(No Model.)

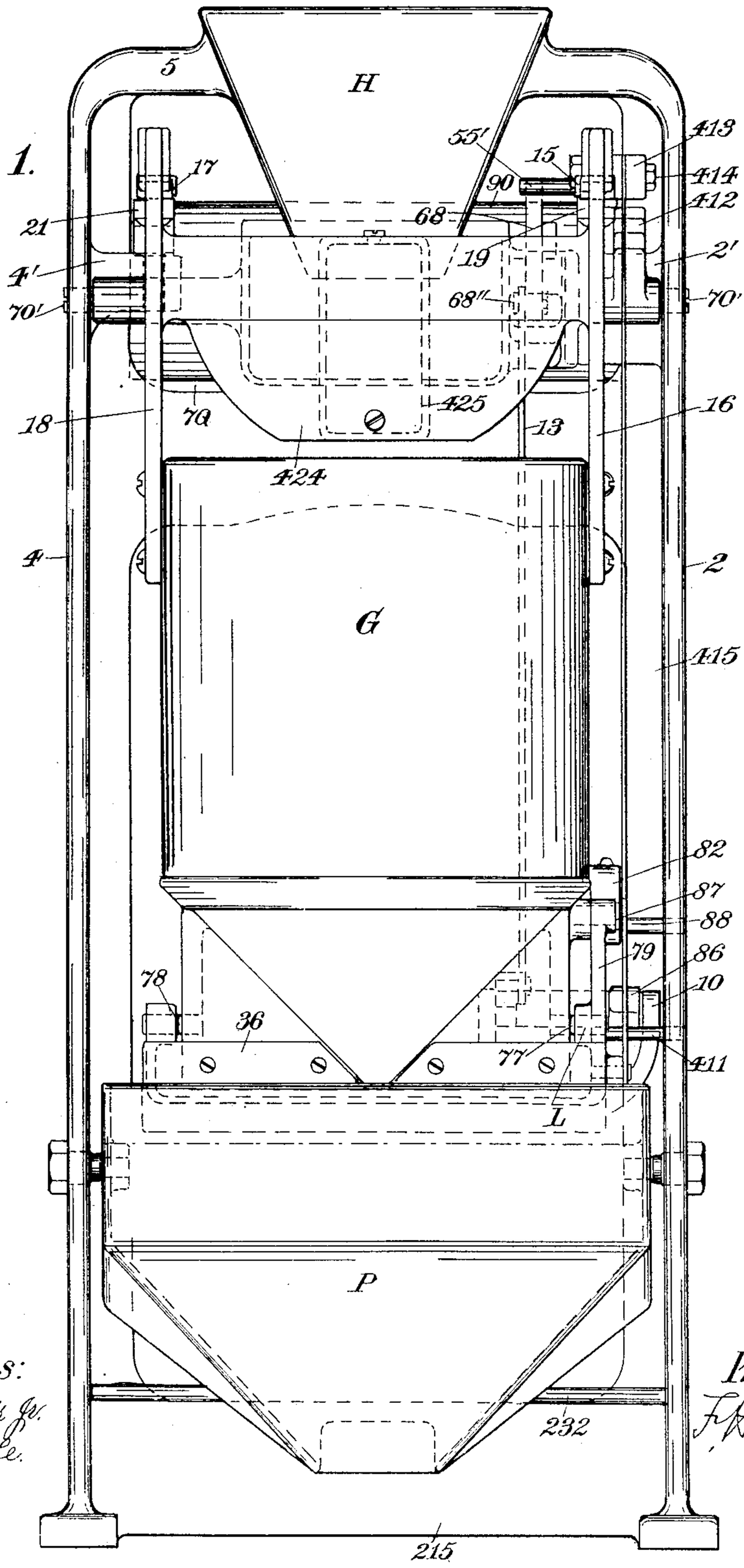
8 Sheets—Sheet 1.

F. H. RICHARDS.

AUTOMATIC WEIGHING MACHINE.

No. 535,729. Patented Mar. 12, 1895.

Fig. 1.



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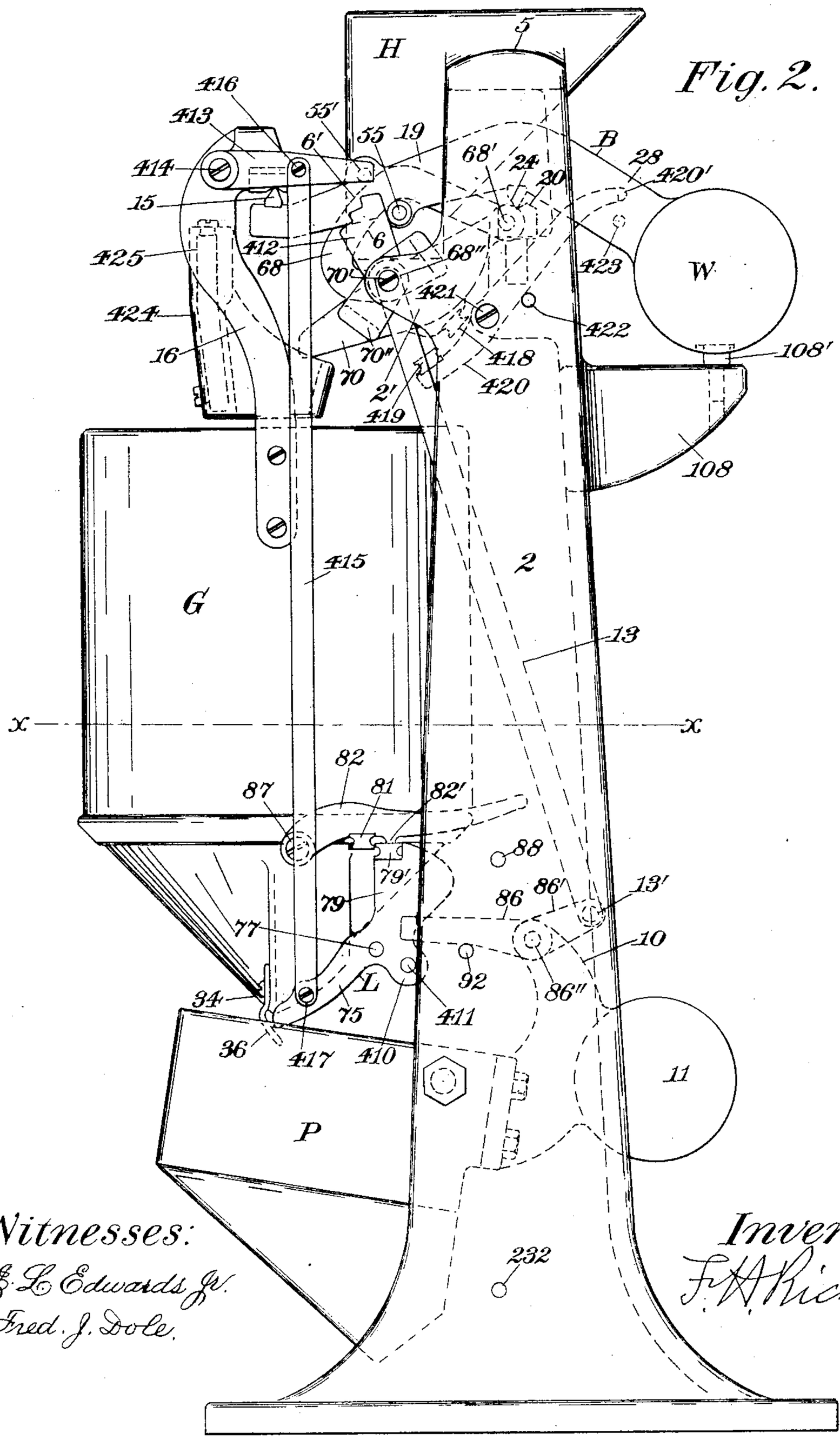

Fig. 2.

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Fig. 3.

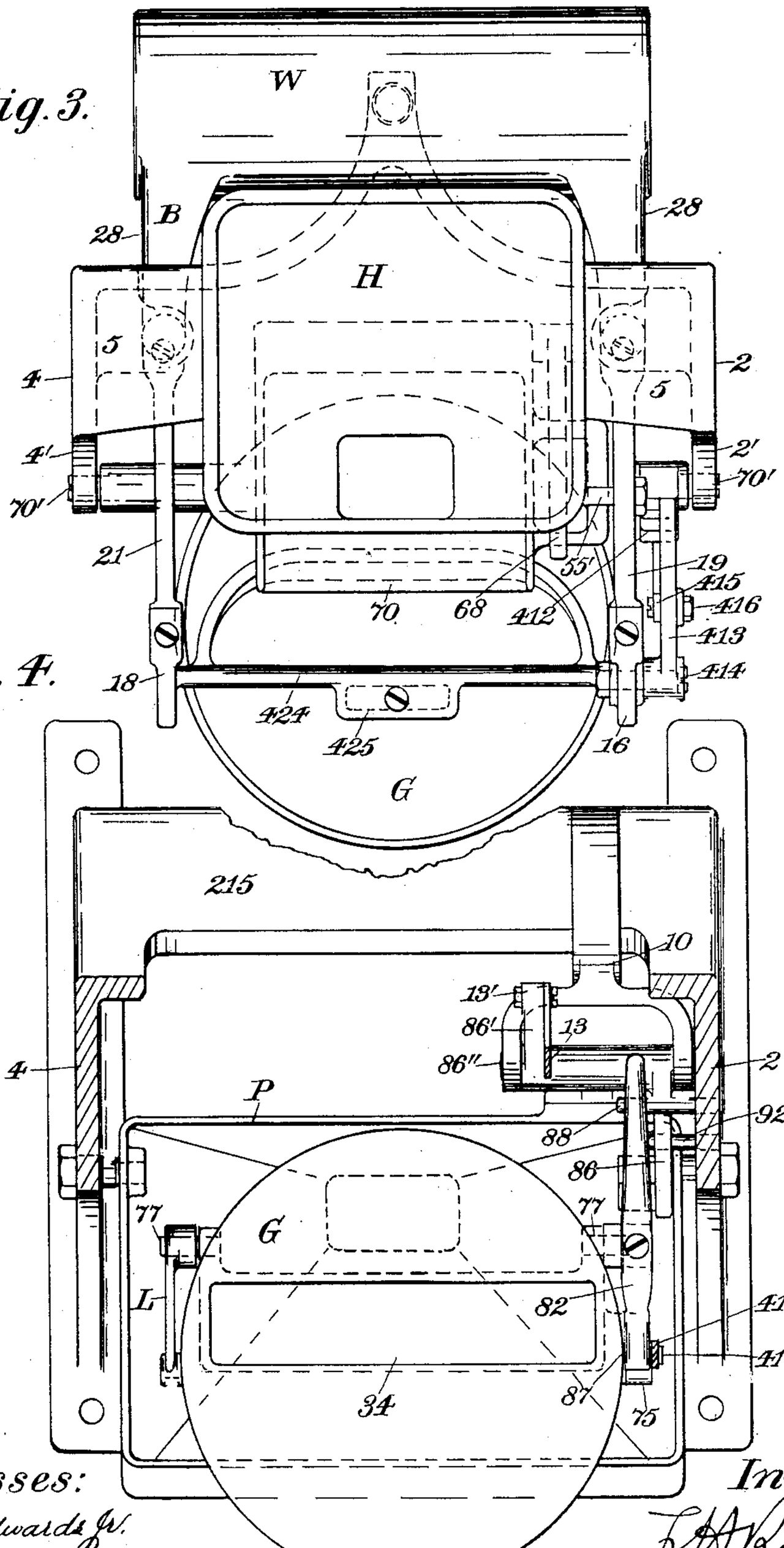

Fig. 4.

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AUTOMATIC WEIGHING MACHINE.

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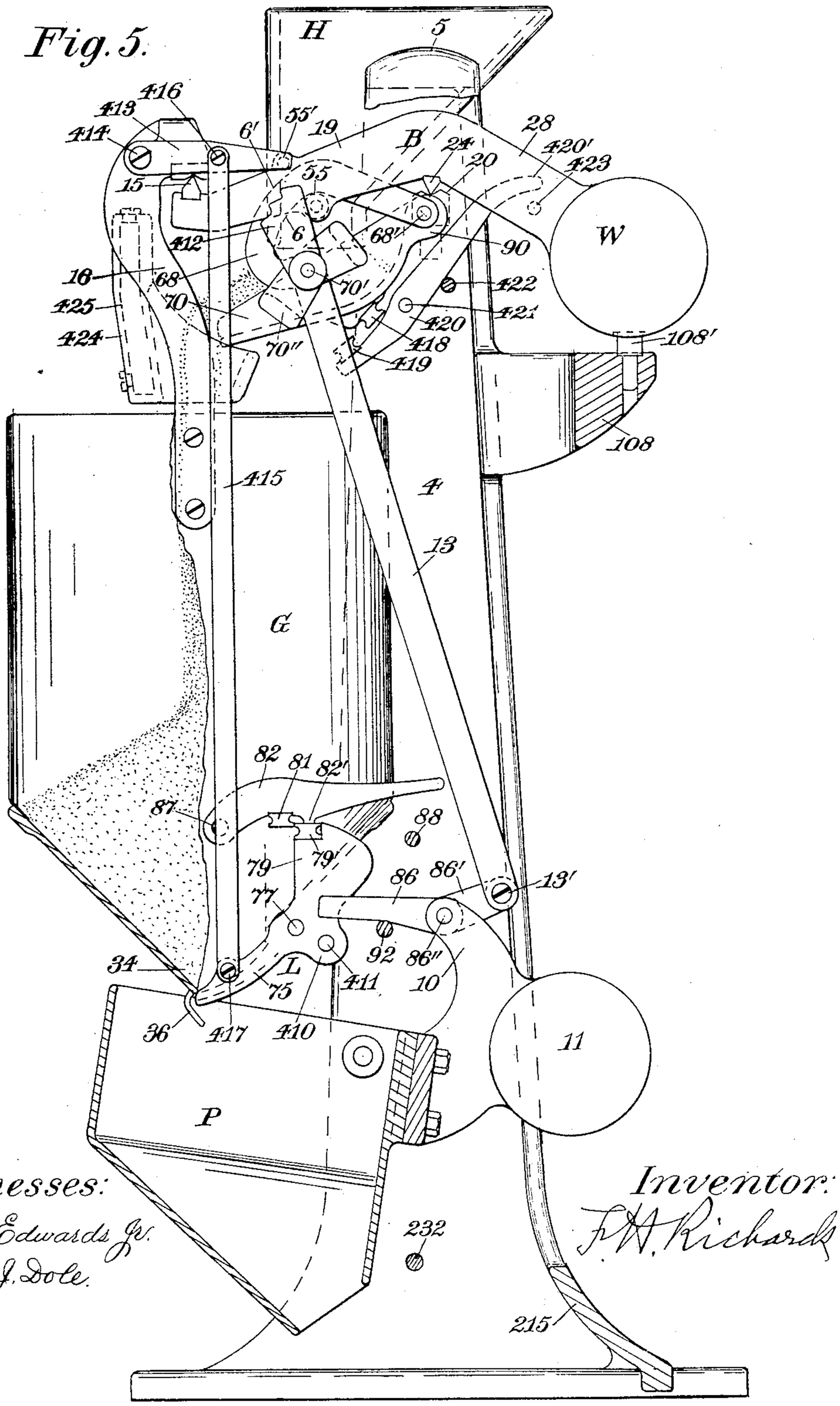
Fig. 5.



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AUTOMATIC WEIGHING MACHINE.

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Fig. 6.

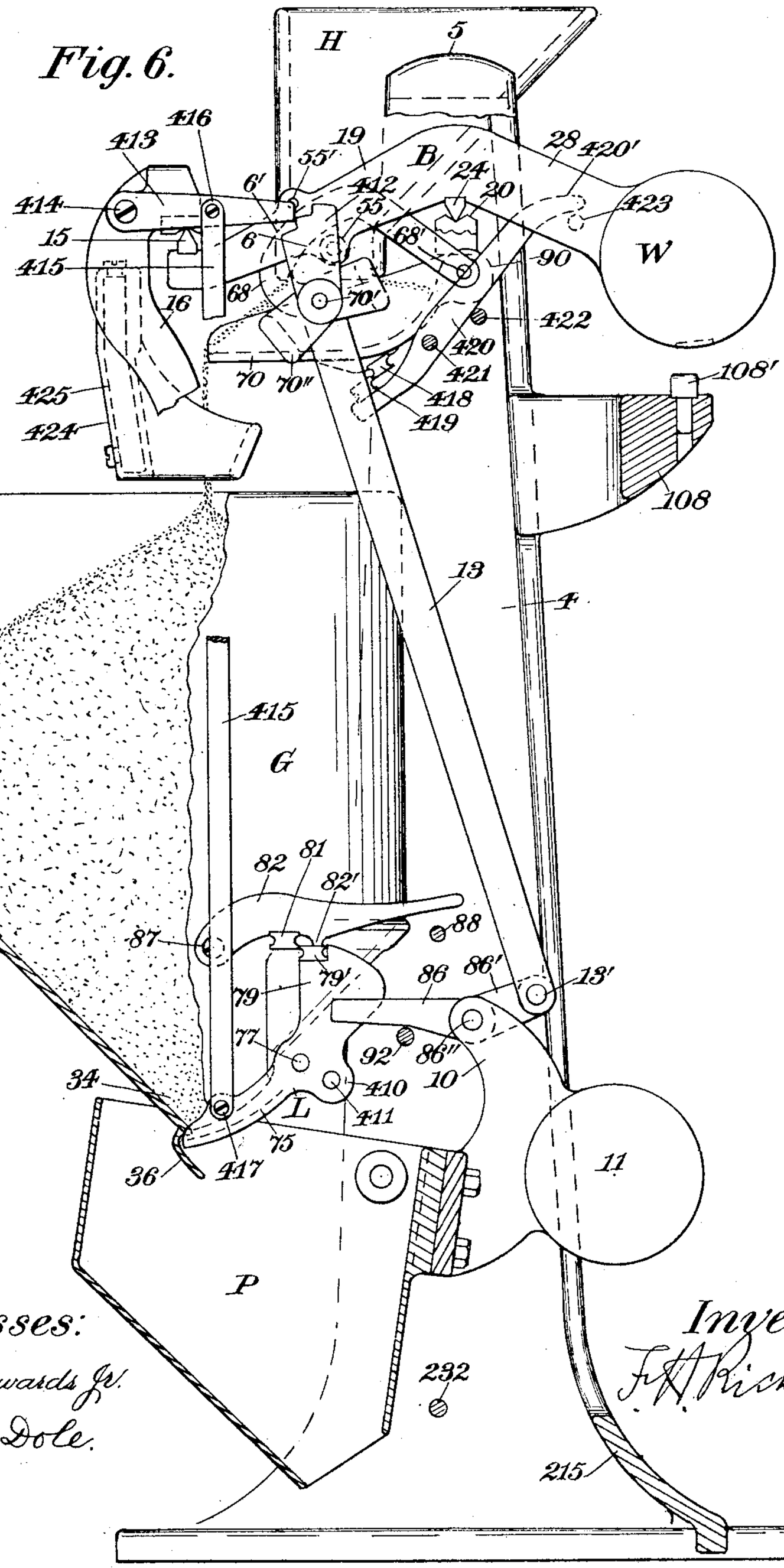

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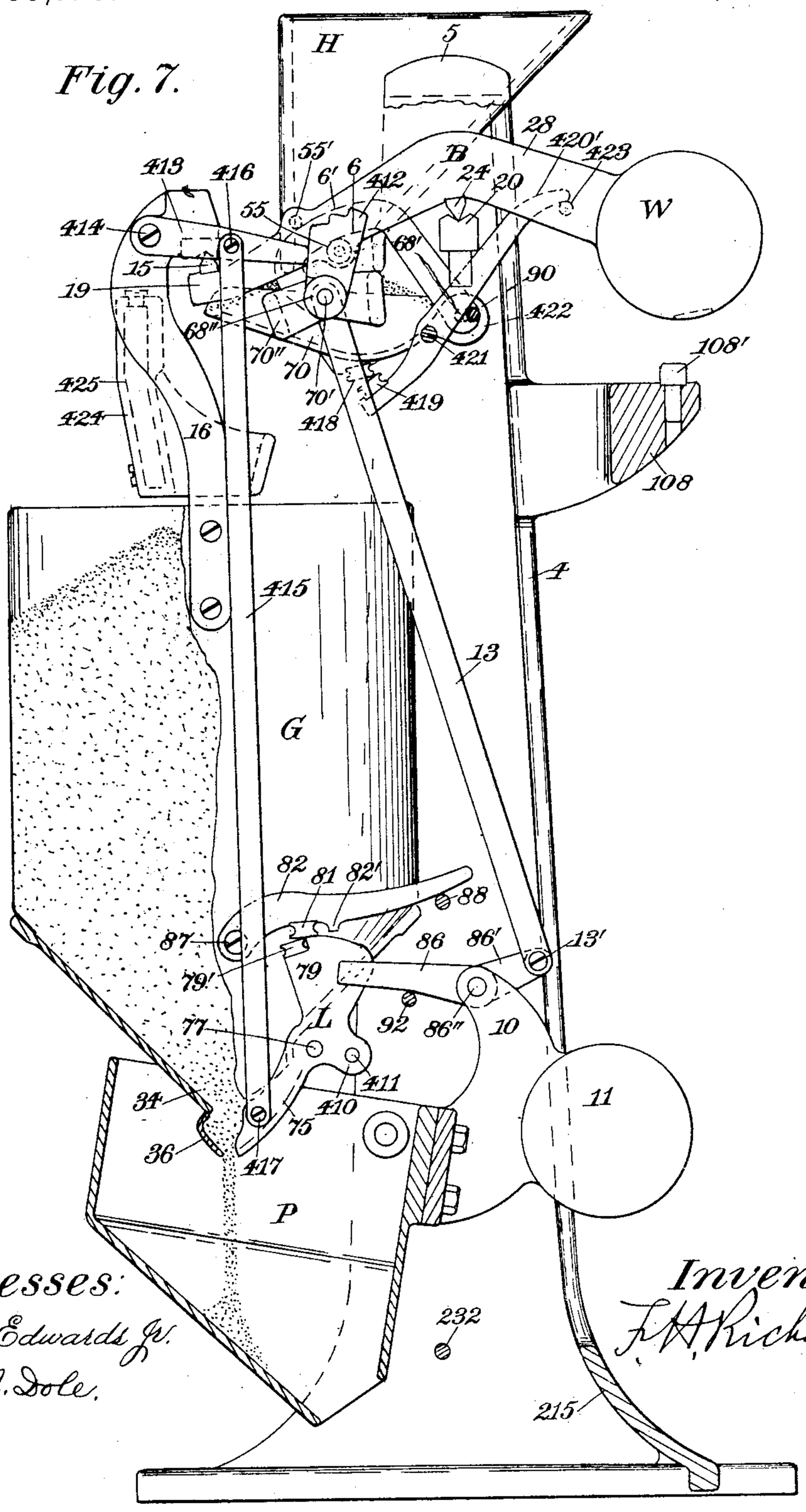
Fig. 7.



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AUTOMATIC WEIGHING MACHINE.

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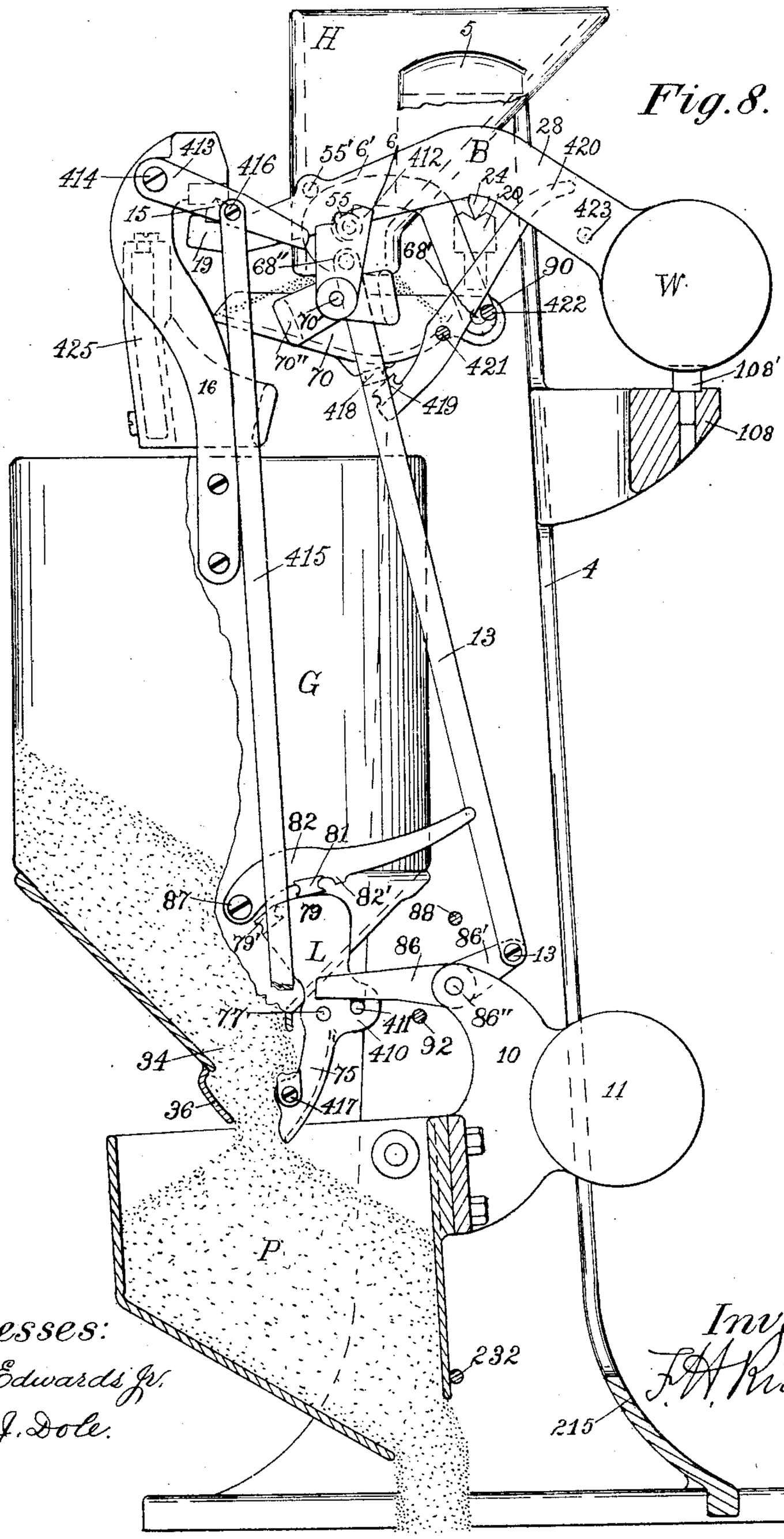
Fig. 8.



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(No Model.) 8 Sheets—Sheet 8.

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AUTOMATIC WEIGHING MACHINE.

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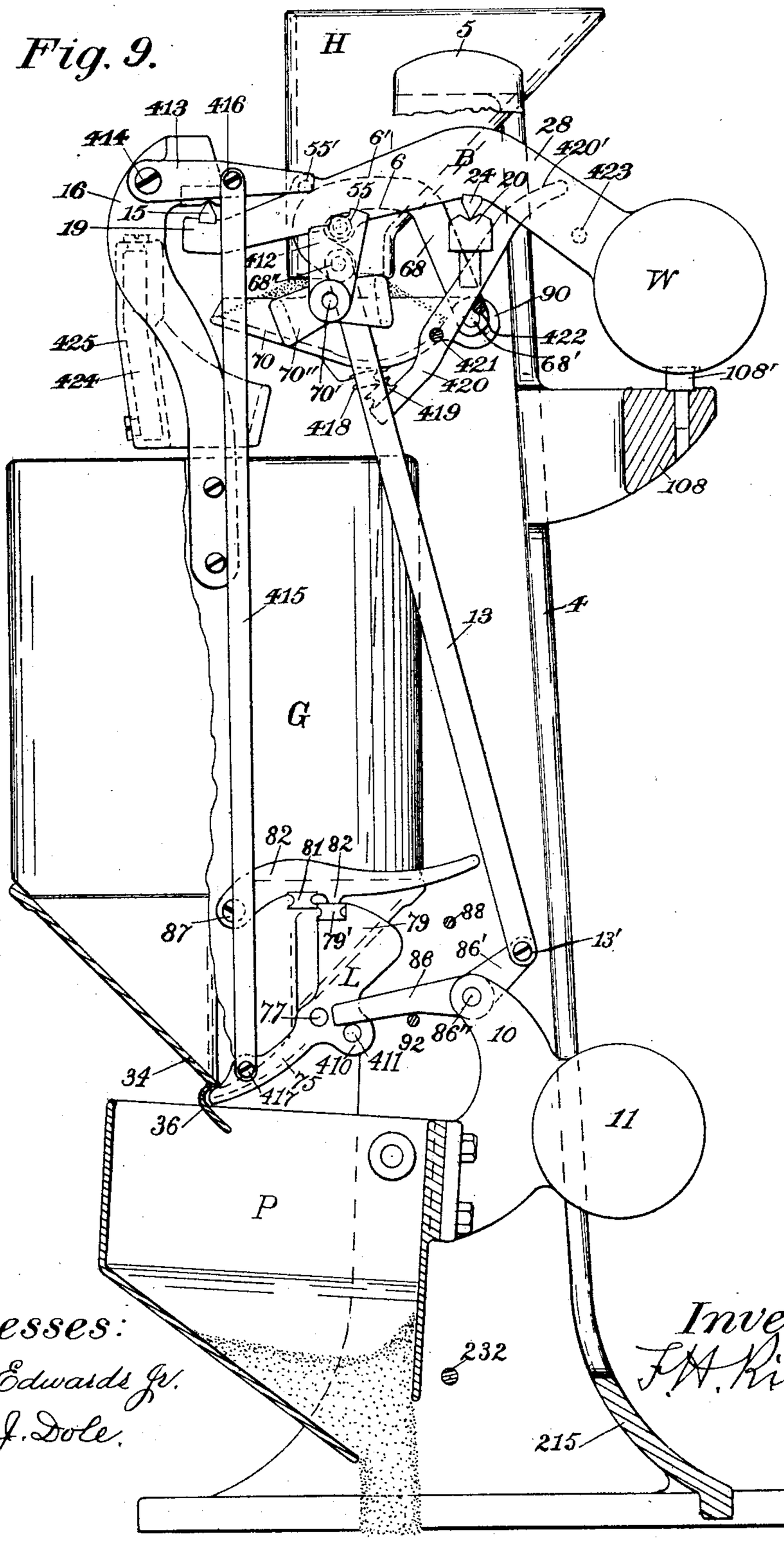
Fig. 9.



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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

AUTOMATIC WEIGHING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 535,729, dated March 12, 1895.

Application filed July 20, 1894. Serial No. 518,100. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Automatic Weighing-Machines, of which the following is a specification.

This invention relates to automatic weighing-machines of the single bucket class; the object being to provide an organization of mechanism adapted to positively and reciprocally interlock the movements of the valve and the bucket-closer operating-devices of such machines so as to prevent either the valve or the bucket-closer opening accidentally while the other is open. This result is obtained by a series of interdependent latches and stop-devices, in operative connection with the bucket-closer, the valve and the hopper into which the bucket discharges, all of the movements of which are positively controlled in a determined order by the preceding movements of the operating and controlling mechanism.

In the drawings accompanying and forming a part of this specification, Figure 1 is a front elevation of an automatic weighing-machine embodying my present improvements. Fig. 2 is a side elevation of the same looking from the right of Fig. 1. Fig. 3 is a plan view of the same. Fig. 4 is a transverse section taken in line *x*—*x* Fig. 2. Figs. 5 to 9 inclusive are sectional side elevations, corresponding to Fig. 2, and showing successive steps of the operation of the machine, including the action of the regulator apparatus.

Similar characters designate like parts in all of the figures.

The framework for carrying the operative parts of this machine usually, and as shown in the drawings, comprises two side frames or uprights 2 and 4, held together by the top-plate 5, carrying the supply-chute H, and at the bottom by the beam or part 215, Figs. 1 and 5.

The grain-bucket G, is of the single-chambered type or class, and is shown suspended under the supply-chute H by means of the hangers 16 and 18, that are fixed to the bucket and are suspended by V-shaped bearings on the pivots or knife-edges 15 and 17, respectively, of the principal arms 19 and 21 of the scale-beam B. This beam has pivots or knife-edges such as 24, one at each side of the machine and near the center of the under side of said beam. Said pivots rest on V-shaped bearings, such as 20, secured upon the side-frames. Opposite to the arms 19 and 21, an arm 28 extends, rearwardly of the scale-beam axis, and is provided with a counterpoise or main-weight such as W, upon its extreme end.

The bucket-closer, designated in a general way by L, is shown as consisting of a suitably-formed plate or closer proper 75, having a weighted arm 79, preferably formed integral therewith and pivoted to the bucket G at 77 and 78. Said plate is preferably formed as shown, so as to hold the material without closing against the edges of the bucket-spout 34, but closes under said spout-edges and contiguous to the guard 36, so that the said material is kept from leaking out without requiring close fitting of said parts. The arm 79 is shown, extending above the pivot 77, to engage with a catch 81, of a latch 82, by means of its catch 79′, and thus lock said closer when the stop faces of these catches are in engagement, as shown in Fig. 2. The bucket-closer is shown as having its center of gravity to the right of its pivot or axis when closed, and said center is shiftable to the left of the axis when the closer stands in its open position. The bearing-face of the arm 79, upon which the catch 81 works is shown as a broad cam-surface so that the said stop will remain in contact with the cam-face while the bucket-closer is in its open position. Said bucket-opening latch or lever 82, is pivoted at 87 to the bucket, and extends rearwardly to engage with a pin or similar stop, 88, which is fixed in the upright 2 of the frame, for unlocking the closer upon the descent of the bucket. The downward movement of said latch is limited as before stated by the weighted arm 79, of the closer.

In order to hold the closer in its open position, and also to return said closer to its shut position when the bucket has been emptied, an arm or stud 410, carrying an eccentrically-disposed pin 411, is shown as forming part of the closer. The said pin is disposed within the path of a latch or lever 86, shown as pivoted to an arm 10 of the regulator-hopper P,

and adapted to engage the pin 411, and hold the closer in its open position when the bucket is discharging. The said latch is also adapted to shut said closer by engagement with said pin, when the hopper rises, after discharging the load received from the bucket, by reason of the downward movement imparted thereto by the descent of the arm 10 and weight 11. This movement of the latch for shutting the bucket-closer is about the point 13′, as a fulcrum. The downward movement of the forward end of the latch or lever 86 is limited by a fixed stop 92, and said stop also forms the pivotal point or fulcrum for the latch or lever when the downward pull of the weight 11 upon the end 86′ thereof draws down the connecting rod 13 for opening the valve. Said rod 13 forms the means for transmitting the movement of the emptied hopper to the devices for opening the main valve, which, with said operating device, forms the stream-controlling means. This valve I have shown at 70 as pivoted within the arms or brackets 2′ and 4′ of the side-frames, the pivot or axis of movement being designated 70′. Said valve is also shown located beneath the mouth of the supply-chute, and as extending beyond the forward edge of said chute sufficiently far to support the descending column or stream when the valve is closed. Said valve is shown also as weighted at its rearward end at 90, so that the valve normally has a tendency to close. The pull of the rod 13 is opposed to the force exerted upon the valve by its weighted end 90, and is transmitted to said valve by means of a valve-operating device, such as the link 68, pivoted to the rear of the valve at 68′ and to the upper end of the connecting-rod at 68″. This link is furnished with a working or cam-face 6, that is in operative relation with the stops or actuators 55 and 55′ upon the scale-beam. In the construction herein shown the connecting-rod and its link are passed through an opening formed by a link 70″, preferably integral with the side of the valve, in order that the movements of said link and rod may not conflict with the movements of the valve or of adjacent portions of the mechanism. The stops or members 55 and 55′ upon the scale-beam serve as valve-actuators only during the downward movement of the beam, when the bucket is being poised and carried to its discharge point. During the opening of the valve from a closed position these stops are fixed points with respect to the link and its cam-face, and the lower stop or member 55 forms the pivotal point or axis upon which the cam-face moves and thereby through the downward movement of the connecting-rod and the upward pull upon the rear end of the valve, the gradual opening of the valve is effected. It will be seen that the pull of the connecting-rod can only be effective to open the valve-mechanism when the member or actuator 55 is a fixed point about which the link may move and that the actuation of said valve for the purpose of opening it can therefore be effected by the hopper only after the discharge of the load emptied therein from the bucket; for, after the bucket reaches its poising point, the member 55 becomes a movable actuator for closing the valve, and after the discharge of the load from the bucket, although the beam returns with the actuator to a position such as to permit the opening of the valve by the hopper, yet the weight of the load discharged into the hopper, has thrown the lever-arm 86 into an inoperative position, with respect to its stop 92 which controls the movement of said lever for opening the valve; and hence the weight 90 continues effective to hold the valve in its closed position.

It will be understood that when the movement of the scale-beam is referred to herein the movement of the bucket-supporting arms is meant, that, of course, coinciding in direction with the movement of the bucket itself.

The valve 70 is also shown as having formed integral therewith a detent or stop-arm 412, provided with a sloping and stepped stop-face. The said stop-face is adapted to be engaged, during the closing movement of the valve, by a lever or latch-arm, such as 413, which is shown as pivoted to the hanger 16 at the point 414. Said latch or stop is also shown as having connection, by means of the rod 415, with the lower end of the bucket-closer L. The pivotal points at which the connecting-rod is joined to the latch and the closer are designated respectively, 416 and 417.

In the normal position of the machine, with the valve open for the introduction of the flow stream into the bucket and with the hopper empty, the lever or guard-latch 413 is out of engagement with the stop-face of the lever detent-arm 412, the rear end of the latch being then above the stop-face. The connecting-rod 415 is so proportioned that the latch can only be clear of the detent when the bucket-closer L is in its shut position, and hence it will be evident that the latch constitutes a valve-stop, operative with the closer, and independently of the operation of the valve, and which stop is positioned and adapted to intercept the opening movement of the valve when the closer is opened.

With the operating mechanism in the position shown in Figs. 2 and 5, there can be no movement of the parts until the bucket has been filled to a sufficient height to bring it to the beginning of its poising movement. At this time, as will be seen from Fig. 6, the actuators 55 and 55′ will ride down the cam-faces 6 and 6′ of the link 68, until they reach a point about midway between the ends of the cam-faces. Simultaneously with the riding down of the actuators on said cam-faces, the valve 70 turns, by reason of the preponderating effect of its weighted, rear end, until it has reached a point where it discharges into the bucket only a very small drop-stream. This may be termed the end of the reducing action of the valve, and at this point the catch 418 upon the valve meets the stop or catch

419, upon the forward end of the latch-lever 420, and is engaged by said stop. A latch 420 is pivoted as at 421, preferably to the side-frame of the machine, and its downward movement is limited by means of a fixed stop, such as 422, which is so disposed that the long or weighted arm 420′, of the lever holds the stop 419 at the proper point for engaging the catch 418 at the end of the reducing movement of the valve. Simultaneously with the movement of the valve the detent arm 412 has been oscillated and carried slightly upward and to the rear. At the same time the guard-latch 413 is carried down by the descent of the bucket until the rear end thereof is brought opposite to and in engagement with the upper end or step of the stop-face of the detent, thereby locking the valve against return movement.

When the scale-beam reaches the end of its poising movement an actuating-pin or stop 423 is caught under the end 420′ of the latch 420, and, raising said arm of the latch, releases the stop 419 from engagement with the catch 418, thereby permitting the weight 90 to become effective again to operate and close the valve. During this final movement of said valve the position of the cam-portion of the link is only slightly altered by the descent of that arm of the link which is connected to the rear of the valve, and it will be understood that the position of the opposite pivotal point of the link, where it connects with the rod 13, has not been altered, owing to the fact that upward movement of said rod is prevented by engagement of the latch 86 against the stop 92, the pivotal point of the said latch with the arm 10 of the hopper being at this time fixed. The overpoising of the beam has at the same time caused the further descent of the bucket and thereby of the guard-latch 413, so that said latch now engages the stop-face of the detent 412 at a lower point thereof, the said detent having been still further oscillated to the rear by the closing movement of its valve, as shown in Fig. 7.

At the end of the overpoise period of movement of the bucket the bucket-closer latch 82 strikes the fixed stop 88, and thereby releases the bucket-closer from engagement with the catch 81. The weight of the load is then effective to fully open said closer and carry it to the position shown in Fig. 8. As soon, however, as the weight of the load in the bucket is sufficiently lessened by the outflow of the material therefrom said bucket returns to its normal position, and the counterpoise weight W is again engaged by its stop 108′, carried by an aperture or recess in the bracket 108, which is shown as formed integral with the side-frames of the machine. As the bucket-closer is carried to the position shown in Fig. 8, by the force of the out-flowing load, the center of gravity thereof is shifted until it lies forward of the pivot 77. It now becomes necessary to prevent further movement thereof in the same direction, and hence the stop 411, becomes effective to prevent too great a movement of said closer. By the oscillation of the bucket-closer said stop is caught under the latch 86 and thereby held from further movement. This engagement of the said bucket-closer stop by the latch 86 is due to the fact that, by the discharge of the material into the hopper, said hopper has descended and thereby given the latch a forward and upward rocking movement, which has released it from engagement with the top 92. When the latch is carried to this position it is maintained therein until the return or ascent of the hopper, as the pivotal point 68″ is fixed with respect to the rod 13 and with respect to the latch and hopper. The rising of the latch and its forward rocking cannot affect the position of the said pivotal point 68″, for the reason that there is no stop on the upper side of the latch 86 to engage said latch, and hence no force can be exerted upwardly upon the rod 13, as the said latch is capable of oscillation upon the two pivotal points 13′ and 86″, and therefore is movable, during the descent of the hopper, with respect to both the connecting-rod 13 and the hopper. The weight of the counterpoise W is also ineffective to actuate the link 68, as the movement of the scale-beam is prevented by the counterpoise resting upon the stop 108′. It will therefore be seen that no force acting in a longitudinal direction can be exerted upon the rod 13 at this time, as the only other force of any kind adapted to act upon said rod is that of the weighted rear portion of the valve, and the preponderating influence of said valve is neutralized and rendered ineffective by the engagement of the end wall of the cam-face against the actuator or stop 55. Simultaneously with the opening of the bucket-closer the connecting-rod 415 is drawn down, and the guard-latch now holds the detent at the lowest point of this stop face. The positions of the valve and bucket-closing devices remain as shown in Fig. 8 until the bucket is completely emptied and until the ascent or return of the hopper. The counterpoise 11 may be of such a weight, relatively to the weight of the hopper and its load, as to cause the return of said hopper either at about the time the hopper is completely emptied or at any other point desired that is within working limits.

As soon as a portion of the load has been discharged sufficient to permit the ascent of the hopper, the descending arm 10 will carry down with it the latch 86, which by engagement with the pin or stop 411, will rock the bucket-closer and force it back to its shut-position, whereupon the stop 79′ will be engaged again by the catch 81 and the closer locked in said position. Simultaneously with the shutting of the bucket-closer, the connecting-rod 415 is carried up, and with it the guard-latch 413, which it then releases from engagement with the stop face of the detent

412. The partial rise of the hopper is sufficient to disengage said latch from the detent, and indeed the movement of the latch 86 to lock the bucket-closer shut is only effected by the beginning of the downward movement of the arm 10. At a predetermined point in the upward movement of the hopper, and the downward movement of the said arm 10 carrying the counterpoise 11, the lever or latch 86 strikes the stop 92, and its effect upon the stop 411, for shutting the bucket-closer, of course ceases. Thereupon the fulcrum of the lever changes and instead of residing in the pivot 13′ said fulcrum is shifted to the stop 92. As the outer end 86′ of the latch must now oscillate about said stop 92 as a center, the connecting-rod 13 will be correspondingly actuated and drawn down. The pull of the rod 13 carries with it the link 68, which, riding down upon the actuator 55, draws up the rear end of the valve and opens said valve until the actuator reaches the rear wall 68′ of the link at the upper end of the cam-face 6, and is stopped thereby. As the valve has now returned to its open position the stream from the supply-chute will again flow into the bucket.

For limiting the downward movement of the regulator-hopper, I employ any suitable stop, such as 232, the said device being here shown as a connecting or tie-rod joining the two side-frames of the machine. In order to secure a uniform and even loading of the bucket I preferably mount upon and within the hangers 16 and 18 a guide or spout such as 424, the front wall of which is so disposed, relatively to the stream flowing from the valve, that the forward flight of the stream is checked, and the descending material caused to flow into the bucket centrally thereof, and thereby insure a uniform and even weighting of the bucket and building up the load. This is important as an uneven loading of the bucket at its forward side tends to cause the descent of said bucket before it has received its proper load and thereby impair the accuracy of the operation. Said guide or chute is provided preferably with a shot-passage, such as 425, in order to obtain a perfect balancing of the bucket-mechanism with respect to the counterpoise-weight W. The bucket-latch 82 is shown provided with a lower stop-face 82′, co-operating with the catches 81 and 79′. This stop-face is provided for the purpose of holding the meeting faces of said catches in position without overlapping.

It will be evident from the foregoing that by means of the guard-latch, co-operating with the detent upon the valve, said valve will be positively held against return movement during the closing thereof and the shutting off of the stream for during the whole of the period commencing with the beginning of the poising movement and ending with the shutting of the bucket-closer after the hopper has returned to its normal position from discharging a load, the end of the guard-latch will be opposed to some part of the stop-face of the detent and engaged thereagainst. This guard-latch and detent, together with the connections to the bucket-closer or their equivalents, constitute an automatic locking-device for holding the valve against opening during the reduction and cut-off of the stream, no matter at what point of said closing movement the valve may be.

It will be seen that the connection of the guard-latch with respect to the hanger and to the bucket and its closer is a normally fixed one. As long as the bucket is up and unloaded, with the closer shut, the said guard-latch will be disconnected from the detent and in an inoperative position. A fixed latch upon the hanger would of course prevent the turning or opening of the valve from the beginning of the poising movement to the end of the over-poise and the beginning of the rise of the bucket, but when the bucket began to rise the latch would be carried up by the hanger and would shortly thereafter become disengaged from the detent before the bucket reached its uppermost position, and, of course, long before the shutting of the bucket-closer by the hopper-actuated devices. Hence the shiftable latch is necessary, in order to prevent the return or opening of the valve during the period beginning with the rise of the bucket which has discharged its load and the ending with the closure of the bucket from the hopper. As soon therefore as the bucket opens the bucket-closer-actuated means draws the latch so far down that the return of the bucket and the scale-beam to their normal positions is ineffective to disengage said latch from its detent, and said latch will be held in engagement with the detent as long as the bucket-closer remains open, which is until the rise of the hopper after discharging the load received from the emptied bucket.

Some suitable connected means operable by the discharged material, by which the opening of the valve and the closing of the bucket are prevented until the regulating devices have returned to their normal position, I term herein a "regulator" or "regulating-means."

It will be seen that, as soon as the beginning of the poising-movement is reached the actuator 55 begins to travel down the cam-face 6 and the said cam-face oscillates or rocks about the actuator, thereby causing the valve-operating member or link controlled by said cam-face to gradually close the valve. When this closing movement begins, backward movement of the valve is prevented by engagement of the guard-latch with the detent, and, when the end of the reducing movement of the valve is reached, the catch 418 is engaged by the shiftable stop 419, controlled by the counterpoised latch or lever 420. Hence, at the end of the reducing movement and while the drip-stream is flowing into the bucket as shown in Fig. 6, the valve will be locked against both forward and backward movement, that is, against closing entirely as

well as against return or opening. This reducing period is necessarily of short duration, and as soon as the end of the poising movement is reached the stop 423 will release the stop 419 from engagement with the catch 418, and thereby permit the closing of the valve and the cut-off of the drip-stream. After the bucket has reached its lowermost position and the bucket-closer is opened by the bucket-latch engaging the stop 88, the material comprising the load of course flows out. As soon as the counterpoise W returns the scale-beam to its original position the guard-latch is also carried upward upon the stop-face of the detent but is not disengaged therefrom, as the additional arc of movement given to it by the bucket-closer in opening is sufficient to hold the end of said latch against the upper part of the stop-face. When the valve reaches the end of its closing movement and the emptied bucket has returned to its normal position, the actuator 55, is at the lower end of the cam-face 6 of the valve-operating member or link, and said link is locked against opening by the abutment of the guard-latch against the stop-face of the detent, and locked against further downward movement of its preponderating rear end by the engagement of the actuator in the elbow of the link at the lower end of the cam-face. The only force that can be exerted now upon the valve is that of the hopper, and this does not become effective until the major portion of the load discharged thereinto by the bucket is emptied. Upon the rise of the hopper, however, the downward movement of its bucket-opening and valve-closing means causes in succession the shutting of the bucket-closer and the opening of the valve. The bucket-closing and valve-opening means being comprised in a single operating lever or latch, working in conjunction with simple stops or operating pins, two movements are herein utilized to effect the two desired results. In the first of these movements the lever rocks or oscillates about the point 13′ as a fulcrum, as the resistance of the bucket-closer is comparatively slight, and causes the shutting of the said closer and its locking in position by means of the latch 82. As soon, however, as the closer reaches the end of its movement the stop or pin 411 becomes a fixed abutment. Exertion now being at the point 86″, the rear end of said lever is drawn down until the under side of the long arm thereof strikes the fixed stop 92 upon the side frame, whereupon said stop becomes the pivotal point of the second movement of the lever, and the connecting-rod 13 is drawn down, causing the valve-operating member to ride down by its cam-face upon the stop or axis 55, and thereby return the valve to its open position. This sequence of the two movements is necessary in order that the guard-latch 413 may not be released from engagement with the detent upon the valve until the bucket is positively closed; and the resistance of the bucket-closer and of the valve to the force of the lever 86 is so proportioned that the bucket-closer will yield first and immediately upon the descent of said lever, whereas the weight upon the valve is so much greater that the valve will not yield until the lever 86 has its fulcrum practically fixed by engagement with a fixed stop upon the frame. An additional factor tending to protect and render absolute this sequence of movements is the variable and gradually increasing force exerted by the hopper as it rises. When it first begins to rise the material therein, as is usual in practice, has not been entirely discharged, so that the force exerted by the counter-weight 11 is at first not very great but gradually increases as the remainder of the load is discharged and as it acquires increased momentum. The very slight force exerted during the initial movement of the hopper is entirely inadequate to move the valve-operating mechanism, but is sufficient to shut the bucket-closer and thereby disengage the guard-latch from the valve-detent. The force exerted subsequently, and during the final part of the ascending movement of the hopper, is very great, and is ample to cause the connecting-rod 13 and the valve-operating link to actuate the valve and draw it open. It will be noticed also that the guard-latch forms a positive locking means in the nature of a fixed abutment, and that any movement tending to cause the opening of the valve before the bucket-closer is shut will bind and wedge the detent even more securely against the end of the latch.

In the drawings two actuators or members 55 and 55′ are shown upon the scale-beam. The former of these two members is the true actuator, however, as the part 55′ is intended principally to serve as a guard to prevent tampering with the valve and consequent movement thereof and of the connected mechanism which would interrupt the operation of the machine.

It will be evident that, by means of my present improvements, a positive control of all parts of the mechanism is maintained; that said control is automatic and not liable to interruption by accident or carelessness; and that all of the movements for reducing and cutting off the flow of the supply stream and for reopening the valve are controlled by the corresponding movements beginning with the commencement of the poising of the bucket and ending with the reclosure of said bucket after the discharge of the load. To obtain this positive control, my invention comprises, in part, and in combination with a bucket having a closer, and with a valve, means for actuating the valve to open and close the same independently of the operation of the bucket-closer, and mutually-dependent means, which are operative, respectively, with the valve and with the closer, for reciprocally limiting the opening movement of the closer by the non-closing of the valve, and for limiting the opening of the valve by

the non-closing of the closer; that is to say, the opening of the closer is prevented by the valve until the valve is closed, and the opening of the valve is prevented by the closer until the closer is shut; so that the closing of the valve and the opening of the bucket are reciprocal with each other, and the closing of the bucket and the opening of the valve are also reciprocal. These mutually-dependent means are shown herein in the form of two coacting stops, one operative with the valve and the other operative with the closer, and so disposed, relatively to each other, that each serves as a stop-device for the other. I preferably provide, in connection with the valve-mechanism, and with the bucket-mechanism, a swinging stop, pivotally supported upon one of said mechanisms, and operative with the bucket-closer, whereby said stop has a swinging movement with said mechanism and relatively thereto; and I also provide a stop carried by and operative with the other of said mechanisms, coacting portions of these two stops being disposed so that each will serve as a stop-device for the other stop. In the preferred embodiment of the invention, which is illustrated in the present application, the swinging stop is shown as having its pivot in fixed relation with the bucket and movable therewith, connecting means, operative with the closer, being shown as having a pivotal connection with said stop substantially midway between the pivot of said stop and the free end thereof, so that such stop will have a multiplied, swinging movement; that is to say, a double movement in one direction, a portion of which movement is due to the descent of the bucket, and the other part of which is caused by the opening of the bucket-closer, the free end of this stop co-operating with the free end of the other stop which is fixed to the valve, each of said stops being adapted to form a stop-device for the other.

The valve is shown as a normally open one, controlled in the open position by the counterweight upon the hopper, but tends to close, and is adapted to be closed by means of the usual actuator on the scale-beam co-operating with the cam-face of the valve-operating member. The opening movement of said valve is not due, however, to the movement of the actuator, but is controlled from and by the hopper, and is effected immediately after the forcing shut of the bucket-closer by said hopper. The valve therefore, is prevented from opening until said closer is shut, as the force exerted for opening the valve is transmitted by the same means that shuts the bucket-closer and by the latter of two movements thereof, or rather by the latter part of one continuous movement. The first of said movements, or the first part of the movement, which controls the shutting of the bucket-closer, also controls the release of the guard-latch, whereby the opening of said valve is prevented until the actual closure of the bucket. The opening of the valve follows the release of the latch, and is dependent upon the prior closing of the bucket for its unlocking, and upon the subsequent movement of the hopper-controlled actuating-means for its opening movement. Moreover, the locking of the bucket-closer is just as effectually maintained during the loading of the bucket, when the valve is in its open position, as the bucket closer latch holds the closer securely in its shut position until the bucket is overpoised, at which time the valve has been carried again to its final shut-off position, and the guard latch will then hold in that position as long as the bucket is down, and also while it is up with the bucket-closer standing in its open position. It is evident therefore that all of the operations necessary to the loading and discharge of the bucket are interdependent and that there is also a mutual dependency of the opening and closing movements of the valve with the loading of the bucket and the opening thereof, and the closing of said bucket, respectively, so that said movements are reciprocals of one another; that is to say, the opening movement of the valve is reciprocal to the closing of the bucket, and the opening of the bucket is reciprocal to the closing of the valve, and in the various operations of the latches, stops, &c., for controlling the movements of the different parts of the operating devices, this reciprocal relation of movements, controlling the loading and the discharge of the bucket, is positively maintained by the proper detents, latches, stops and other controlling means.

The effective force of the loaded-bucket and hopper during their downward movements and until the beginning of the ascent of the hopper, I term the "load-force;" and the interval between the commencement of poising of the bucket and the beginning of ascent of the hopper I term the "load-force period." During this load-force period the valve is either closing or else closed, for, from the moment the load-force becomes effective to start the bucket upon its downward course until the hopper begins to rise, this force is present and acting upon the valve, either to permit its being carried through its cycle of closing movements or else to positively lock it against return movement. The guard-latch is brought opposite the stop-face of the valve detent as soon as the load-force begins to act, and it is not removed from engagement therewith until the bucket-closer is shut upon the commencement of the ascent of the hopper. Hence it will be seen that, by means of this positive locking of the valve, return movement thereof is prevented during the whole of the load-force period, whether the valve is in the closed position or is being closed. It will also be noticed that this load force comprises the sum-total of several forces acting in the same direction and that these forces are not only simultaneous in their periods but separately considered have dif-

ferent functions. The first part of the load force is the force exhibited by the bucket from the beginning of the poising movement thereof until the end of its downward movement is reached and the closer is unlocked. This part of the load-force reduces the drip-stream, cuts off the flow of the material and unlocks the bucket, thus causing its discharge. It also brings the guard-latch into engagement with the valve-detent. The second part of the load-force is that exerted upon the hopper by the discharge of the material from the bucket. It serves to prevent the shutting of the bucket-closer, thereby maintaining the locking of the valve against return movement, permits the return of the valve-operating member, and shifts the operating devices into position for closing the bucket and opening the valve when the hopper returns to its normal position. The force exerted by the weighted valve is, of course, included in the load-force. The other half of the cycle of movements of the machine is effected by what I term the "reactive-force." This reactive-force is exerted through the gravital inclination of the two counterpoise weights W and 11. The weight W acts first to return the bucket to its normal position; and the counterpoise 11 subsequently returns the hopper also to its normal position, closes the bucket and opens the valve. I do not wish to be understood as including the actuating force of the weight W for returning the bucket to its normal position as a part of the reactive-force, but simply as including within the term "reactive-force" those portions of the force exerted by the machine which are effective for closing the bucket, releasing the valve-locking means and returning the valve to its open position. Hence the actuating force of the weight W for returning the bucket is not included within the term "reactive-force," but only the static force of position of said weight, for holding the bucket in its normal position, is so included.

So far as the operation of the machine is concerned with respect to the reciprocal closing of the valve and opening of the bucket and, conversely, with respect to the closing of the bucket and the opening of the valve, the force exerted for returning the bucket to its normal position need not be considered.

In order to distinguish the operation of the machine for closing the bucket and opening the valve from the operation of closing the valve and opening the bucket, I term the interval beginning with the rising of the hopper after discharging its load and ending with the beginning of the poising of the bucket the "reactive-period." From the foregoing it will be apparent that the load-force acts, during the load-force period, to control the valve movement, to discharge the bucket and to prevent return movement of the valve; while the reactive-force is effective, during the reactive-period, to close the bucket, to release the valve-locking means and to positively actuate said valve to open it.

Having thus described my invention, I claim—

1. In a weighing-machine, the combination with a bucket having a closer, and with a valve, of means for actuating the valve to open and close the same independently of the operation of the bucket-closer, and mutually-dependent means operative respectively with the valve and with the closer for reciprocally limiting the opening movement of the closer by the non-closing of the valve and the opening of the valve by the non-closing of the closer.

2. In a weighing-machine, the combination with a scale-beam, a valve-mechanism, a bucket carried by the scale-beam, and a closer for the bucket, of means in position and adapted for actuating the valve-mechanism on the descent of the scale-beam for reducing the supply-stream, a stop-arm on the valve-mechanism, and means in connection with the bucket-closer and in position and adapted for engaging said stop-arm during the load-force period to hold the valve-mechanism against return movement during said period.

3. In a weighing-machine, the combination with a scale-beam, a valve-mechanism, a bucket carried by the scale-beam, and a closer for the bucket, of means actuated by the poising movement of the beam for reducing the supply-stream and locking the valve-mechanism against closing, means actuated by the overpoise movement of the beam for releasing the valve-mechanism and cutting off the supply-stream, a stop-arm on the valve-mechanism, and means in connection with the bucket-closer and in position and adapted for engaging said stop-arm during the load-force period to hold the valve-mechanism against return movement during said period.

4. In a weighing-machine, the combination with a valve-mechanism, and with a bucket having a closer, of two coacting stops one operative with the valve and the other operative with the closer and in position and adapted each to serve as a stop-device for the other, substantially as described.

5. In a weighing-machine, the combination with valve-mechanism having a stop-arm, and with a bucket having means for closing the same, of a stop adjacent to the valve-mechanism and connected with the bucket-closing means and in position and adapted for engaging said stop-arm to hold the bucket-closing means closed when the valve-mechanism is open and for engaging said stop-arm to hold the valve-mechanism closed when the bucket-closing means is open, substantially as described.

6. In a weighing-machine, the combination with a valve-mechanism, and with a bucket-mechanism having a closer, of a pivotally-supported swinging stop operative with the closer and having its pivot in fixed relation

with one of said mechanisms and movable therewith whereby said stop has a swinging movement with said mechanism and relatively thereto, and a stop carried by and operative with the other of said mechanisms, said stops having coacting portions in position and adapted to serve each as a stop-device for the other stop, substantially as described.

7. In a weighing-machine, the combination with a valve-mechanism, and with a bucket having a closer, of a pivotally-supported swinging stop having its pivot in fixed relation with the bucket and movable therewith, connecting means operative from the closer and pivoted to said stop substantially midway between said first mentioned pivot and the free end of the stop whereby said stop has a multiplied swinging movement with the bucket and relatively thereto, and a stop carried by and operative with the valve, said stops having their free ends in position and adapted to serve each as a stop-device for the other, substantially as described.

8. In a weighing-machine, the combination with a bucket having a closer, and with a valve, of means actuating the valve independently of the operation of the closer, and a valve-stop operative with the closer and independently of the operation of the valve and in position and adapted for intercepting the opening movement of the valve on the opening of the closer.

9. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and the regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby cutting off the supply-stream, a stop-arm upon the valve-mechanism, and means in connection with the bucket-closing means and in position and adapted for engaging said stop-arm during the load-force period to hold the valve mechanism against return movement during said period, substantially as described.

10. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby reducing and cutting off the supply-stream, a stop-arm upon the valve-mechanism, and means in connection with the bucket-closing means and in position and adapted for engaging said stop-arm during the load-force period to hold the valve-mechanism at any point of its closing movement against return movement during said period, substantially as described.

11. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means actuated by the poising movement of the beam for reducing the supply-stream and locking the valve-mechanism against closing, means actuated by the overpoise movement of the beam for releasing the valve-mechanism and cutting off the supply-stream, a stop-arm upon the valve-mechanism, and means in connection with the bucket-closing means and in position and adapted for engaging said stop-arm during the load-force period to hold the valve-mechanism against return movement during said period, substantially as described.

12. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means actuated by the poising movement of the beam for reducing the supply-stream, a stop adapted to lock said valve-mechanism against closing at the end of the reducing movement, means actuated by the overpoise movement of the beam for releasing the valve-mechanism and cutting off the supply-stream, a stop arm upon the valve-mechanism, and means in connection with the bucket-closing means and in position and adapted for engaging said stop-arm during the load-force period to hold the valve-mechanism at any point of its closing movement against return movement during said period, substantially as described.

13. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, and a bucket, of means controlled by the descent of the scale-beam for actuating said valve-mechanism and thereby cutting off the supply-stream, a detent for said valve-mechanism, a latch adapted to engage said detent upon the descent of the beam, and thereby prevent return movement of the valve-mechanism, and means controlled by the opening of the bucket for holding said latch in engagement with the detent upon the return of said bucket, substantially as described.

14. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means connected with the bucket-closing means and in position and adapted for closing the valve-mechanism and releasing said bucket-closing means during the load-force period and preventing return movement of said valve-mechanism during said period, and means also connected with the bucket-closing means and in position and adapted for locking said bucket-closing means closed and opening the valve-mechanism during the reactive period, substantially as described.

15. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means connected with the bucket-closing means and in position and adapted for closing the valve-mechanism and releasing said bucket-closing means during the load force period and preventing return movement of said valve-mechanism during said period, and means also connected with the bucket-closing means and in position and

adapted for simultaneously locking said bucket-closing means closed and releasing the valve-mechanism during the reactive period and subsequently opening said valve-mechanism during said period, substantially as described.

16. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, a regulator, and a stop-arm upon the valve-mechanism, of mutually-dependent means cooperating with said stop-arm and in position and adapted, respectively, for closing the valve-mechanism and opening the bucket during the load-force period, and mutually dependent means connected with the regulator and in position and adapted for closing the bucket and opening the valve-mechanism during the reactive period, substantially as described.

17. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, a regulator, and a stop-arm upon the valve-mechanism, of mutually-dependent means cooperating with said stop-arm and in position and adapted, respectively, for releasing and closing the valve-mechanism and preventing the opening of the same and opening the bucket during the load-force period, and mutually-dependent means connected with the regulator and in position and adapted for closing the bucket and opening the valve-mechanism during the reactive period, substantially as described.

18. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, a regulator, and a stop-arm upon the valve-mechanism, of mutually-dependent means cooperating with said stop-arm and in position and adapted, respectively, for closing the valve-mechanism and opening the bucket during the load-force period, and mutually-dependent means connected with the regulator and in position and adapted for successively closing the bucket and opening the valve-mechanism during the reactive period, substantially as described.

19. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means connected with the bucket closing means and in position and adapted for closing the valve-mechanism and releasing the bucket-closing means during the load-force period and for preventing return movement of said valve-mechanism during said period, and means connected with the regulator for locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, substantially as described.

20. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing the bucket, and a regulator, of means connected with the bucket-closing means and in position and adapted for closing the valve-mechanism and releasing the bucket-closing means during the load-force period and for preventing return movement of said valve-mechanism during said period, and means connected with the regulator for successively locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, substantially as described.

21. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, and a regulator, of means connected with the bucket-closing means and in position and adapted for closing the valve-mechanism and releasing the bucket-closing means during the load-force period and for preventing return movement of said valve-mechanism during said period, means connected with the regulator for locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, and means actuated by the closure of the bucket for unlocking the valve-mechanism and permitting said return movement thereof, substantially as described.

22. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing said bucket, and a regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby cutting off the supply-stream, a detent for said valve-mechanism, a latch adapted to engage said detent upon the descent of the beam and thereby prevent return movement of the valve-mechanism, means connected with the bucket-closing means and in position and adapted for bringing said latch into engagement with the detent upon the release of said bucket-closing means and for maintaining said latch and detent in engagement upon the return of the bucket, and means also connected with the bucket-closing means and in position and adapted for locking said bucket-closing means closed and opening the valve-mechanism during the reactive period, substantially as described.

23. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing said bucket, and a regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby cutting off the supply-stream, a detent for said valve-mechanism, a latch adapted to engage said detent upon the descent of the beam and thereby prevent return movement of the valve-mechanism, means connected with the bucket-closing means and in position and adapted for bringing said latch into engagement with the detent upon the release of said bucket-closing means and for maintaining said latch and detent in engagement upon the return of the bucket, and means connected with the regulator for locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, substantially as described.

24. In an automatic weighing-machine, the

combination with a scale-beam, valve-mechanism, a bucket, means for closing said bucket, and a regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby cutting off the supply-stream, a detent for said valve-mechanism, a latch adapted to engage said detent upon the descent of the beam and thereby prevent return movement of the valve-mechanism, means connected with the bucket-closing means and in position and adapted for bringing said latch into engagement with the detent upon the release of said bucket-closing means and for maintaining said latch and detent in engagement upon the return of the regulator, and means connected with the regulator for successively locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, substantially as described.

25. In an automatic weighing-machine, the combination with a scale-beam, valve-mechanism, a bucket, means for closing said bucket, and a regulator, of means in position and adapted for actuating said valve-mechanism upon the descent of the scale-beam and thereby cutting off the supply-stream, a detent for said valve-mechanism, a latch adapted to engage said detent upon the descent of the beam and thereby prevent return movement of the valve-mechanism, means connected with the bucket-closing means and in position and adapted for bringing said latch into engagement with the detent upon the release of said bucket-closing means and for maintaining said latch and detent in engagement upon the return of the bucket, means connected with the regulator for locking said bucket-closing means closed and opening the valve-mechanism upon the ascent of said regulator, and means actuated by the closure of the bucket for unlocking the valve-mechanism and permitting said return movement thereof, substantially as described.

FRANCIS H. RICHARDS.

Witnesses:
FRED. J. DOLE,
EMMA G. FOWLER.