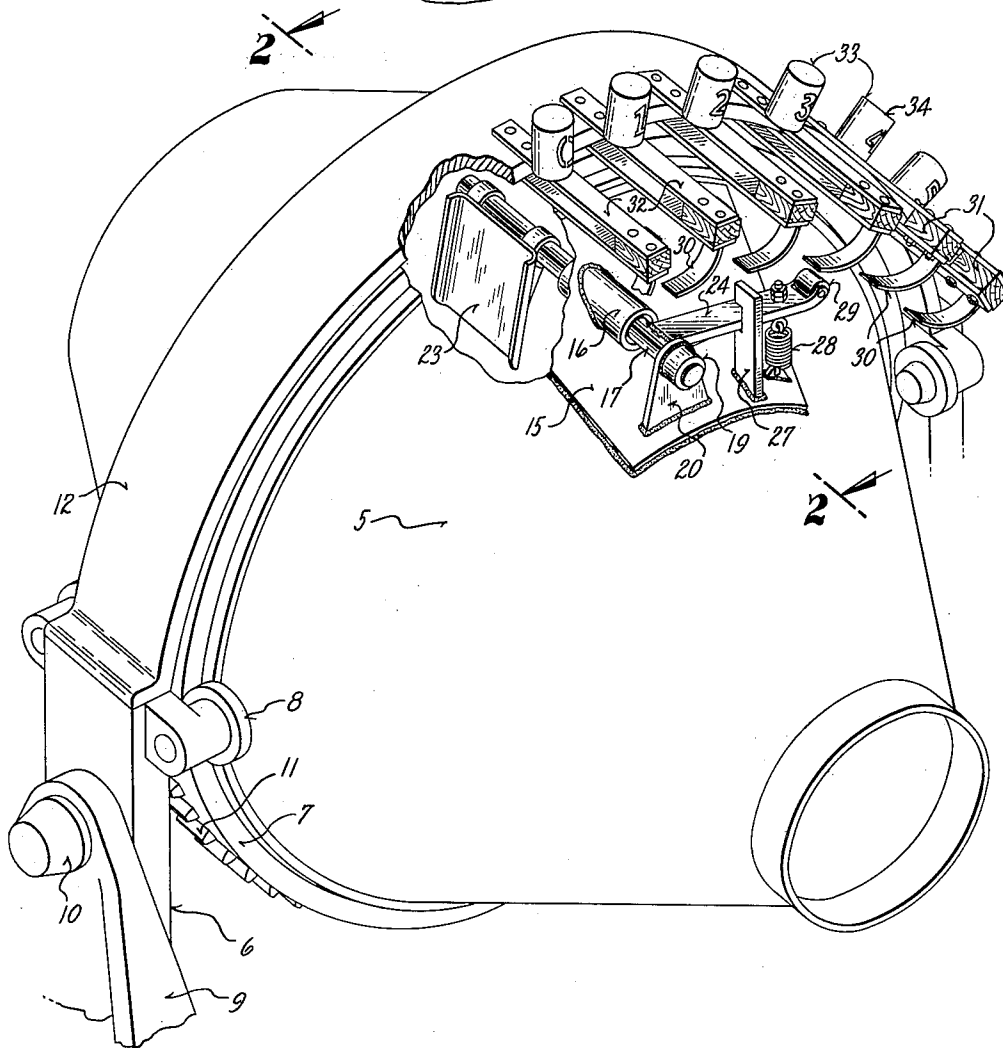
G. MAXON, JR
CONSISTENCY METER

2,630,706

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Fig. 1.



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Fig. 2.

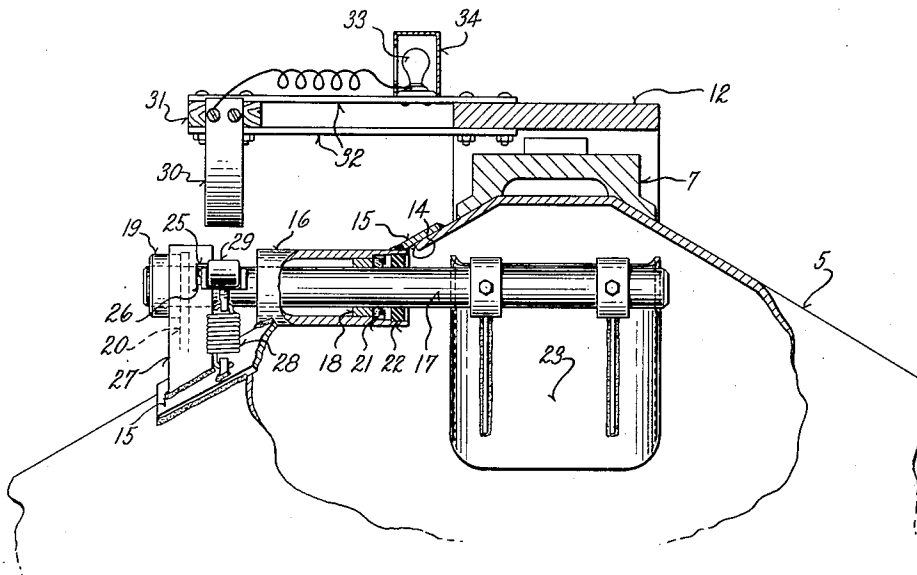
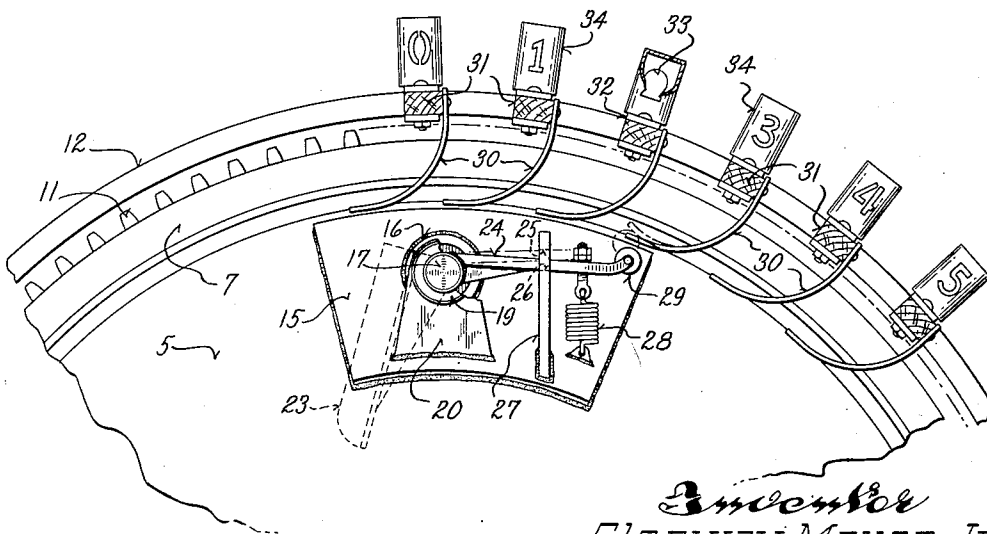


Fig. 3.



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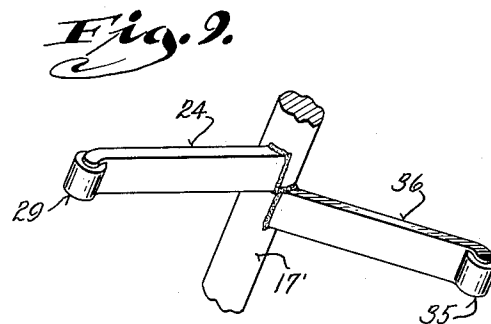
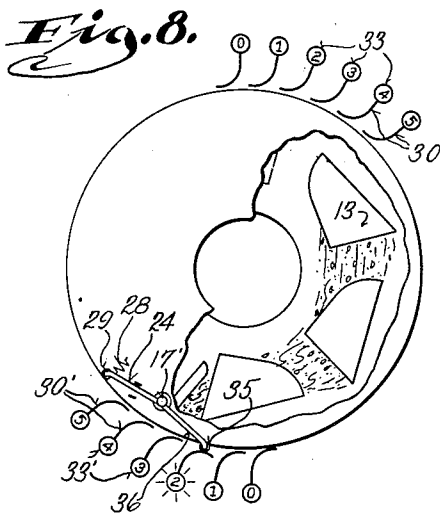
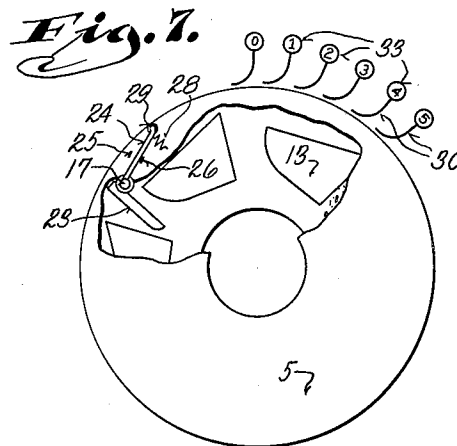
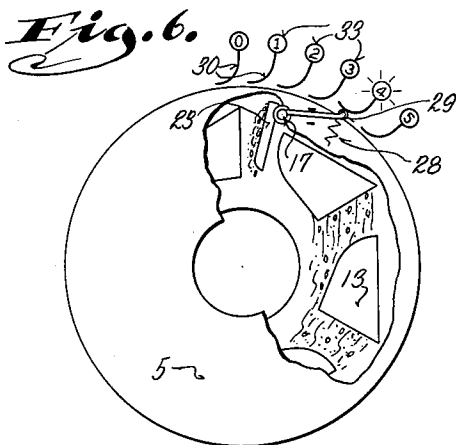
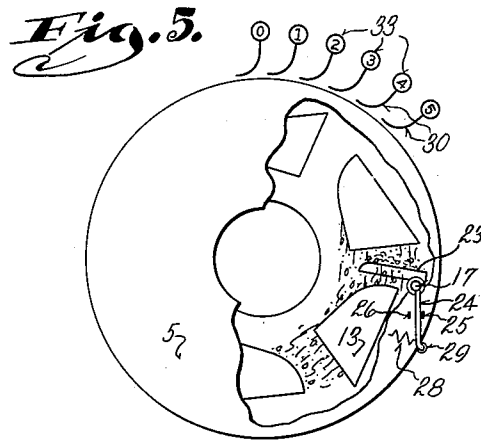
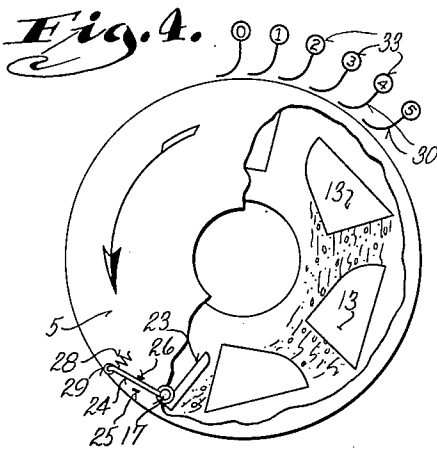
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UNITED STATES PATENT OFFICE

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8 Claims. (Cl. 73-54)

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This invention relates to the measurement of the consistency of semi-fluid mixtures and has as its general purpose to provide means for effecting such measurement during the mixing operation.

More specifically the invention has as its object to provide a simple way of accurately measuring the consistency and consequently the workability of concrete being mixed in a rotating mixing drum and depicting the measure thereof in terms indicative of its degree of workability to give the operator a reliable guide for moisture control during the mixing cycle.

While it has always been important to have the correct water-cement ratio, the advent of air-entrained concrete has placed even greater emphasis upon moisture control for with air-entrained concrete the mixture should be as dry as possible consistent with good workability. This follows from the fact that air-entrained concrete is more durable the less moisture it contains at the time of placement. Air-entrained concrete is also more workable for the same amount of slump than the conventional concrete. The old well-known slump cone test thus does not give the full information. Moreover, the slump cone test is diagnostic since it cannot be made until the mixing process is completed and, of course, cannot be used to show the consistency of the mixture during the actual mixing cycle. Unless the operator has this information he has no assurance that all concrete produced in his plant is of the specified consistency (moisture content) and corresponding workability.

In a general way the invention achieves its purpose by mounting a feeler or trigger inside the drum to rotate therewith and react to the contents of the drum during part of each turn, the reaction of the feeler or trigger to the drum contents being used to operate an indicator mounted for convenient observation by the operator. The location of the points on the orbit of the feeler or trigger with reference to a datum point on a non-rotating part of the mixer, at which the drum contents respectively contacts the feeler or trigger and leaves the same in the operation of the mixer, provides a reliable indication of the consistency of the mixture. This follows from the fact that in the mixing of concrete in a rotating drum revolving about a substantially horizontal axis, the drum blading picks up the material, carries it up the ascending side of the drum and intermittently spills the same back into the drum. As a result the material

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in the drum assumes an average angle which is steep for a dry, low slump mix and relatively flat for a more fluid, high slump mix.

For purposes of illustration, if the front of the mixer drum is compared to a clock face (with the drum rotating counter clockwise) with a dry low slump mix the location of the point at which the feeler or trigger first comes in contact with the drum contents will be closer to six o'clock than eight o'clock and the location of the point at which the drum contents leaves the feeler or trigger will be somewhere near the top of the dial; whereas with a more fluid high slump mix these points will be farther around the dial, in a clockwise direction.

By utilizing the response of the feeler or trigger to the reaction of the drum contents thereon, either at the instant the material first contacts the same or when it leaves the feeler or trigger, to actuate the indicator, the location of these points can be shown and by calibrating the indicator against slump cone tests or in degrees of workability the resulting indication will be a reliable, accurate depiction of the consistency of the mixture.

While the feeler or trigger may be constructed in a variety of ways, for consistency measurement in a concrete mixer it has been found desirable to use a vane-like reaction member mounted for limited swinging movement within the drum and operable by its movement to effect the functioning of the indicator.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate two complete examples of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view of a concrete mixer of the tilting type as viewed from the front or discharge end and illustrating the application of this invention thereto;

Figure 2 is a view partially in side elevation and partially in longitudinal section on the plane of the line 2-2 in Figure 1;

Figure 3 is an enlarged view in end elevation of the upper portion of the mixer and il-

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lustrating particularly the manner in which the indicator is actuated;

Figure 4 is a diagrammatic view in end elevation with part of the mixer shown broken away and showing the reaction member about to pick up a load or charge of concrete;

Figure 5 is a view similar to Figure 4 but showing the mixer rotated to a point at which the reaction member has been fully loaded and is moving up with the ascending side of the mixer;

Figure 6 is a similar diagrammatic view but showing the mixer rotated to the point at which the reaction member is about to discharge or spill its load;

Figure 7 is a similar diagrammatic view showing the reaction member free of material and travelling downwardly to again pick up a load;

Figure 8 is a diagrammatic view like Figures 4 to 7, inclusive, but showing two sets of indicators, one showing the location of the point at which the reaction member picks up its load and the other showing the corresponding point at which the load is spilled from the reaction member; and

Figure 9 is a detail view (in perspective) of the actuator lever for the arrangement shown in Figure 8.

Referring now particularly to the accompanying drawings in which like numerals indicate like parts throughout the several views, the numeral 5 designates the drum of a tilting type concrete mixer. The drum is mounted for rotation in a cradle-like tilting frame 6, by means of a ring 7 belting the large diameter middle of the drum and riding on face and edge rollers set in the tilting frame, only one of the edge rollers 8 being shown. The frame 6 is tiltably supported between pedestals 9 by means of trunnions 10, only a portion of the tilting frame and part of one of the pedestals being shown.

A drive pinion (not shown) meshes with a ring gear 11 carried by the ring 7 to impart unidirectional rotation to the drum in the well known manner, and a gear guard 12 mounted on the tilting frame embraces and covers the top half of the ring gear.

The inside of the drum is equipped with the customary mixing blades 13 (see Figures 4 to 7 inclusive) to impart the desired mixing action to the drum contents, and as is well known to those skilled in the art these blades carry the aggregates being mixed upwardly along the ascending side of the drum until the mixture spills from the blades and tumbles down. The height to which the mixture is carried before it discharges from the blades and tumbles and slides down the ascending side of the drum depends upon the consistency of the mix. The drier and stiffer it is the higher it will be carried and the steeper the average angle of the materials in the drum.

To mount the feeler or trigger of this invention on the drum, the shell of the drum has an opening 14 cut into it near the ring 7 and a curved cover plate 15 is welded or riveted to the outside of the drum over the opening 14. The plate 15 has a tube 16 fixed thereto and protruding therethrough with its axis parallel to the axis of the drum and a rock shaft 17 extends axially through this tube.

The shaft 17 is journaled in suitable anti-friction bearings 18 and 19, the former located in the tube and the latter in a bearing post 20 fixed to the plate 15. To protect the bearing 18 from the abrasive action of the drum contents

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suitable packing rings 21 and 22 are seated in the inner end of the tube 16.

As best shown in Figure 2 the rock shaft 17 projects into the interior of the drum a distance to extend beyond its median plane and has a vane-like reaction member 23 fixed thereto. The outer end of the shaft 17 protrudes from the tube 16 and has a lever arm 24 fixed thereto. Angular motion of the lever arm, and consequently the rock shaft and the reaction member fixed thereto, is limited by a pair of stops 25 and 26 conveniently formed by a notch in the side of a bar 27 fixed to and extending from the curved plate 15. As viewed in Figures 1 and 3, the stop 25 limits counterclockwise rotation of the lever arm and consequently the rock shaft and reaction member, while the stop 26 limits clockwise rotation of these parts.

A spring 28 connected to the outer free end of the lever arm 24 and anchored to the mounting plate 15 exerts a yielding force upon the lever arm tending at all times to impart clockwise rotation to the rock shaft 17 and yieldingly holds the shaft at its limit of rocking motion defined by the stop 26. In this normal or free position of the rock shaft the vane-like reaction member is in a position at which it picks up a "load" of the drum contents as it is carried through the batch by the rotation of the drum, to spill the same back into the interior of the drum as the reaction member moves through the upper portion of its orbit.

At the extreme outer end of the lever arm 24 is a contactor roller 29 adapted to make physical and electrical contact with a series of contact fingers 30. These contact fingers are electrically insulated from the body of the mixer, being mounted upon blocks 31 of wood or other suitable insulation on the outer ends of brackets 32 fixed to the gear guard 12. The contact fingers 30 thus are arranged in an arc concentric to the axis of the drum and in position to be engaged by the contactor roller 29 providing the rock shaft has rotated far enough in a counterclockwise direction to bring the roller into contact engaging position. Such movement is imparted to the lever arm 24 by the reaction of the drum contents upon the vane-like reaction member 23 exerting a force thereon in opposition to the yielding force of the spring 28.

Each contact finger 30 is electrically connected with one side of an indicator lamp 33 and each lamp is wired to a common source of electric current not shown, the return of which is grounded to the mixer. Thus, since the contactor roller 29 is grounded it follows that its engagement with a contact finger lights the corresponding lamp 33.

Each of the lamps 33 has a translucent hood 34, the front of which bears an identifying number. In the present case there are six lamps and the numbers thereon range from 0 to 5. Together the hooded lamps provide a consistency indicator calibrated in degrees of workability or in terms of inches of slump. Obviously the contact fingers 30 must be arranged in a certain relationship with respect to a fixed datum point, which arrangement is empirically predetermined, so that the numbers on the lamps as they successively light up will accurately show the degree of workability for different mixtures.

Operation

As clearly illustrated in Figures 4 to 7, inclusive, as the mixing drum turns and the vane-

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like reaction member travels around its circular orbit it comes in contact with the drum contents at a point near the bottom of the drum, depending upon the consistency of the mixture. Figure 4 shows the reaction member just contacting the materials in the drum and about to pick up a quantity thereof. In the analogy to a clock face as noted hereinbefore, this initial contact between the reaction member and the materials undergoing mixing is shown as occurring at approximately seven o'clock.

Rotation of the drum beyond the point shown in Figure 4 causes the drum contents to react against the vane-like reaction member 23 and thereby rock the shaft 17 in a counterclockwise direction against the force of the spring 28. Such rocking of the shaft swings the lever arm 24 and the contact roller 29 carried thereby outwardly into a position shown in Figure 5 in which position it will engage the contact fingers 30 upon further rotation of the drum as shown in Figure 6.

As each contact finger 30 is engaged by the roller 29 the circuit for the corresponding lamp is completed and that lamp lights up and remains lighted during the time its contact finger is in engagement with the roller 29.

Attention is directed to the fact that the numbering of the lamps progresses in a clockwise direction, that is, the highest number is farthest to the right so that its contact finger 30 will be the first to be engaged by the roller 29.

As rotation of the drum proceeds a point in the orbit of the reaction member is reached at which the charge of concrete carried by the reaction member spills or slides off and thereby frees the rock shaft for rotation under the force of the spring 28. The point on the orbit of the reaction member at which this occurs, as already noted, depends upon the consistency of the mixture. With a relatively fluid mixture the charge carried by the reaction member slips or spills off earlier than when the mix is stiffer.

The last of the lights to be lit as the reaction member moves past the contact fingers indicates the degree of workability or slump of the concrete in the drum. Thus, from Figure 6, which shows the charge of the materials on the reaction member and the lamp designated by the number 4 lit, it will be seen that at about the time the roller 29 contacts the finger 30 of the lamp 2 the material will slide off the reaction member, indicating that the mixture in the drum is two inch slump concrete.

Obviously after the material on the reaction member leaves the same the shaft 17 and the parts attached thereto are brought back to their normal or free positions as shown in Figure 7 to repeat the described cycle during the next rotation of the drum.

The modified embodiment of Figures 8 and 9

As noted hereinbefore, the point at which the reaction member picks up its load as well as the point at which it spills the same therefrom (both with reference to a fixed datum point), is an indication of the consistency of the mixture. In the embodiment of the invention specifically illustrated in Figures 1 to 7, inclusive, the latter of these two points is used to effect the desired indication.

In the embodiment of the invention shown in Figure 8, both points, i. e. the loading and the discharging points, are utilized to effect the desired indication. Actually in this case there

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are two indications both, however, giving the same information. To this end a second set of contact fingers 30' and a corresponding series of lamps 33' are provided and arranged in an arc extending from approximately five-thirty o'clock to seven-thirty o'clock. The contact fingers 30' are adapted to be engaged by a contactor roller 35 carried by a second arm 36 on the shaft 17' and to preclude engagement of the roller 35 with the contacts 30 the arm 36 and the contact fingers 30' lie on a plane spaced axially from the plane upon which the fingers 30 are arranged. Figure 9 illustrates the relative disposition of the two lever arms.

In the operation of the embodiment of the invention shown in Figure 8 the lamps 33' are progressively lit as the reaction member picks up its load and the lamps 33 are progressively lit as the reaction member discharges its load.

By correct placement of the contact fingers 30 and 30' the two indicators afforded by the two sets of lamps will give substantially the same reading every time. Obviously, of course, the lower series of lamps 33' may be used alone if desired.

From the foregoing description taken in connection with the accompanying drawings, it will be apparent to those skilled in the art that this invention provides a simple, reliable method of measuring and showing the consistency of concrete or any other semi-fluid mixture while it is being mixed in a drum rotating on a substantially horizontal axis, and that insofar as the mixing of concrete is concerned it enables the operator to accurately control the moisture content of each batch and thereby affords assurance that all concrete delivered from his plant will meet specifications.

What I claim as my invention is:

1. In a concrete mixer: a mixing drum rotatable in one direction about a substantially horizontal axis; a rock shaft protruding through a wall of the drum and journaled in bearings carried thereby; means for limiting rocking motion of the shaft; a vane-like member mounted upon the shaft inside the drum; a spring yieldingly holding the rock shaft at one of its limits of rocking motion and resisting rocking motion of the shaft toward the other of its limits of motion, said vane-like member being positioned to pick up some of the mixture as said member rotates with the drum and spill the same therefrom during its passage across the top of its orbit, the reaction of the mixture upon said member rocking the shaft in opposition to the spring so that the shaft moves in one direction as the reaction member picks up its load and moves in the other direction as it discharges its load, the points on the orbit of the vane-like member with respect to a fixed datum point at which said two motions are imparted to the shaft as a result of the reaction member picking up and discharging its load depending upon the consistency of the mixture; a lever mounted on said rock shaft at the exterior of the drum and adapted to be swung by said rock shaft to predetermined positions corresponding to said predetermined positions of the rock shaft; and a plurality of stationary indicator means successively engageable by said lever when the same is in one of its predetermined positions for indicating the points on the orbit of the vane-like member at which such rocking motion is imparted to the shaft.

2. In a concrete mixer, the structure set forth in claim 1 further characterized by the fact that

the indicator means is electrical and comprises a plurality of contacts arranged in an arc in juxtaposition to the orbit of the rock shaft and connected with electrically operated indicators; and said lever comprises a contactor mounted on the shaft and engageable with said contacts in one position of rotation of the rock shaft.

3. Consistency measuring and indicating means for mixers having a rotatable mixing drum, comprising: a reaction member; means mounting the reaction member inside the drum for bodily motion with the drum during rotation of the latter and for motion with respect to the drum between a pair of predetermined positions, toward one of which the reaction member is adapted to be moved in response to force imposed upon it by material being mixed in the drum and which is transiently engaged by the reaction member as the drum rotates; means biasing the reaction member toward the other of said predetermined positions so that the member returns to said other predetermined position when it is disengaged by the drum contents at a point in its orbit dependent upon the consistency of said contents; an arm movably mounted on the drum at the exterior thereof and connected with said reaction member to be swung thereby from an inoperative position when said reaction member is at one of its limits of motion to an operative position when said reaction member moves toward its other limit of motion; a plurality of actuators stationarily mounted with respect to the drum at spaced intervals along an arc adjacent the periphery of the drum in positions to be successively engaged by said arm when the latter is in its operative position; indicating means fixed with respect to the drum upon which the consistency of the mixture may be depicted; and means connected with the indicating means and governed by engagement of the actuators by the arm for actuating the indicating means.

4. Apparatus for measuring and detecting the consistency of a mixture being mixed in a mixing drum mounted for rotation on a horizontal axis, comprising: a reaction member; means movably mounting the reaction member in the mixing drum for motion with respect to the drum between a pair of predetermined positions but constraining the reaction member to bodily motion with the drum so that the reaction member rotates with the drum but is moved to one of said positions in response to force imposed upon the reaction member by material being mixed in the drum and which is picked up by the reaction member and carried thereby as the drum rotates; means biasing the reaction member toward the other predetermined position so that when the material so picked up is dropped by the reaction member, at a point in its orbit dependent upon the consistency of the material being mixed, the reaction member will move to said other position; a lever movably mounted on the exterior of the drum for swinging motion between a retracted position and an extended position; means connecting said lever with said reaction member so that motion of said reaction member to one of its predetermined positions moves the lever to one of its two positions; and a plurality of indicating means stationarily mounted with respect to the drum at spaced intervals along an arc swept by said lever in its extended position and cooperable with said lever to indicate the point in the orbit of the reaction

member at which the latter moves from one of its predetermined positions to the other.

5. The apparatus of claim 4 characterized by the fact that each of said indicating means comprises: an electrical indicator; means defining an electrical circuit for energizing said indicator; and switch means in said circuit adapted to be actuated by said lever.

6. In a combination: a mixing drum rotatable about a substantially horizontal axis and in which the entire mass of materials being mixed is displaced in the direction of drum rotation a distance dependent upon the consistency of the mixture; a reaction member; means mounting the reaction member inside the drum for rotation with the drum through the materials therein and for movement with respect to the drum between defined positions, to one of which the reaction member is moved by its engagement with materials being mixed as it passes through the same during a portion of each revolution of the drum; means yieldingly biasing the reaction member to its other position so that the reaction member will move to said other position upon its disengagement from the materials being mixed, the points in the orbit of the reaction member at which it moves from one of its positions to the other in consequence of its engagement with and disengagement from said materials being determined by the consistency of the mixture; a movable element mounted on the exterior of the drum for rotation therewith and connected with the reaction member to be moved thereby, as the reaction member moves from one of its positions to the other, between operative and inoperative positions; and indicating means rendered operative in consequence of movement of said movable member by the reaction member from one of its positions to the other to effect indication of the point in the orbit of the reaction member at which the latter correspondingly moves from one position to the other thereof, and thus depict the consistency of the mixture.

7. Apparatus for measuring and showing the consistency of a mixture while it is being mixed, comprising: a mixing drum mounted for rotation in one direction about a substantially horizontal axis and wherein the mass of materials being mixed is displaced in the direction of drum rotation by an amount depending upon the consistency of the mixture; a reaction member mounted inside the drum for rotation therewith through the material in the drum and for movement with respect to the drum between defined positions, to one of which it is moved by engagement of the reaction member with the mixture in the drum; yieldable means for returning the reaction member to its other position as it disengages the mixture in the drum, so that the points in the orbit of the reaction member at which it changes its position are determined by the consistency of the mixture; indicating means stationarily mounted on an arc concentric with and adjacent to the drum; a movable element mounted on the exterior of the drum for rotation therewith and connected with the reaction member to be moved by the latter to a retracted position in which the orbit of a part of the movable element is spaced from the indicating means and to an extended position in which the orbit of said part of the movable element is adjacent to the indicating means; said indicating means being mounted in that part of the orbit of the indicator element in which the latter normally moves from one of its positions to the other so that said indicating

means cooperates with said part of the movable element to indicate the point in the orbit of the reaction member at which it changes its position, and thus depicts the consistency of the mixture.

8. In combination: a mixing drum rotatable about a substantially horizontal axis and in which the entire mass of materials being mixed is displaced in the direction of drum rotation a distance dependent upon the consistency of the mixture; a reaction member; means mounting the reaction member inside the drum for rotation with the drum through the materials therein and for movement with respect to the drum between defined positions, to one of which the reaction member is moved by its engagement with materials being mixed as it passes through the same during a portion of each revolution of the drum; means yieldingly biasing the reaction member to its other position so that the reaction member will move to said other position upon its disen-

gement from the materials being mixed, the points in the orbit of the reaction member at which it moves from one of its positions to the other in consequence of its engagement with and disengagement from said materials being determined by the consistency of the mixture; and means for indicating one of the points in its orbit at which the reaction member moves from one of its positions to the other.

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