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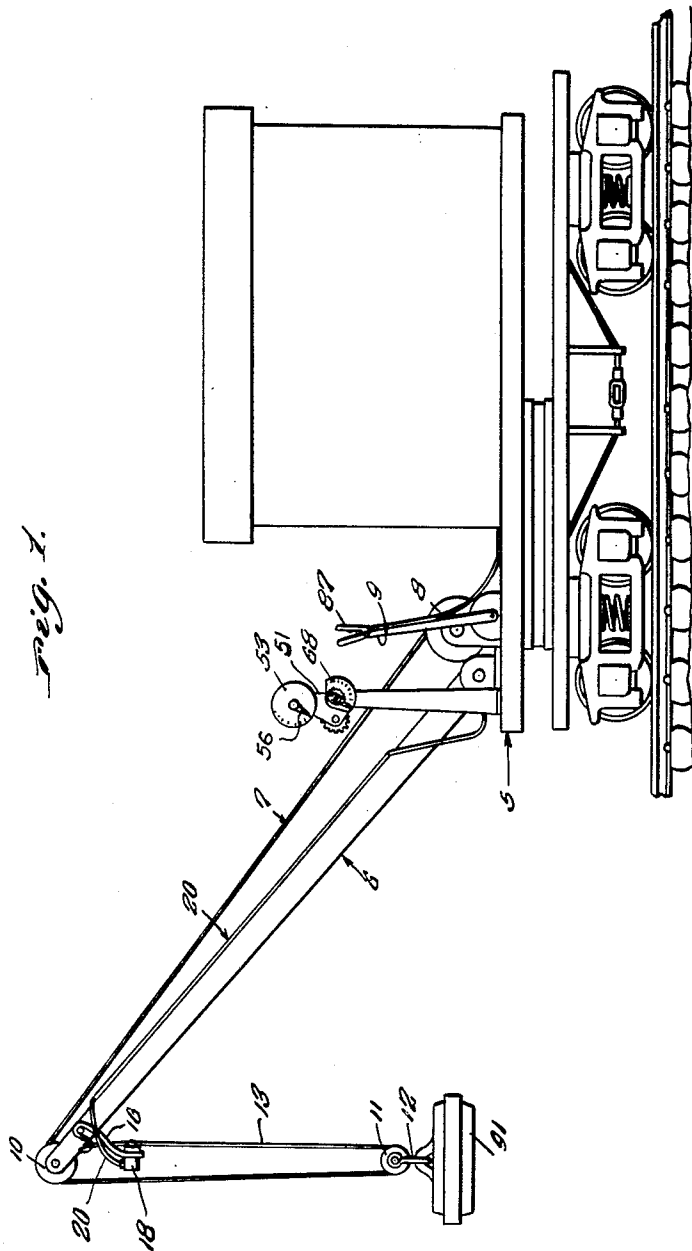
S. H. DAVIS

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LOAD WEIGHING AND TOTALING DEVICE FOR CRANES, HOISTS, AND THE LIKE

Filed July 24, 1940

3 Sheets-Sheet 1



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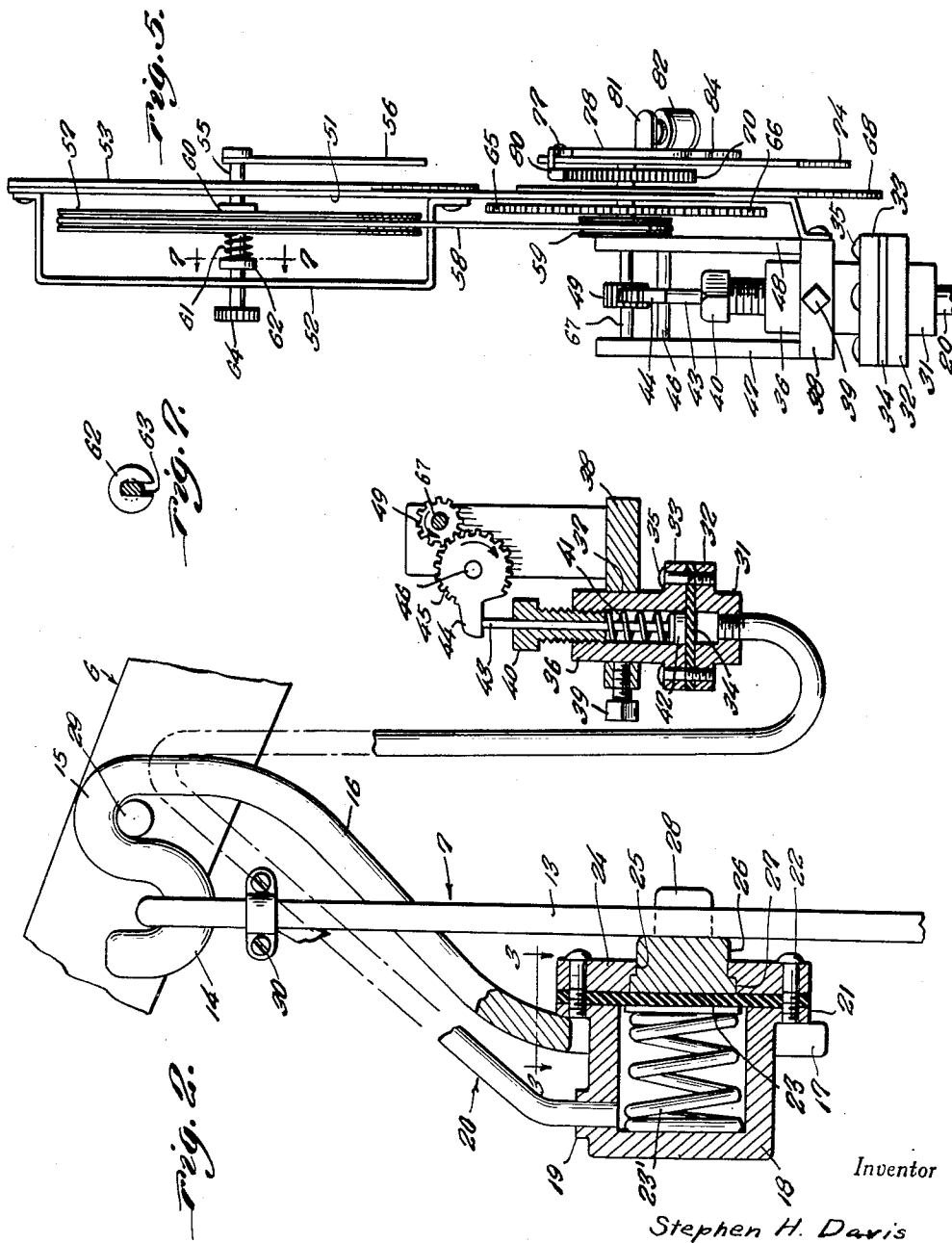
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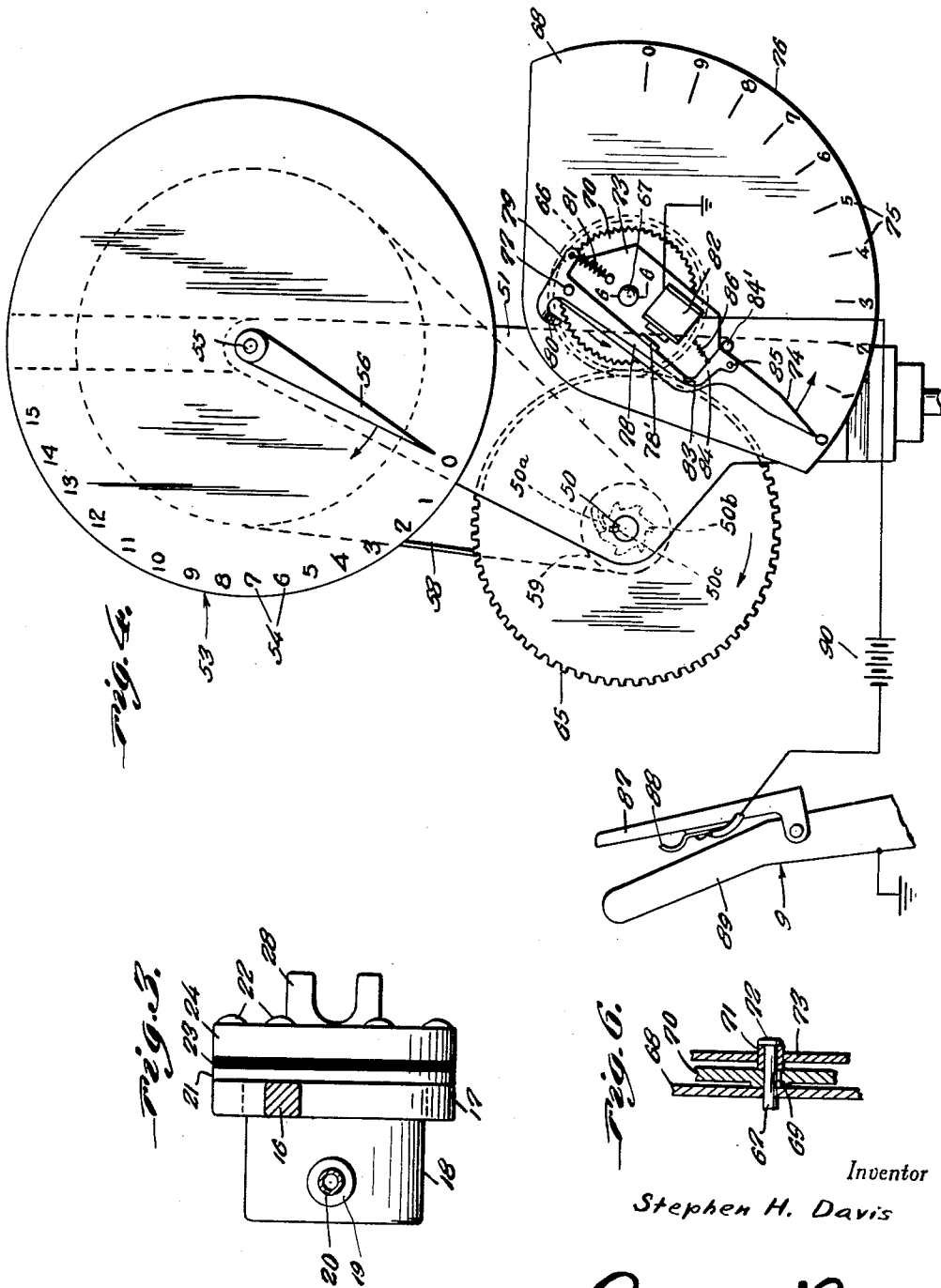
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UNITED STATES PATENT OFFICE

2,324,769

LOAD WEIGHING AND TOTALING DEVICE
FOR CRANES, HOISTS, AND THE LIKE

Stephen H. Davis, Chicago, Ill., assignor of one-fourth to W. C. Revis and one-fourth to J. H. Davis, both of Chicago, Ill.

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5 Claims. (Cl. 265—1.6)

My invention relates to a combined load weighing and totaling device for cranes, hoists, and the like, and an important object of my invention is to provide an arrangement of this character which is simple and efficient and can be readily incorporated or connected with the crane, hoist, or the like so that the operator thereof has available an accurate and convenient means showing the weight of each load as it is handled by the crane, and the total weight of a number of loads handled consecutively.

Other important objects and advantages of my invention will be apparent from a reading of the following description taken in connection with the drawings, wherein for purposes of illustration I have shown a preferred embodiment of my invention.

In the drawings:

Figure 1 is a general side elevational view of a railway crane showing adaptation of the present invention thereto.

Figure 2 is an enlarged side elevational and sectional view of the hydraulically actuated components.

Figure 3 is a horizontal sectional view taken through Figure 2 approximately on the line 3—3 and looking downwardly in the direction of the arrows.

Figure 4 is an enlarged side elevational view of the dials and operating mechanism thereof.

Figure 5 is an end or edge elevational view of Figure 4 looking from left to right.

Figure 6 is an enlarged fragmentary transverse vertical sectional view taken through Figure 4 approximately on the line 6—6.

Figure 7 is a transverse vertical sectional view taken through Figure 5 approximately on the line 7—7 and looking toward the left in the direction of the arrows.

Referring in detail to the drawings, the numeral 5 generally designates a suitable supporting surface such as a platform, and in the present instance, the platform of the crane, on which the boom 6 of the crane is mounted in connection with the hoist cable 7 which may be trained over a winch or other handling and winding means 8 on the platform 5, with a winch operating lever 9 mounted on the platform in a convenient position for operation by the operator of the crane. As ordinarily obtains, the hoist cable 7 is trained over a block 10 on the outer end of the boom 6 and depends and is trained around the sheave 11 on the hook 12. The upward flight 13 of the cable 7 returns toward the outer end of the boom 6 and passes through a hook por-

tion 14 on an S-shaped part 15 on the upper end of the heavy bar 16 which declines in a direction away from the platform 5 and is secured to extend from one side of the middle of the top of an annulus 17 to which is substantially concentrically connected the cup-shaped form 18 which has a receptor 19 formed in one end of its top to couple the lower end of the hydraulic fluid pipe 20 thereto. The cup-shaped element has a laterally projecting flange 21 which is abutted to the rubber or other suitable material diaphragm 23. Bolts 22 pass at circumferentially spaced intervals through an annular retainer 24 which abuts the outer side of the diaphragm, through the diaphragm and thread into the flange 21. The retainer 24 has a step cut central opening 25 in which works the plunger 26. The plunger has an annular shoulder 27 which is limited in its right hand movement by engagement with the shoulder on the retainer 24. A relatively heavy helical spring 23' is positioned between the end of the cup 18 and the diaphragm 23 to take up the dead weight so that the scales can be easily balanced. The larger and inner end of the plunger 26 is smaller in diameter than the interior diameter of the cup-shaped element so that the plunger is free to press the diaphragm 23 to a position inwardly of the right hand edge of the cup-shaped element. The plunger has a U-shaped lug 28 whose arms extend on opposite sides of the flight 13 of the hoist cable 7, with the inverted U-shaped portion of the S-shaped part 15 suspended on a peg 29 projecting laterally from one side of the boom 6 as illustrated in Figure 2. The upper end of the hoist cable 13 is looped over the hook portion 14 and returned and secured to the main portion of the flight by means of a clamp 30. The hydraulic tube or hose 20 is brought along the boom 6 to the platform 5 where it is connected in communication with the central opening in the bottom of the annulus 31 which has the lateral annular flange 32 which is opposed to a similar flange 33, with a rubber or similar material diaphragm 34 disposed therebetween, and with bolts 35 traversing all three to effect their assembly. The flange 33 is on the lower end of a cylinder 36 which passes upwardly and snugly through an accommodating opening 37 in a horizontal support member 38 which includes a locking screw 39 which is adapted to engage the side of the cylinder as shown in Figure 2 to lock the same in place. Inserted into the upper end of the cylinder 36 is the vertically adjustable tubular nut 40 which is arranged to adjust the compression

of the helical spring 41 which works in the bore of the cylinder between the lower end of the nut 40 and the top of the plunger head 42 which is directly engaged with the upper side of the diaphragm 34. The plunger head has a relatively small rod 43 connected thereto and extending through the spring 41 and the nut 40 and rising above the nut to engage a radial arm 44 which projects from a mutilated gear 45 which is mounted on a shaft 46 supported by and between the side members 47 and 48 which rise from the base 38 at one side of the cylinder 36. The unmutilated toothed portions of the gear 45 are in mesh with a pinion 49 on a shaft 67 which is journaled through portions of the side members 47 and 48 and located above the shaft 46 and to one side thereof as clearly illustrated in Figures 2 and 5. The base 38 may be a part of or may be mounted on the platform 5 close to the position of the operator of the crane, and preferably at one side of the platform as generally indicated in Figure 1 of the drawings.

Mounted preferably to the laterally outward side of the assembly consisting of the side member 48 and the base 38 is a laterally outwardly evident vertical frame member 51 which may conveniently be of the irregular shape indicated in Figure 4 and has secured to the upper part of the inner side thereof the U-shaped supplement 52 and to the laterally outward side the circular totaling disk 53 containing on its exposed face indicia 54. A manually adjustable pointer shaft 55 extends rotatably through the right portion of the supplement 52 and through the frame member 51 and the totaling disk 53 and has fixed thereto the hand or pointer 56 which swings across the face of the totalling disk. The pointer 56 is arranged to be moved as each load is released so as to indicate the total weight of the loads already handled.

Loosely mounted on the shaft 55 between the frame members 52 and 51 is the relatively large pulley wheel 57 which has trained thereover the belt 58 which is also trained over the smaller pulley 59 provided with a spring pressed dog 60a engaging a ratchet wheel 60b keyed, as at 60c, on the shaft 50 and whereby said shaft when rotated clockwise, as viewed in Figure 4, similarly drives the pulley and the shaft 50 is permitted to idle in a reverse direction counter-clockwise relative to said pulley 59. A fixed stop 60 on the shaft 55 is adapted to engage one side of the larger pulley 57 while the opposite side of the pulley is engaged by one end of an expanding spring 61 which has its opposite end engaged with a stop 62 which has the horse-shoe shape illustrated in Figure 7 for non-rotatable engagement with a straight sided portion 63 on the shaft 55. This arrangement provides a frictional drive between the spring 61 and the pulley 57 which permits manual rotation of the shaft 55 by means of the knob 64, to turn the pointer 56 to zero after operation thereof, without disturbing the position of the pulley 57 and hence of the other mechanism with which it is operatively connected.

The shaft 50 has fixed thereto outwardly of the smaller pulley 59 a relatively large gear wheel 65 which is in mesh with a smaller gear wheel 66 which is fixed on the shaft 67. The shaft 67 extends laterally outwardly to pass through the segmental shaped scale plate 68 which is fastened to the frame member 51. Keyed as indicated by the numeral 69 to the shaft 67 outwardly of the scale plate 68 is the relatively small gear wheel 70. A bushing 71 freely rotatable on the shaft

67 outwardly of the gear wheel 70 is held in place by a head 72 on the adjacent end of the shaft. This bushing acts as a journal for the depending pointer plate 73 and also to space the pointer plate from the gear wheel 70. The pointer plate 73 can swing freely in either direction on the axis of the shaft 67, but the action of gravity keeps the pointer normally in the extreme left-hand or "zero" position, to which the pointer returns after actuation.

The pointer plate 73 is elongated polygonal in shape and terminates at its lower end in a tapered finger 74 which has reference to the weight scale 75 distributed along the curved lower edge 76 of the scale plate 68 as shown in Figure 4, the edge 76 being concentric with the axis of the shaft 67. Pivoted as indicated by the numeral 77 to the upper corner of the pointer plate 73 is the T-shaped armature 78 whose cross head comprises the arm 79 and the laterally directed dog 80, the latter being engageable with the teeth of the wheel 70 to operatively connect the pointer and the wheel 70. A contractile spring 81 is stretched between the arm 79 and the plate 73 to normally maintain the armature 78 with its magnetizable button 78' retracted from the core of the electro-magnet 82 which is mounted on the lower part of the plate 73 below its pivotal point. The electromagnet 82 is located on the pointer plate 73 below the axis of the shaft 67 to act as a weight to assist in returning said pointed plate 73 to zero indicating position when the dog 80 is disengaged from the gear 70. The terminal end of the standard portion of the armature is beveled as indicated by the numeral 83 to co-operate with an oppositely beveled free end portion of the latch or detent 84 which is pivoted as indicated by the numeral 85 on the upper part of the finger 74 below the main body of the plate 73 and in a position offset with respect to the longitudinal extension of the armature. A contractile spring 86 is stretched between the upper part of the latch or detent 84 and a point above it on the plate 73 so that the beveled end is normally engaged with the beveled terminal of the armature so as to hold the armature up in a position away from the magnet 82. A further function of the latch 84 is to limit swinging of the armature 78 under the urge of the spring 81 and thereby establish a normal position of said armature. A stop 84' on said armature 78 limits swinging of the latch 84 under the urge of the spring 86. The bevels on the mentioned ends serve to produce a cam action displacement of the latch 84 when the armature is attracted to the magnet. The attraction of the armature to the magnet effects engagement of the dog 80 with the teeth of the wheel 70 in a manner to operatively connect the pointer with the wheel 70 during such time as the operator of the crane or the like contracts the switch handle 87 on the upper end of the lever 9 in a manner to engage the insulated contact 88 with the grounded portion 89 of the lever and thereby close the magnet energizing circuit. The contact 88 is connected to one side of a suitable source of electrical energy 90 which is, in turn, connected to one terminal of the coil of the electro-magnet 82, with the opposite terminal of the coil of the magnet being grounded, so that the operator can, upon the completion of each lift, and without disturbing the usual method of operation of the lever 9 in effecting the lifting operation, provide for advancement of the finger 74 along the weight scale 75 from zero to indicate the weight of each

load as it is picked up by the lifting member 91 on the crane hook 12. When the operator releases the switch handle 87 and thereby de-energizes the electromagnet 82, the pointer plate 73 rotates back to zero indicating position on the scale 75 under the influence of gravity. In the present instance the object 91 may be itself the load or may be an electro-magnet lifting member such as is used for lifting and carrying iron and other magnetizable materials.

The mutilated gear 45, whose operation originates all of the movements described above, is given its motion by reason of the rise of the plunger rod 43 as the diaphragm 34 is deflected upwardly due to hydraulic pressure coming through the hydraulic fluid pipe 20 as a result of deformation in the diaphragm 23 in the left hand direction, as viewed in Figure 2, due to a movement in the same direction of the plunger 26. This movement of the plunger 25 is produced by the movement in a right hand direction of the lower part of the member 16 as the cable flight 13 tightens under the load of the lifting operation and draws downwardly on the hook-shaped part 14, thereby swinging the member 16 as described while at the same time the flight 13 maintains substantially its original position and acts as an abutment for the plunger 25. Thus in reality the plunger 26 remains stationary, while the diaphragm is carried by its supporting media toward the left and is thereby deformed so as to expel the fluid from the cup-shaped element 18 and pass the same under pressure through the hydraulic fluid pipe 20 so as to raise the plunger rod 43 with the consequences already pointed out. Because of these arrangements, the proportionate pressure which will be exerted on the diaphragm 34 and consequently the height to which the plunger 43 will be lifted, depend on the weight of the load lifted by the crane and imposed on the hoist cable 7. It is thus possible by watching the positions of the pointers 56 and 74 on the scales 54 and 75, to know at any instant of the operation of the crane the approximate weight of the load being lifted, and the total weight of the loads which have already been lifted by the crane. The latter information is available, of course, only in the event that the operator of the crane has pressed the switch arm 87 each time that a separate load was handled.

It will be understood that as the plunger 43 moves upwardly it rotates the gear 45 clockwise, as viewed in Figure 2, and said gear rotates the gear 49 clockwise together with the shaft 67, gear 66 and gear 70. The gear 66 rotates the gear 65 and the shaft 50 counter-clockwise, as viewed in Figure 4, and said shaft 50, through the ratchet wheel 50b and ratchet dog 50a rotates the pulley 59 clockwise and said pulley 59 through the belt 58 and pulley 57 rotates the pointer 56 clockwise to move the same from zero, or, to successively higher value number symbols of the scale 54. The electromagnet 82 being energized by movement of the switch handle 87 to engage the insulated contact 88 with the grounded lever 9, and during the act of operating said lever 9 to pick up a load, said electromagnet attracts the armature 78 disengaging the same from the latch 84. The consequent swinging of the armature 78 on the pin 77 engages the dog 80 with the gear 70, whereupon the armature 78 is swung counter-clockwise, as viewed in Figure 4, likewise the pointer plate 73 and finger 74, so that said finger is swung from zero indicating position on the

scale 75. Movement of the switch handle 87 to disengage the contact 88 from the lever 9 results in deenergizing the electromagnet 82, the return of the armature 78 to normal latched position, and disengagement of the dog 80 from the gear wheel 70. The pointer plate 73 and finger 74, being thus released from the gear wheel 70, swing clockwise, under the influence of gravity, back to starting position in which the finger 74 registers with zero of the scale 75. Under clockwise rotation of the shaft 50, the pulley 59, the ratchet wheel 50d, and ratchet dog 50a impart rotation to the pulley 57, through the belt 58, to thereby swing the pointer 56 clockwise in degree corresponding to the degree of movement of the finger 74. When the load on the cable 7 has been released, hydraulic pressure against the plunger head 42 and rod 43 ceases, and said head and rod are returned by the spring 41. If, at this point, the switch handle 87 is still held by the operator so as to maintain the contact 88 in engagement with the lever 9, thus maintaining the electromagnet 82 energized, and consequently the dog 80 engaged with the gear wheel 70, the pointer plate 73 will gravitate back to starting position and in so doing, since it is locked to the gear wheel 70, will rotate said wheel, the shaft 67, gears 66, 49, 45 and 65 back to starting position leaving the pointer 56 in its previously operated position. It has already been described how the pointer 56 may be returned to zero registering position. As will now be seen, the pointer 56 and scale 54 may be used to totalize weights and by successive operation of the pointer 56 from previously set positions.

Although I have shown and described herein a preferred embodiment of my invention, it is to be definitely understood that I do not desire to limit the application to the precise structure and arrangement of parts disclosed, except as may be required by the scope of the subjoined claims.

Having described the invention what is claimed as new is:

1. A device of the character described for use with hoisting apparatus including a hoisting cable loop one side of which terminates in a free end, said device comprising a lever adapted for pivoting on and suspension from said apparatus and having a lateral upper end arm for connection of said free end of the cable loop thereto whereby a load on the cable tends to swing the lower end of said lever toward said one side of said loop, a fluid containing housing fixed on the lower end of said lever to swing therewith, a plunger working in said housing and adapted to be pressed against said side of the cable loop by swinging of said lower end of the lever and housing toward said one side of the loop whereby said plunger is forced inwardly of the housing to create hydraulic pressure in the latter, and weight indicating means comprising a scale, a pointer movable over said scale, and hydraulically operated means to move said pointer operative by hydraulic pressure created in said housing.

2. A device according to claim 1, wherein said hydraulically operative means comprises a cylinder, a fluid pressure line establishing communication between said cylinder and said housing, a piston rod working in said cylinder, and operating connections between said piston rod and pointer including a gear train.

3. A device according to claim 2, wherein said hydraulically operative means comprises a cylinder, a fluid pressure line establishing communica-

tion between said cylinder and said housing, a piston rod working in said cylinder, operating connections between said piston rod and pointer including a train of gears, and means to operatively connect one of said gears to said pointer at will, said pointer being mounted for gravitational swinging movement independently of said one gear to register with zero on said scale when disconnected from said one gear.

4. A device according to claim 3, wherein said hydraulically operative means comprises a cylinder, a fluid pressure line establishing communication between said cylinder and said housing, a piston rod working in said cylinder, operating connections between said piston rod and said pointer including a train of gears, and means to operatively connect one of said gears to said pointer including a dog on said pointer operative to engage said one gear, electromagnetic means for operating said dog, and means to energize said electromagnetic means at will.

5. In combination, a support, a lever pivoted on said support to depend therefrom and having a lateral arm at the upper end thereof, a hydraulic ram cylinder fixed on the lower end of said lever, a weight lifting cable having an upper end fixed to said arm to swing the lower end of the lever and said cylinder toward an intermediate portion of the cable under the pull of the weight on the cable, a piston projecting from one end of the cylinder for swinging against said portion of the cable to be moved inwardly of the cylinder under pressure exerted against the same through said portion, such inward movement of said piston creating hydraulic pressure in the cylinder, and fluid pressure responsive means connected to said cylinder for operation by hydraulic pressure created in said cylinder and including indicating devices.

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