CONTINUOUS WEIGHING APPARATUS

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This invention relates to apparatus for deliver-
ing material in a measured quantity and by con-
tinuous operation from a hopper to some type of a 
material receiving apparatus.

Among the objects of this invention is to pro-
vide a system for controlling the operation of the 
driving motor for a conveying belt, whereby the 
material may be stopped when material is no longer 
being deposited on the belt, or the amount of 
material on the belt drops below a desired mini-
mum, and automatically started when a predeter-
determined amount again becomes deposited on the 
belt. As a part of the system indicating means 
are provided for informing an attendant (or a 
central station) that the conveyor and motor are 
not functioning. A further object of the inven-
tion contemplates a motor controlling and sig-
alling system for a plurality of motor driven 
belts, whereby a drop in the operating condition 
of one belt will cause the stopping of the motor 
for driving that belt and the motor of a related 
conveying belt, and if either or both of two 
motors is shut down because of a drop in load of 
either or of both belts a signal will be given.

Other objects contemplate circuits and indicat-
ing means whereby different operating conditions 
of a flexible belt conveyor may be observed or 
recorded.

The invention has application to an ordinary 
conveyor belt of the endless variety type and 
which passes over a drum at each end. The 
drums and belt may be fixed or tiltable as a unit 
in relation to a hopper and reference will be 
made hereinafter to both types of conveyors.

The invention has other and incidental objects in 
view which consist in certain novel features of 
construction and combinations of parts, the es-
sential elements of which are set forth in the 
appended claims and a preferred form of embed-
ded of which is described hereinafter with ref-
ence to the drawings.

In the drawings, Fig. 1 is a side elevation of a 
conveyor belt unit tiltably mounted in relation 
to a hopper.

Fig. 2 is a section on line 2—2 of Fig. 1, show-
ing the position of the circuit controlling device 
under load conditions;

Fig. 3 is a section of the apparatus, similar to 
Fig. 2, illustrating the position of the circuit con-
trolling device when the conveyor is not carrying 
any load;

Fig. 4 is an enlarged view of the circuit con-
trolling device shown in Fig. 2, with the belt-con-
tacting roller shown in section;

Fig. 5 is a section of the circuit controlling 
device taken on line 5—5 of Fig. 4;

Fig. 6 is a plan of the circuit controlling device 
illustrated in Fig. 4;

Fig. 7 is a section on line 7—7 of Fig. 4;

Fig. 8 is a circuit diagram in which two pairs 
of contacts and circuits are illustrated, one for 
controlling the operation of a motor and the other 
for controlling an electrical indication or signal.

Fig. 9 is a circuit diagram showing the ar-
rangement for subjecting the operation of one 
conveyor to the control of the other conveyor, and 
indicating means for signalling the operating 
conditions of the two driving motors.

Fig. 10 shows a mercury contacts tube having 
four pairs of contacts.

Fig. 11 is a side elevation of an endless belt 
conveyor in which the drums and the belt are 
fixed in relation to the hopper.

The apparatus shown in Figs. 1, 2 and 3 com-
prises a frame and an endless belt which are 
mounted for pivotal movement as a unit about 
an axis. The endless belt, which is carried by 
the frame, is disposed beneath the outlet of a 
hopper from which material descends onto one 
end of the conveyor or belt. The driving mech-
anism, which consists of a motor and speed re-
duction mechanism, is mounted upon the pivoted 
frame and all of the devices carried by the frame 
are so related to one another as to maintain the 
frame in a position of substantial equilibrium 
about its pivotal axis when material is being 
measured by the conveyor. The material in the 
hopper bears upon the endless belt and the amount 
of the material leaving the hopper is depen-
dent upon the position of a gate which is 
mounted upon lever arms having link connection 
with the frame. The hopper, gate and linkage 
associating the gate with the frame is such that 
when the desired amount of weight of material 
being measured exceeds a desired weight, the 
gate will be lowered, and when the delivery of 
material falls below the desired weight, the gate 
will be opened; the normal tendency of the ap-
paratus being such that the gate inclines to be 
maintained in a definite position when the ma-
terial being weighed does not vary in specific 
gravity.

In view of the fact that it is possible to regu-
late the feed of material according to weight, 
several apparatuses may be used to measure dif-
ferent ingredients which are desired to be mixed 
together, and all of such apparatuses may be 
arranged to deliver into a common mixing ma-
chine. Owing to unavoidable circumstances,
such as bin segregation, and variation in the actual weight per unit of volume of a material containing coarse and fine particles, it is desirable that the feeding mechanism be sensitive to weight variation. In order that the weight of the material discharged may be determined with exactness, some materials, such as ores of certain grades and kinds, vary in specific gravity, and it would be wasteful if it should be necessary to segregate the ore before measuring it. In such cases, it is more economical to directly determine the quantity of ore as it is being delivered from a hopper, than to attempt "still" weighing or sorting for determination of quantity by summation of weights of segregated volumes of material sorted according to specific gravity.

Having reference to the drawings, frame 10 is mounted for pivotal movement about bearings 20, 21 which are carried by arms 12, depending from the sides of hopper 18. The conveyor or belt 14 passes over rollers 15, 16 and is driven in such a manner as to advance the upper span of the belt toward the roller 16. The rollers and the conveyor belt are so positioned on the frame 10 as to receive material from the hopper 13 in the vicinity of roller 15. The material carried by the belt is delivered from the apparatus as the belt passes over roller 16. The belt may be of any material which is capable of flexing under load and the ordinary commercial types of belts used for conveying material may be used. Leather, rubber or composition and fabric reinforced belts are suitable.

It is a feature of the apparatus of Figs. 1, 2 and 3 that the power means for driving the belt be mounted upon the pivotal frame in order that the balance of the frame and conveyor may not be affected because of the delivery of power thereto from power means located on the ground or from some place other than the pivoted portion of the apparatus. An electric motor is a convenient and compact power means, nonviable for operating the belt. The such power means for operating the belt. The motor 18 and speed reduction mechanism 19 are mounted upon the frame in such position as to partially compensate for the dead weight of the belt and rollers. A sprocket and chain 20 is used for driving the roller 15 from the speed reduction mechanism.

The quantity of material delivered from the hopper onto the belt is under the control of a gate 22 which is adapted to move in a vertical direction for varying the height of the heap of material being conveyed thereunder by the moving belt. The movement of the gate 22 is directly associated with the weight of material being conveyed, for when the weight of material being conveyed exceeds a desired weight for which the apparatus is designed or adjusted to measure, the gate will be caused to descend under the control of the conveyor whose delivery end will have tilted downwardly because of the excess weight carried thereby. When the weight of material carried by the conveyor falls below a desired normal delivery weight, the delivery end of the conveyor will rise and thereby cause the gate 22 to rise and permit an increase in the quantity of material to be withdrawn from the hopper by the belt. The gate is moved at a greater rate than the rate of rise of the belt below the gate and this results in a recurring effect to maintain a constant rate of delivery of material.

The gate 22 is carried by arms 23, one on each side of the hopper, and these arms are mounted for pivotal movement about shaft 24. One of arms 23 extends beyond shaft 24 and forms another arm 25, which is connected to frame 10 by means of arm pivot at its ends to arm 25 and frame 10. It is this mechanism which causes the gate 22 to be lowered when the delivery end of the conveyor lowers and vice versa, for the reasons above set forth.

In order to effect an adjustment of the apparatus for delivering a desired weight of material per unit of time, a weight 27 is provided, which is slidably mounted upon an extension of one arm 23. By a certain setting of the weight, the apparatus will continuously deliver a constant weight of material and will automatically maintain the delivery constant until readjustment of the apparatus is made.

When several apparatuses of this kind are being used to measure and maintain the weights of materials subsequently to be mixed, it is important that an operator be advised if one or more of the apparatuses should cease to deliver material. Even when only one apparatus is being utilized it is always desirable that the operator know if it is operating without performing any part of the material is being delivered from the hopper to the conveyor, it is wasteful to permit the conveyor to be driven, and its revolution counter will give a false reading. In order to apprise the operator of the operation of any particular apparatus and the character of the material being measured, I have provided circuit means suitable for giving necessary indications to inform the operator. I have disclosed forms of such means as being illustrative of the application of my invention. In Figs. 4 and 5, particularly, the circuit controlling means comprises a contacts carrying member 30, which is pivotally mounted to tip about pin 31, which is supported in a fixed position by means of a member 32. The normal position of member 32 is illustrated in Fig. 3.

Referring to Figs. 4 and 5, member 32 is mounted upon the upper end of a screw 33, which, in turn, is supported by a bracket 34 fastened to a bar 35 extending across the frame and between the upper span and the lower span of the belt 16. The bar 35 is carried by arms 36 which have their upper ends permanently fastened to the frame 10. The contacts carrying member 30 has mounted thereon a belt-engaging element, preferably in the form of a roller which is so positioned below the upper span of the belt as to be contacted by the same when the belt is carrying material. For this purpose a roller 40 may be placed in a position similar to that illustrated in Figs. 2 and 3, or it may be placed laterally at that position, but in most cases it is preferable to place the contacting element or roller nearer the center line of the belt than its edge. The roller 40 may be bevelled to a more or less degree as at 41, in order that the wear upon the belt may be maintained at a minimum. Screw 33 provides the means for varying the height of the roller in respect to the bracket 34 and the frame 10, and, when a desired adjusted position is obtained, the nut 42 is screwed home so as to lock the screw in a desired position.

In general, when the apparatus is adjusted and delivering a constant weight of material per unit of time, the position of the roller should be such as to engage the upper span of the deflected belt. Such a relation is illustrated in Fig.
When the belt is without load or with light load, the upper span of the belt is not deflected sufficiently to engage and tip the roller, see Fig. 3. The belts which are used are sufficiently flexible to deflect when loaded. The contacts carrying member 30 is so mounted upon pin 31 that it will tip to the position illustrated in Fig. 3 unless pressure is brought to bear upon the roller 40. The limits of swinging movement of the member about the pin 31 are determined by adjustment screws 43, 44, mounted in oppositely disposed arms 45, 46, respectively, which depend from member 32. The ends of the screws are so positioned as to engage an arm 47 which is carried by the contacts carrying member 30. The arm 47 is midway between the ends of screws 43, 44. In Fig. 2, the arm 47 maintains the contacts carrying device in the position illustrated by virtue of its engagement with the end of screw 43, and in Fig. 3 the engagement of arm 47 with screw 44 serves to prevent pivotal movement of the contacts carrying member 30. For the purposes of the disclosure of the invention, I have described what is my preferred form of device for mounting the roller 60, but it is to be understood that the specific construction described is merely illustrative and that other forms of device for mounting the belt engaging element and contacts carrying member may be utilized for practicing the invention.

For the purpose of simplifying the disclosure of my invention, I have illustrated the circuit controlling device as a glass tube 50 Figs. 2, 3, 4, 5 and 8 containing mercury and having but two pairs of contacts 51, 52 in Fig. 8. In order to facilitate positioning of the glass tube 50 on the contacts carrying member 30, pairs of spring members 53 are provided. In the wiring diagram of Fig. 8, terminal 53 is connected with a motor 54 which is connected to one side of battery 55. Terminal 56 is connected with the other side of the battery. When the contacts carrying member 30 and the tube 50 are tilted to the position shown in Fig. 2, terminals 53 and 56 will be closed by the mercury contained within the glass tube. When no load or a light load is being carried by the belt, the contacts carrying member 30 and the tube 50 are tilted into the position illustrated in Fig. 3, with the result that terminals 59 and 60 will be closed by the mercury 58 contained within tube 50. The closing of these terminals causes current to flow from battery 55 through lead 61, terminal 58, mercury 58, terminal 60, indicator 62, lead 63, back to battery 55, thus causing an indication to be given by the indicator 62. Th' indicator may be in the form of an audible signal such as a bell, or may even be used to operate the printing of a time indication upon a clock-controlled tape.

In Fig. 5, I have shown a wiring diagram showing how the contacts tubes for two conveyors may be placed in circuit so that if either (or both) of the two motors is shut off the other motor is shut off and an indication is given by signalling means. Briefly, contacts 65, 66 are in series and motors 67, 68 are in parallel with the source of power 69. If tube 70 is tilted, contacts 66 are opened and the motors receive no current, also contacts 71 close and current flows through contacts 65, contacts 71, (or 72), line 73, indicator 74, to the source of power 69.

The features of the invention so far described are also applicable to measuring apparatus having a frame tiltable as a unit in respect to the hopper. In Fig. 11 I have diagrammatically shown such a conveying belt up to two drums 77 and 78 whose axes of rotation are fixed in relation to a hopper 79. Just below or in the vicinity of the outlet of the hopper, a contacts carrying member similar to the one illustrated in Figs. 4, 5, 6 and 7 is mounted. With the contacts carrying member so placed and in contact with the under side of the upper span of the belt, different quantities of material on the belt under different operating conditions will cause different degrees of deflection of the belt and of the member. As a means of obtaining various indications of different operating conditions of the apparatus, I contemplate the use of a multi-contact signaling system, which will afford the means of indicating more than two different conditions.

The mercury tube having double sets of contacts, as illustrated in Figs. 2 and 3, 4, 5, and 6, is suitable for controlling the operation of the motor and for giving an indication of the fact that the operation of the motor has been discontinued. For controlling circuits operating means for indicating different degrees of loading, a number of similar contacts tubes may be used, and a single tube may be used similar to the tube illustrated in Fig. 10. This tube is curved and is provided with several pairs of contacts. This tube could be carried on a mounting similar to that provided for the contacts carrying member 30. Its various contacts would be closed, depending upon the position of the mercury within the tube and the angular position of the tube. In a multi-contact tube, for example, four sets of contacts might be provided. Contacts 61 could serve to maintain the motor in operation and to give an indication, if desired, that the apparatus is operating under normal conditions. Contacts 53 likewise would maintain the motor in operation and give an indication that the apparatus is measuring a quantity of material in excess of normal weight of material desired to be delivered per unit of time. Contacts 56 would maintain the motor in operation and give an indication that the apparatus is performing under a lighter load than normal. Contact 84 would be connected to an indicator to advise the operator that the motor had ceased operation.

It is apparent from the foregoing that one operator may watch the performance of several different apparatus, operating independently of each other or as a group of related apparatus and always be informed of the operating condition of any particular apparatus, whether in a group or not, as well as the condition of operation of the various groups of apparatuses. One operator may supervise the operation of several groups of measuring apparatuses and may also obtain a record of the performance of any one apparatus. When several apparatuses are being used to measure the quantities of different ingredients entering into a mix, a variation from normal operation of any one apparatus would cause the giving of a signal to indicate that the prevailing condition should be remedied.

I claim:
1. In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, an endless conveyor carried by said frame and tiltable with said frame, and operable to convey material in a direction lateral to the pivotal axis of said frame, means for indicating the loaded condition of said conveyor, said means comprising a contacts-carry
In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a conveyor including a belt and rollers carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said conveyor, said member including a multi-contact mercury containing tube for selectively controlling the circuits in accordance with various weights of material on said conveyor, at least one of said circuits being operative to control the operation of the conveyor.

In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said frame, means for indicating the loaded condition of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, and circuit means including contacts carried by said member for controlling the operation of said motor.

In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, and circuit means including contacts carried by said member for controlling the operation of said motor.

In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, and circuit means including contacts carried by said member for controlling the operation of said motor.

In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, and circuit means including contacts carried by said member for controlling the operation of said motor.

In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt carried by said frame and capable of being operable to pivot about the axis of said frame, a member carried by said frame and pivotally mounted thereon to respond to loaded conditions of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, and circuit means including contacts carried by said member for controlling the operation of said motor.
means for adjusting the operating position of said member in respect to said frame.

13. In combination, a continuous weighing apparatus comprising a frame pivotally mounted on a horizontal axis, a belt and rollers for actuating the same, mounted on said frame, and tiltable therewith, said belt being operable to convey material in a direction lateral to the pivotal axis of said frame, means for indicating the loaded conditions of said belt, said means comprising circuits and a contacts-carrying member pivotally mounted below said upper span, and adapted to be contacted by said belt when said belt is loaded with material, and means for adjusting the range of the angle of tilt of said member.

14. In combination, a continuous weighing apparatus comprising a belt, a motor for driving said belt, means for indicating different loaded conditions of said conveyor, means comprising an indicating device, circuits to said indicating device and circuits to said motor, and a tube containing contacts adapted to be closed by means of a selectively closing said circuits.

15. In combination, a continuous weighing apparatus comprising an endless conveyor, means for indicating the different loaded conditions of said conveyor, said means comprising a member pivotally mounted to respond to loaded conditions of said conveyor, pairs of contacts closable when said member is pivotally loaded and adapted to be engaged by the upper span of said belt when carrying material, and means for closing various circuits of said circuit means.

16. In combination, a continuous weighing apparatus comprising an endless conveyor, means for indicating different loaded conditions of said conveyor, said means comprising a contacts-carrying member pivotally supported below the upper span of said conveyor, a roller carried by said member pivotally mounted below the upper span of said conveyor, a motor for driving the belt, contacts-carrying means responsive to the deflection of the belt and circuit means for selectively controlling the circuits in accordance with various weights of material on said belt, and contacts-carrying means, being operative to control the operation of the motor.

17. In combination, a continuous weighing apparatus comprising a belt, an electric motor for operating said belt, a member pivotally mounted to respond to loaded conditions of said belt, and circuit means including a multi-contact mercury-containing tube for selectively controlling the circuits in accordance with various weights of material on said belt, at least one circuit being operative to control the operation of the motor.

18. In combination, a continuous weighing apparatus comprising a belt, a motor for driving said belt, a hopper having at least a portion thereof above an unsupported portion of the upper span of said belt, means for shutting down the motor when the load on said belt falls below a predetermined minimum, and means operable to shut off the motor when the load on said belt drops to a predetermined minimum and operable to give a signal when said motor is shut off, said circuit means being under the control of said contacts-carrying member.

19. In combination, a continuous weighing apparatus comprising a belt, a motor for driving said belt, a hopper having at least a portion thereof above an unsupported portion of the upper span of said belt, a contacts-carrying member pivotally mounted below said upper span and in the vicinity of said hopper, said member being in contact with said belt, and circuit means operable to shut off the motor when the load on said belt drops to a predetermined minimum and operable to give a signal when said motor is shut off, said circuit means being under the control of said contacts-carrying member.

20. In combination, a continuous weighing apparatus comprising a belt, a member adjustable in position by the deflection of said belt, a motor for actuating said belt, and circuits under the control of said belt for controlling the operation of said motor.

21. In combination, a continuous weighing apparatus comprising a belt, a hopper, means for indicating the loaded conditions of said belt, said means comprising circuits and a contacts-carrying member carried by said frame and pivotally mounted thereon and adapted to be contacted by said belt when said belt is loaded with material, and means for adjusting the operating position of said member in respect to said hopper.

22. In combination, a continuous weighing apparatus comprising a belt, a hopper, means for indicating the loaded conditions of said belt, said means comprising circuits and a pivotally mounted contacts-carrying member adapted to be contacted by said belt when said belt is loaded with material, and means for adjusting the range of the angle of tilt of said member.

23. In combination, a continuous weighing apparatus comprising a belt, a contacts-carrying member pivotally supported below the upper span of said belt, said member being adapted to be engaged by the upper span of said belt when carrying material, a motor for driving said belt, circuit means including contacts carried by said member for controlling the operation of said motor.

24. In combination, a plurality of continuous weighing devices, each comprising a traveling belt and a motor for driving the belt, contacts-carrying means responsive to the deflection of the belt and circuit means under the control of said contacts carrying means for shutting down the driving motors of all of said belts under the control of the contacts means of any one of said belts.

25. In a device of the class described, the combination with a frame mounted on a horizontal axis, of a conveyor including a belt, rollers, and a motor carried by said frame and tiltable with said frame, an indicating device, circuits to said indicating device and said motor, a contacts-carrying member carried by said frame and tiltable independently of said frame for selectively closing said circuits.

26. In a device of the class described, the combination with a frame mounted on a horizontal axis, of a conveyor including a belt, rollers, and a motor carried by said frame and tiltable with said frame, an indicating device, circuits to said indicating device and said motor, a contacts-carrying member carried by said frame and tiltable independently of said frame for selectively closing said circuits.