

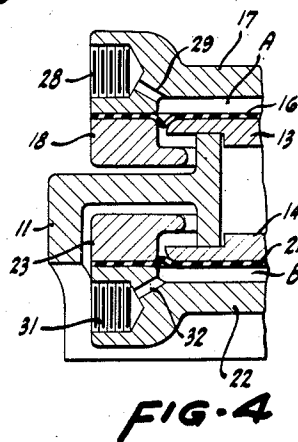
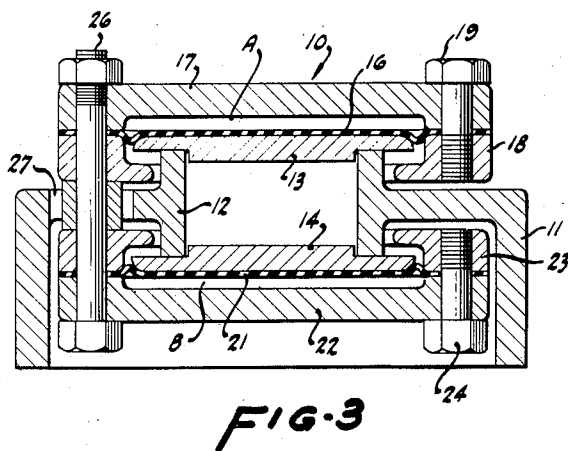
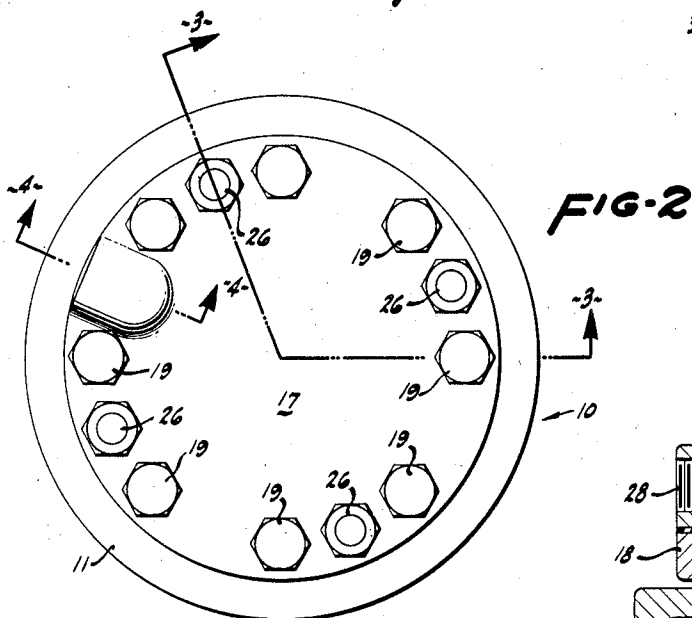
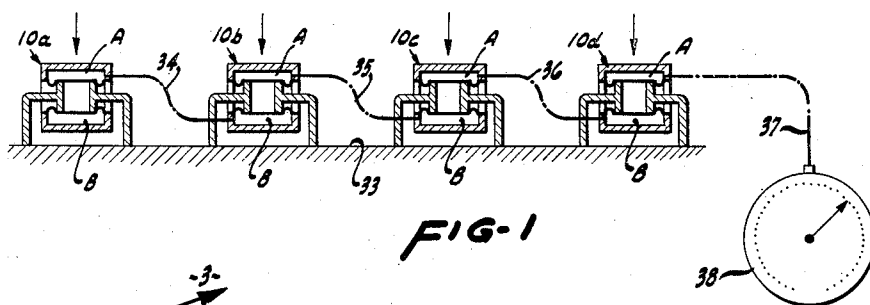
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2,830,804

HYDRAULIC SCALES

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HYDRAULIC SCALES

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My invention relates to hydraulic scales wherein a plurality of weight receiving hydraulic load cells and a pressure indicating device are serially connected one to another to summate the total weight imposed on the load cells.

An object of this invention is to provide a double acting hydraulic load cell provided with a pair of expansible chambers each having a wall engageable with the frame of the cell and a wall movable with respect to the frame, and in which the movable walls are interconnected so that one chamber will be contracted upon expansion of the other chamber.

A further object of the invention is to provide a plurality of load cells each provided with a first expansible chamber having a wall normally engaged with the frame of the cell and a wall adapted to have a load imposed thereon and movable with respect to the frame engaging wall, a second expansible chamber having a wall normally engaging said frame but movable away therefrom and a wall movable with respect to the frame, and means interconnecting the movable walls so that the first chamber will be contracted upon expansion of the second chamber, and in which the plurality of load cells are serially interconnected, with the first chamber of each cell fluidly connected to the second chamber of the next cell, and in which the first chamber of the last serially connected cell communicates with a pressure indicating device.

Other objects and advantages will become apparent in the course of the following detailed description.

In the accompanying drawings, forming a portion of the specification, and in which like parts are designated by like reference numerals throughout the same,

Fig. 1 is a schematic view of my invention showing a plurality of load cells connected in serial manner to serve as a load totalizing device.

Fig. 2 is a plan view of one of the load cells shown schematically in Fig. 1.

Fig. 3 is a cross-sectional view of a load cell, taken along line 3—3 of Fig. 2.

Fig. 4 is a partial cross-sectional view of a load cell, taken along line 4—4 of Fig. 2.

Referring to the drawings, and particularly to Figs. 2, 3 and 4 thereof, the reference numeral 10 refers generally to a load cell having a frame member 11 provided with a central annular flange 12. Seated on the upper end of flange 12 is a circular supporting plate 13, and a corresponding supporting plate 14 is rested on the lower end of flange 12.

A flexible diaphragm 16 rests on supporting plate 13 and is confined between the upper rigid load receiving member 17 and an annular rim member 18 by suitable bolts 19. Similarly, a second flexible diaphragm 21 abuts supporting plate 14 and is confined between the lower rigid circular member 22 and annular rim member 23 by suitable bolts 24.

The upper and lower members 17 and 22 are held together in rigid relation by suitable bolts 26 extending

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from the upper member 17 through openings 27 formed in frame 11 to the lower member 22. With this arrangement, the upper and lower members 17 and 22 are rigidly connected together so that they may move equally and oppositely with respect to frame 11.

With the load cell 10 as thus constructed, a first expansible chamber A is formed having opposed walls movable relative to each other; that is, chamber A is formed by the upper load receiving member 17 and the supporting plate 13, with the plate 13 normally engaging the frame flange 12 and the diaphragm 16 allowing the load receiving member 17 to move downwardly relative to the frame engaging plate 13 to contract chamber A. A second expansible chamber B is also formed, having opposed walls; that is, the supporting plate 14 and the lower member 22, with the supporting plate 14 being engaged with the frame flange 12 when a pressure exists therein, but being free to move downwardly therefrom. The diaphragm 21 enables the supporting plate 14 to engage the frame while the lower member 22 moves downwardly relative to the frame upon expansion of chamber B. The movable walls of the expansible chambers A and B are interconnected so that expansion of chamber B will contract chamber A.

The upper member 17 is provided with an opening 28 communicating through passage 29 to chamber A, enabling fluid to pass into or out from chamber A as member 17 moves away or towards frame 11. Similarly, the lower member 22 is provided with an opening 31 communicating by passage 32 to chamber B for the same purpose.

The load cells 10 are interconnected as shown in Fig. 1, with the frames 11 thereof being supported on a common frame 33. The lower chamber B of load cell 10a is open to atmosphere, and chamber A thereof is connected by conduit 34 to chamber B of load cell 10b. Similarly, chamber A of load cell 10b is connected by conduit 35 to chamber B of load cell 10c. Conduit 36 connects chamber A of load cell 10c to chamber B of load cell 10d, and conduit 37 connects chamber A of load cell 10d to a conventional pressure indicating device 38. Each of the chambers A and B, as well as the intercommunicating conduits 34—37, is filled with an incompressible fluid, preferably oil.

Although four load cells are shown in Fig. 1, it is to be realized that any number thereof may be used, as desired, as long as they are connected in a series arrangement as illustrated.

To illustrate the operation of the serially connected system of Fig. 1, let it be assumed that a load has been imposed on load cell 10d alone. Since the chamber A is free to contract by virtue of the flexible diaphragm 16, the internal pressure within the chamber will increase in direct proportion to the load imposed thereon. The conduit 37 places chamber A in fluid communication with the pressure indicator 38, and thus the same pressure exists at the pressure indicator 38 as exists within chamber A. The indicator 38 is suitably calibrated so that the increase in pressure therein is directly converted into unit weight, as desired.

The load imposed on chamber A will cause this chamber to contract slightly, the amount of contraction being equal to the volume of oil required to operate the pressure indicator 38, such contraction causing the rigidly connected upper and lower members 17 and 22 to move downwardly relative to frame 11. Since the pressure within chamber B has not been changed from the initial conditions, the diaphragm 21 and supporting plate 14 will drop away from flange 12, and move downwardly with the lower member 22. The pressure in chamber B and the preceding load cells 10a, 10b and 10c will be unaffected by the load imposed on load cell 10d.

Now let it be assumed that a load is imposed solely on load cell 10c. Again, the load will increase the pressure within chamber A thereof. Since chamber B of load cell 10d is in direct fluid communication therewith, the pressure within chamber B of load cell 10d will be the same as chamber A of load cell 10d. This increase in pressure in chamber B will cause the interconnected upper and lower members 17 and 22 of load cell 10d to move downwardly in unison, increasing the pressure within chamber A thereof to an amount equal to that in chamber B thereof. Again, this increase in pressure of chamber A will be indicated by the indicator 38, and will be in direct proportion to the amount of the load on load cell 10c. It will be noted that the pressure resulting from the load on load cell 10c is transmitted forwardly through the system, to the pressure indicator 38, and is not transmitted backwardly through the system, since the expandible chamber B of a load cell is not changed in volume by mere contraction of chamber A thereof.

In the same manner, a load imposed solely on either load cell 10a or 10b will increase the internal pressure therein which is transmitted finally to the indicator 38.

Again, let it be assumed that a load is imposed on load cells 10c and 10d. The load on load cell 10d will cause it to register on indicator 38 as above described, with the pressures within chamber A of load cell 10c and chamber B of load cell 10d being unaffected thereby. However, the load imposed upon load cell 10c will be transmitted to load cell 10d as above described, so that the pressure within chamber A thereof will be the total of the downward force of the load thereon plus the downward force of the internal pressure within chamber B thereof. This combined pressure within chamber A is then read on the indicator B as a summation of the separate loads on load cells 10c and 10d.

The same operation will result from a loading of any, or all, of the load cells in the system, with the pressure in chamber B of any one of the load cells being proportional to the total load imposed on all of the preceding serially connected load cells, and the pressure in chamber A of any one load cell being proportionate to the load on that load cell plus the total load on the preceding serially connected load cells.

In actual practice, only a very small amount of fluid passes through the conduits 34-37; the amount being that necessary to operate the pressure indicator 38. Therefore, the amount of mechanical movement of the upper and lower rigidly interconnected members 17 and 22 of the load cells is very slight and the system is very quickly and accurately responsive to variations in loading imposed on the load cells. The only mechanical movement in the system is that which takes place in the slight flexing of the diaphragm, which, of course, reduces to a minimum the amount of mechanical friction in the system, and also eliminates any necessity for recalibration as would ordinarily be required in a mechanical system due to the wearing of bearings and the like.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of my invention, or the scope of the attached claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A load cell comprising a frame, means forming a first expandible chamber having a wall normally engaging said frame and a rigid load receiving wall opposite and movable in parallelism to said frame engaging wall, means forming a second expandible chamber having a wall normally engaging said frame but free to move therefrom and a rigid wall opposite and movable in parallelism to said second chamber frame engaging wall, and means for moving said rigid wall of said first chamber towards

said frame to contract said first expandible chamber upon movement of said rigid wall of said second chamber away from said frame on expansion of said second expandible chamber.

2. A load cell comprising a frame, means forming a first expandible chamber having a wall normally engaging said frame and a rigid load receiving wall opposite and movable in parallelism to said frame engaging wall, means forming a second expandible chamber having a wall adapted to engage said frame upon expansion of said second chamber and a rigid wall opposite and movable in parallelism to said second chamber frame engaging wall, and means for moving said rigid wall of said first chamber towards said frame to contract said first chamber upon movement of said rigid wall of said second chamber away from said frame on expansion of said second chamber.

3. A hydraulic scale comprising: a frame; a plurality of load cells each having a first and second expandible chamber, each of said expandible chambers having a wall engageable with said frame and a wall movable with respect to said frame, and means engageable with said movable walls to contract the first expandible chamber upon expansion of the second expandible chamber; a fluid pressure indicator; conduit means connecting said plurality of load cells and said pressure indicator in series; and an incompressible fluid filling said expandible chambers and said conduit means.

4. A hydraulic scale comprising: a frame; a plurality of load cells each having a first and second expandible chamber, each of said expandible chambers having a wall engageable with said frame and a wall movable with respect to said frame, and means engageable with said movable walls to contract the first expandible chamber upon expansion of the second expandible chamber; conduit means connecting said plurality of load cells in series whereby the first expandible chamber of one load cell is connected to the second expandible chamber of the next load cell; and a pressure indicator connected to the first expandible chamber of the last of the serially connected load cells.

5. A hydraulic scale comprising: a frame; a plurality of load cells each having a first and second expandible chamber, each of said expandible chambers having a wall engageable with said frame and a wall movable with respect to said frame, and means engageable with said movable walls to contract the first expandible chamber upon expansion of the second expandible chamber; conduit means connecting said plurality of load cells in series whereby the first expandible chamber of one load cell is connected to the second expandible chamber of the next load cell; a pressure indicator connected to the first expandible chamber of the last of the serially connected load cells; and an incompressible fluid filling all of the serially connected expandible chambers and said conduit means.

6. A hydraulic scale comprising: a frame; a plurality of load cells each having means forming a first expandible chamber having a wall normally engaging said frame and a rigid load receiving wall movable with respect to said frame, a second expandible chamber having a wall engaging said frame upon presence of pressure within said second chamber but free to move therefrom and a rigid wall movable with respect to said frame, and means engageable with said movable walls to contract said first chamber upon expansion of said second chamber; a fluid pressure indicator conduit means connecting said plurality of load cells and said pressure indicator in series; and an incompressible fluid filling said expandible chambers and said conduit means.

7. A hydraulic scale comprising: a frame; a plurality of load cells each having means forming a first expandible chamber having a wall normally engaging said frame and a rigid load receiving wall movable with respect to said frame, a second expandible chamber having a wall normally engaging said frame but free to move therefrom

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and a rigid wall movable with respect to said frame, and means engageable with said movable walls to contract said first chamber upon expansion of said second chamber; a fluid pressure indicator conduit means connecting said plurality of load cells and said pressure indicator in series; and an incompressible fluid filling said expansible chambers and said conduit means.

8. A hydraulic scale comprising: a frame; a plurality of load cells each having means forming a first expansible chamber having a wall normally engaging said frame and a rigid load receiving wall movable with respect to said frame, a second expansible chamber having a rigid wall movable with respect to said frame and a wall engageable with said frame upon expansion of said second chamber, and means engageable with said movable walls to contract said first chamber upon expansion of said second chamber; conduit means connecting said plurality of load cells in series whereby the first expansible chamber of one load cell is connected to the second expansible chamber of the next load cell; a pressure indicator connected to the first expansible chamber of the last of the serially connected load cells; and an incompressible fluid filling all of the serially connected expansible chambers and said conduit means.

9. A hydraulic scale comprising: a frame; a plurality of load cells each having means forming a first expansible chamber having a wall normally engaging said frame and a rigid load receiving wall movable with respect to said frame, a second expansible chamber having a wall engaging said frame upon presence of pressure in said second chamber but free to move therefrom and a rigid wall movable with respect to said frame, and means engageable with said movable walls to contract said first chamber upon expansion of said second chamber; conduit means connecting said plurality of load cells in series whereby the first expansible chamber of one load cell is connected to the second expansible chamber of the next load cell; a pressure indicator connected to the first expansible chamber of the last of the serially connected load cells; and an incompressible fluid filling all of the serially connected expansible chambers and said conduit means.

10. A load cell comprising a frame, first and second expansible chambers, each chamber having a wall engageable with said frame and a wall movable relative to said frame engageable wall and in which movement of said movable wall in one direction relative to the frame engageable wall will contract the chamber and movement of said movable wall in a second direction relative to the

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frame engageable wall will expand the chamber, and means movable relative to the frame and engageable with said movable walls for directly moving the movable wall of the first chamber in said first direction thereof to contract said first chamber in response to movement of the movable wall of said second chamber in said second direction thereof upon expansion of said second chamber and in which said means further allows other first direction movement of said first chamber movable wall without causing movement of said second chamber movable wall relative to said second chamber frame engageable wall.

11. A hydraulic scale comprising: a plurality of load cells, each load cell comprising a frame, first and second expansible chambers, each chamber having a wall engageable with said frame and a wall movable relative to said frame engageable wall and in which movement of said movable wall in one direction relative to the frame engageable wall will contract the chamber and movement of said movable wall in a second direction relative to the frame engageable wall will expand the chamber, and means engageable with said movable walls for directly moving the movable wall of the first chamber in said first direction thereof to contract said first chamber in response to movement of the movable wall of said second chamber in said second direction thereof upon expansion of said second chamber and in which said means further allows other first direction movement of said first chamber movable wall without causing movement of said second chamber movable wall relative to said second chamber frame engageable wall; a fluid pressure indicator; conduit means connecting said load cells and indicator in series wherein the first chamber of said load cell is fluidly connected to the second chamber of a different load cell and in which the first chamber of the last serially connected load cell is fluidly connected to said fluid pressure indicator; and an incompressible fluid filling said chambers and said conduit means.

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