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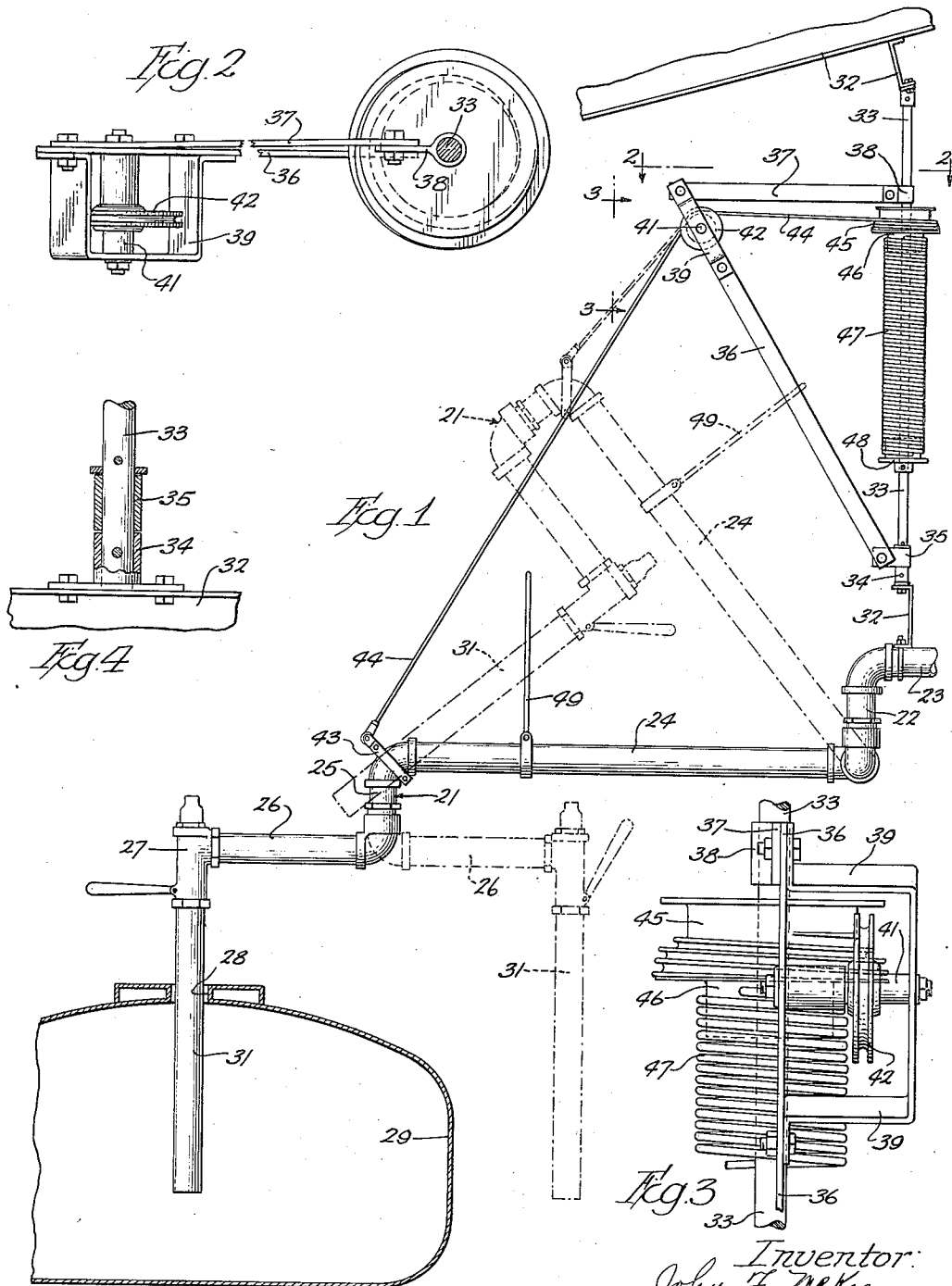
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2,090,136

COUNTERBALANCING MECHANISM

Filed March 8, 1935

3 Sheets-Sheet 1



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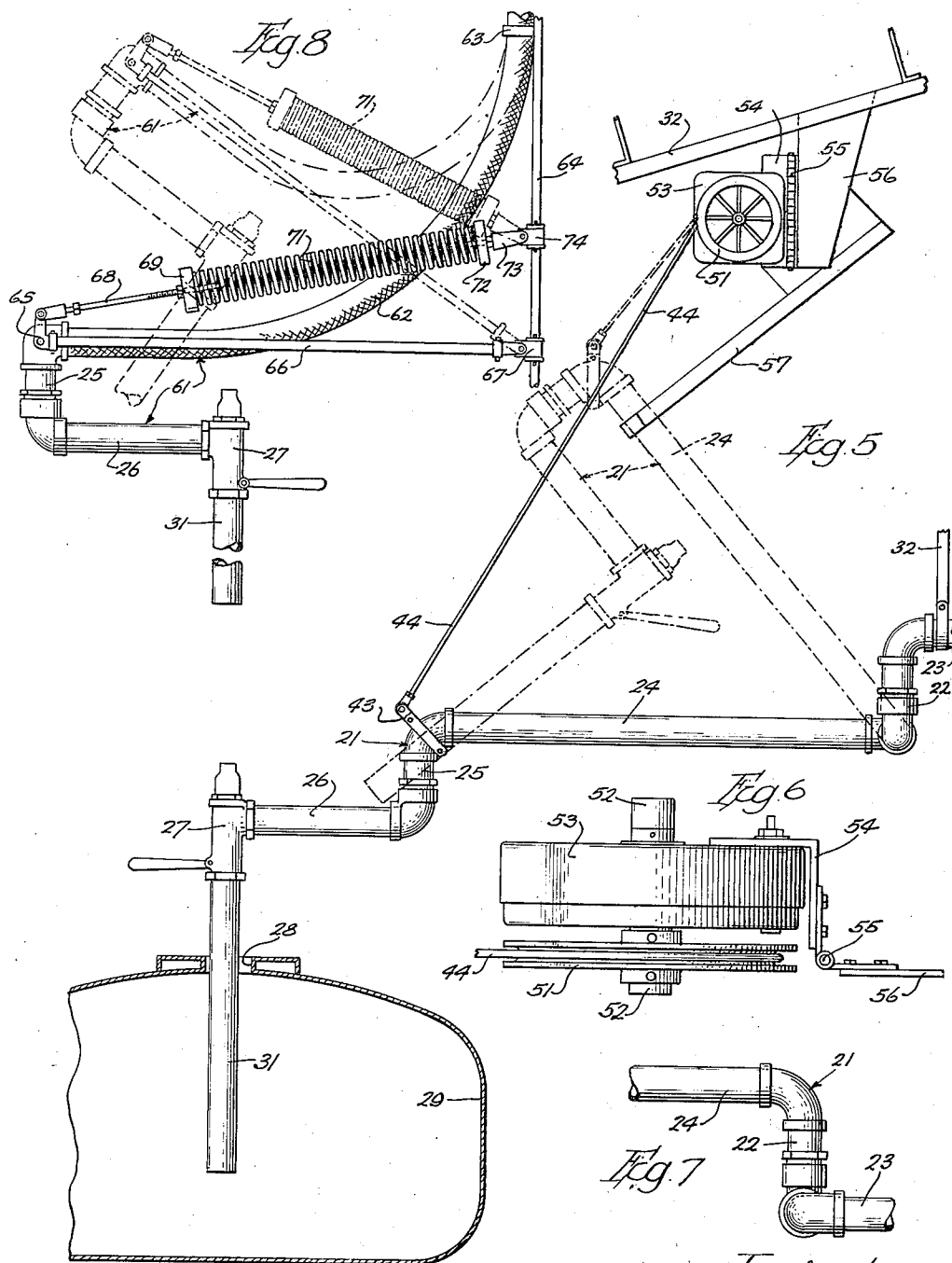
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3 Sheets-Sheet 2



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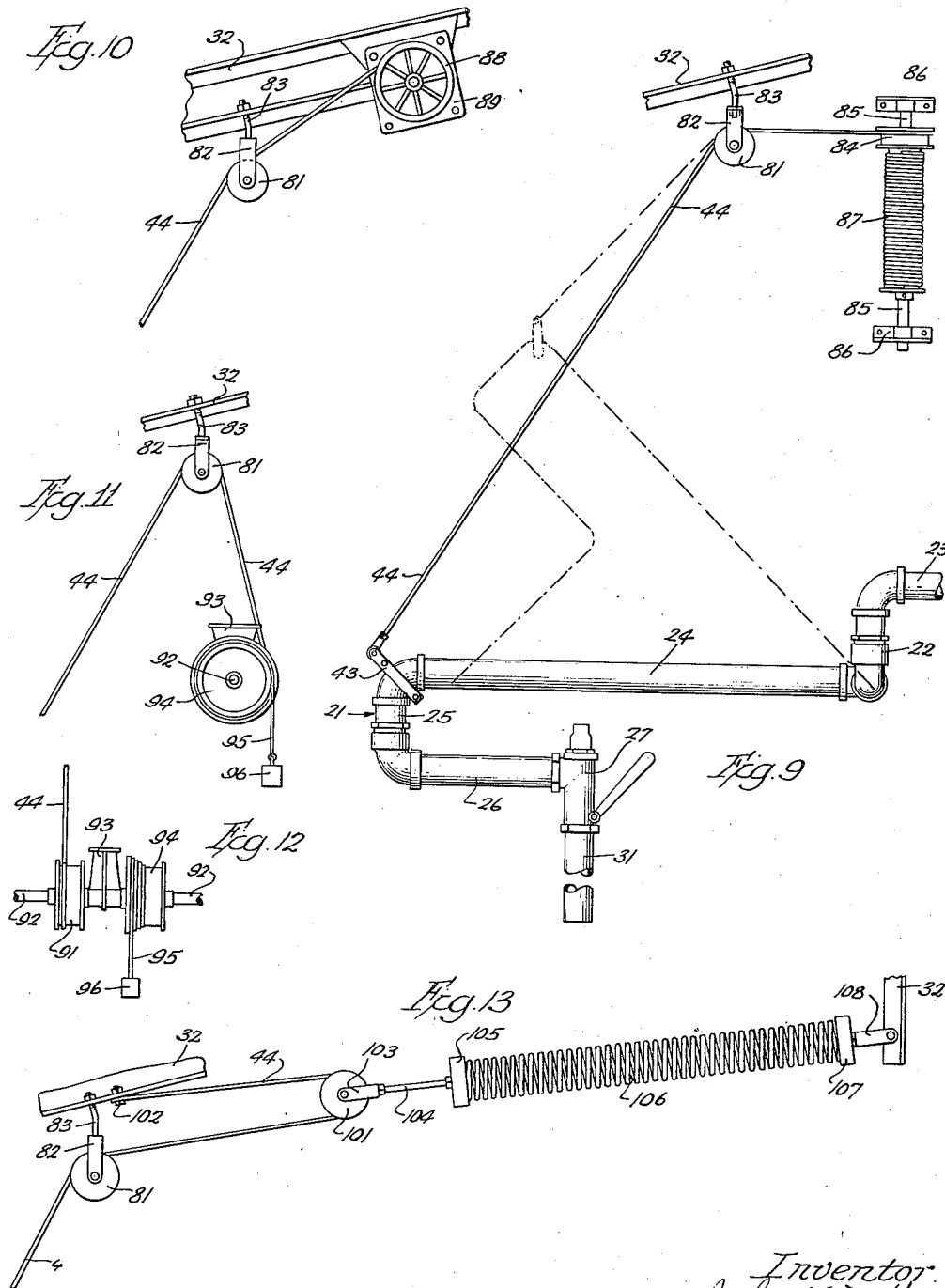
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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COUNTERBALANCING MECHANISM

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7 Claims. (Cl. 221—67)

This invention relates in general to counterbalancing mechanism, and more particularly to the application of such mechanism to loading arms and the like used to deliver fluids, such as petroleum products, to portable containers or receptacles, such as tank trucks.

Such loading arms normally weigh upwards of 125 pounds and must be so mounted as to permit of vertical movement to raise them out of the way when not in use, and limited horizontal movement to allow the outlet thereof to be located at the exact position of any one of a plurality of adjacent receptacle openings.

Heretofore, such loading arms have only been partially balanced in their vertical movements by means of a constant weight connected thereto by a chain or cable over one or more pulleys. Such an arrangement has proven to be unsatisfactory for several reasons.

As the loading arm is swung in a vertical plane, its effective weight at the point of attachment thereto of the balancing means will vary greatly, depending upon the particular position assumed thereby. This effective weight will be the least at the uppermost position of the arm, and the most when the arm is in the horizontal position normally employed while actually loading. The change in value of the effective weight between these two positions is not, however, directly proportional to the change in the angle between the arm and a vertical line through its pivot point.

In the prior art devices referred to there is no provision made for this variation in effective weight, with the result that the operator cannot handle the loading arm easily. Consequently the vertical travel to operating position is limited, and only a relatively short vertical extension can be used at the outer end of the loading arm because of the usual small size of receiving opening employed in the tank or other receptacle.

In addition to this, the weights employed generally take up a good deal of space, and if the pulleys cannot be placed high enough, the weight in its downward travel is very liable to injure anyone standing near the loading arm.

The pulleys employed in the prior art devices, because of their fixed position, do not permit of uniformly free operation except in a central vertical plane. This also causes the entire loading arm to move horizontally instead of only the single swing joint revolving, unless the loading arm be in some manner restrained or held in place.

Although a horizontal slip pipe is sometimes

employed, they are not substantial nor easy to handle, and it is extremely difficult to use a vertical extension at the outer end thereof. Further, when loading is done under pressure, a slip pipe will not stay in adjusted position, and will cause unnecessary waste in leakage.

A principal object of the invention, therefore, is the provision of counterbalancing mechanism for such loading arms, which will obviate the several above-noted objectionable features of the prior art devices.

A further important object of the invention is the provision of mechanism which will substantially perfectly counterbalance such a loading arm in any of its vertically adjustable positions, requiring the application of only a very small force to move the loading arm in either direction from any given position.

Another important object of the invention is to so mount such a counterbalancing mechanism that it will have a uniform effect in any one of a plurality of vertical planes within limits as defined by the usual amount of lateral movement allowed such a loading arm in a horizontal plane.

Another important object of the invention is the provision of such counterbalancing mechanism for a loading arm so that a relatively long vertical extension may be employed at the outer end of the arm, which will extend substantially to the bottom of the receiving tank, despite the usual small opening therein, to appreciably limit vapor loss during loading.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

In the drawings,

Figure 1 is a side elevational view of a device embodying my invention;

Fig. 2 is an enlarged plan view, partly in section, taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail front elevational view as indicated by the line 3—3 of Fig. 1;

Fig. 4 is a detail view, partly in section, of the lower swivel support of the counterbalancing mechanism of Fig. 1;

Fig. 5 is a side elevational view of a modified form of my invention;

Fig. 6 is an enlarged plan view of the motor spring and sheave of Fig. 5;

Fig. 7 is a plan view of the double swing joint of Figs. 1, 5 and 9;

Fig. 8 is a side elevational view of another modified form of my invention;

Fig. 9 is a side elevation of another modified form of my invention;

5 Figs. 10, 11 and 13 are side elevational views of modified forms of weight compensating mechanism which may be substituted for that shown in Fig. 9; and

Fig. 12 is a front elevational view of the mechanism of Fig. 11.

Referring more particularly to Figs. 1, 5, 7 and 9, a loading arm, indicated generally at 21, is shown which is of the type usually employed for petroleum fuels. The term loading arm as here
15 used, however, is intended to cover any piping, hose, tubing or combination thereof, with either flexible or swing joints, which is adapted to be moved vertically or horizontally and vertically to be properly positioned to deliver a desired fluid.

20 The loading arm 21 comprises a double swing joint 22 suitably connected at one end to a stationary supply pipe 23 and at the other end to a pipe 24. The other or forward end of the pipe 24 is suitably connected to a single swing joint
25 25 which is also connected to one end of a shorter length of pipe 26 which is parallel to the pipe 24 and has a downwardly opening control valve 27 attached to its other end.

The outlet from the valve 27 need only be such
30 that it will deposit the fluid into a tank opening, such as that indicated at 28 in a suitable tank or container 29, without unnecessary waste. For handling liquids that vaporize easily, however, as gasoline or the like, an outlet pipe 31 is
35 rigidly secured to the valve 27 at right angles to the pipes 24, 26, which pipe is sufficiently long to extend substantially to the bottom of the container 29 when in vertical operative position. With such an arrangement, as the tank is filled,
40 a very great saving in loss of vapor is effected.

If a flexible tube or hose bent so as to enter the opening 28 were used in lieu of the pipe 31, however, it would not straighten out after being inserted, and would therefore have no effect upon
45 the vapor loss. But a relative long rigid outlet pipe, such as pipe 31, can only be used, especially with the usual small opening 28, when the loading arm is properly counterbalanced so as to enable the operator to handle it easily throughout its range of travel, as has been pointed out.

It will be apparent that the double swing joint 22 permits vertical movement of the loading arm 21 relative to the stationary supply pipe 23 and the usual supporting framework 32 therefor from
55 its full line operative position to its inoperative position, as shown in dotted lines, wherein it is high enough to afford the necessary clearance while within convenient reach of the operator. At the same time the double swing joint 22 allows
60 the loading arm to be swung sideways, as in a horizontal plane, which, in conjunction with the provision for revolving the pipe 26 about the single swing joint 25 in a plane parallel to that occupied by the pipe 24, permits the outlet 31 to
65 be positioned over any of the several openings in an ordinary tank truck. The two swing points also allow the use of the long outlet pipe 31, even though the opening 28 is very small, since by changing the relative angular relationship of
70 the pipes 24 and 26 while imparting a downward and sideward movement to the pipe 24, the axis of the pipe 31 may be kept in contact with a fixed point in space, i. e. the center of the opening 28.

Such operation is only possible, however, as has
75 been pointed out, when the changing effective

weight of the loading arm is properly counterbalanced at all times. In order to accomplish this, I have provided the following mechanism of Figs. 1 to 4.

Rigidly secured in any suitable manner to the stationary supporting framework 32 and approximately coaxial with the vertical axis of rotation of the double swing point 22 is a vertical supporting post or rod 33. Mounted for pivotal movement on the rod 33 adjacent its lower end and bearing against a thrust and anchor member 34
10 is a swivel and supporting strap 35. Rigidly connected to the swivel 35, in any desired manner, is the lower end of an arm 36, the upper end of which is rigidly secured to the forward end of a horizontally disposed arm 37, which in turn is fastened at its other end to a swivel or pivot member 38 mounted on the rod 33. The swivel
15 38 as well as, or instead of, the swivel 35 may be supported against downward axial displacement by means of a stationary thrust member on the rod 33 similar to the member 34.

A U-shaped member 39 is rigidly secured to the arm 36 adjacent its upper end, and is adapted to function as a guard and as a support for one
25 end of a horizontal shaft 41, the other end of which is mounted in the arm 36. A pulley 42 is rotatably mounted on a reduced portion of the shaft 41 so as to be also capable of limited axial sliding movement thereon.

Rigidly secured to the loading arm 21 at any suitable point is a clamp member 43, of any desired construction, to which is pivotally secured
30 one end of a flexible cable or chain 44. The cable 44 passes over and is guided by the pulley 42, and has its other end wound upon and secured to a drum 45 which is rotatably mounted on the post 33 below the pivot member 38. The drum 45 is provided with a reduced portion 46 at its lower
35 end which acts as a guide for the upper end of a torsion spring 47 which is rigidly secured thereto in any desired manner. The lower end of the spring 47 is anchored to a guide member 48 which is in turn rigidly secured to the post 33 in any
40 suitable manner.

A safety hook 49 may be secured to the pipe 24, which is adapted to be engaged over the supporting arm 36 when the loading arm 21 is in its raised or inoperative position, to insure against
45 the arm falling should the counterbalancing mechanism for any reason fail.

The torsion spring 47 has sufficient initial tension to hold the loading arm 21 up in its inoperative or dotted line position by means of the cable
50 44. As the arm is lowered and the effective weight thereof at the clamp 43 increases, the spring is wound up to exert the additional load pull required to properly counterbalance the arm in any position which it may assume. A plain drum 45
55 may be used, if desired, but due to the fact that the effective weight of the loading arm does not have a constant variation, as has been pointed out, and the best type of spring 47 is one which exerts a constant force for each turn that it is wound up, it is preferable to use a drum in which the cable radius is varied to exactly compensate for
60 such variations from a constantly changing effective weight.

For this reason the pulley 42 is mounted, as above described, to permit axial movement thereof on the shaft 41 so that it may at all times keep
65 in perfect alignment with any of the radially variable positions of the cable 44 on the drum 45, as can best be seen in Fig. 3.

The effective weight of the loading arm, and
75

consequently the counterbalancing load pull required, will also vary depending upon the position assumed by the revolving pipe 26. Since the pipe 26 is most commonly used when in its horizontal position at some point between its completely extended position and that wherein it is perpendicular to the vertical plane containing the pipe 24, a mean between such positions is used to determine the maximum effective weight of the loading arm during actual delivery of the fluid. Also, since the weight of the members 26, 27 and 31 will cause the pipe 26 to be centered under the pipe 24 when the loading arm is being raised, this position of these members is used in determining the load pull required during such upward movement of the arm.

With the above described mechanism, it will therefore be seen that the loading arm 21 will be automatically maintained in any desired position in a given vertical plane, and only a very small force need be applied thereto to raise or lower it from such position.

The pivotal mounting of the supporting arms 36, 37, as above described, will permit the loading arm to be freely swung sideways to a position in any desired vertical plane within reasonable limits, and it will be maintained therein without any tendency to swing back to a central vertical plane. This is due to the fact that the rod 33 is so positioned that the cable will always be maintained in the vertical plane of the vertical axis of the double swing joint or other pivotal mounting of the loading arm and the point of attachment of the cable to the loading arm. If the rod 33 is moved forwardly or backwardly of its preferred position co-axial with the vertical axis of the double swing joint, but the cable is maintained in the normal vertical plane of such vertical axis and point of attachment of the cable to the loading arm, the device will operate satisfactorily, but with a more limited lateral travel. Such an arrangement is of particular importance where several loading arms are located close together, as is usually the case, especially in large bulk plants, to give full freedom of use to each of the loading arms.

In Figs. 5 and 6 is shown a modified form of counterbalancing mechanism applied to the same type of loading arm 21 as disclosed in Figs. 1 to 4.

In this device, the supporting cable 44 is wound upon and secured at one end to a sheave or pulley 51. This pulley 51 is rigidly secured to a shaft 52 of a motor spring 53 of well-known construction. The motor spring 53 is mounted upon and supported by an angle iron 54 which is secured to one side of a hinge member 55. The other side of the hinge member 55 is rigidly secured to a gusset plate 56 which is supported by the stationary framework 32 in any suitable manner. A safety hook 57 may also be attached to the gusset plate 56, if desired, to engage the pipe 24 when the loading arm 21 is in raised position.

The pivot of the hinge member 55 is positioned substantially in the normal vertical plane of the loading arm and is parallel to the vertical pivot of the double swing joint 22. Thus perfect alignment is maintained between the cable 44 and the sheave 51 in the normal lateral positions assumed by the loading arm, sideways movement of the latter causing similar movement of the motor spring and sheave.

The motor spring 53 has sufficient initial tension to properly counterbalance the loading arm 21 in its raised or inoperative position, and as

the arm is moved down, the spring is wound up to exert the additional load pull required. Since such a motor spring does not exert a uniformly increasing force as it is wound up, a plain drum may be used in lieu of the sheave 51, or a variable radius arm drum similar to drum 45 may be used as required to provide proper counterbalancing of the loading arm throughout its vertical travel.

In Fig. 8 is shown a modified form of counterbalancing mechanism embodying the same concepts of my invention as those above described, which is peculiarly adapted for use with a differently constructed loading arm.

The loading arm, indicated generally at 61, comprises the same single swing joint 25, revolving pipe 26, control valve 27 and outlet pipe 31 as used in the loading arm 21. Connected to the upper end of the single swing joint 25, however, in place of the pipe 24, is a flexible supply hose 62 which is anchored in any desired manner, as at 63, to a stationary supporting post or rod 64 similar to the rod 33, and like the latter rigidly secured in any suitable manner to the stationary framework 32 (not shown in Fig. 8).

An L-shaped member 65, which is rigidly secured to the single swing joint 25 adjacent the upper end thereof, has fastened to one of its ends the forward end of an arm 66 which constitutes part of the loading arm assembly 61. The rearward end of the rod 66 is pivotally secured to a swivel or supporting strap 67, similar to the swivel 35, which is rotatably mounted upon the post 64.

The upper end of the member 65 has pivotally secured thereto the forward end of a tie-rod 68, to the rearward end of which is adjustably fastened a collar member 69. One end of a suitable coil spring 71 is secured to the collar 69, and the other end of the spring is fastened to a similar collar 72 which is adjustably attached to a clevis 73. The clevis 73 is pivotally mounted on a swivel or supporting strap 74 which is similar to the swivel 67 and is also rotatably mounted on the post 64.

The pivotal mounting of the counterbalancing mechanism and the loading arm 61 on the post 64 permits of any lateral swinging of the two that may be desired, while at the same time allowing pivotal movement of the parts in any such vertical plane.

Because of the spacing between the pivot points of the rod 66 and the clevis 73, downward movement of the loading arm 61 from its inoperative or dotted line position will stretch or compress the spring 71 a proportional amount. The spring may be of such characteristics and be so adjusted that it will, as a consequence of such stretching or compression, exert a variable force which will properly counterbalance the loading arm 61 in any adjusted position.

Referring now to Figs. 9 to 13 inclusive, several modified forms of counterbalancing mechanism are shown as applied to a loading arm 21, as above described, by way of illustration, in each of which the supporting cable 44 passes upwards over a guide pulley 81. The pulley 81 is pivotally mounted in a yoke 82 which is mounted, either rotatably or for universal movement, as may be desired, on the lower end of a supporting rod 83. The rod 83 is rigidly secured in any suitable manner to the stationary framework 32 in substantially the same vertical plane as that containing the vertical axis of the double swing joint 22 and the point of attachment of the cable to the loading arm in its normal position. Such an arrange-

ment insures against the supporting cable jamming or leaving the guide pulley 81, and allows the loading arm to be swung laterally as desired.

- 5 In the mechanism of Fig. 9, after passing over the guide pulley 81, the cable 44 is wound around and secured at its upper end to a drum 84. The drum 84 may be plain or it may be similar to the drum 45 of Figs. 1 to 3, and like the latter is rotatably mounted on a stationary post 85. The post 85, like post 33, is rigidly secured in any suitable manner, as at 86, to the stationary framework 32, so that the periphery of the drum 84 on the cable receiving side will be in alignment with the vertical plane containing the cable 44 when the loading arm is in its central position. A torsion spring 97, similar to spring 47, is rigidly secured at its upper end to the drum 84 and at its lower end to the stationary post 85.
- 20 It will be apparent that the spring 87 and drum 84 comprise a weight compensating mechanism like that previously described and illustrated in Fig. 1.

Similarly the weight compensating mechanism of Fig. 10, comprising a sheave or pulley 88 and an associated motor spring 89, which is rigidly secured in any desired manner to the stationary framework 32, operates in an identical manner to the sheave 51 and motor spring 53 of Fig. 5.

- 30 In the mechanism of Figs. 11 and 12, after passing over the guide pulley 81, the cable 44 is wound around and secured at its end to a drum 91 which is rigidly secured to a shaft 92. The shaft 92 is rotatably mounted in a suitable bearing member 93 which may be supported by the framework 32 in any desired manner (not shown). Rigidly secured to the shaft 92, preferably on the opposite side of the bearing member 93 from the drum 91, is a variable radius arm drum 94. A cable 95 wound upon said drum 94 has one end secured thereto, and the other end is fastened to a weight 96.

The drum 91 may also have a variable radius arm and the variable radius thereof and of the drum 94 is such as to cause the variable load pull required to be applied to the loading arm 21 through the cable 44 although the weight 96 is constant.

- In the device of Fig. 13, the cable 44 passes first over the guide pulley 81 and then around a second pulley 101 and has its end anchored, as at 102, to the stationary framework 32. The pulley 101 is pivotally connected by means of a yoke member 103 to one end of a tie-rod 104, the other end of which is secured to a collar member 105. One end of a suitable coil spring 106 is fastened to the collar 105 and its other end is secured to a similar collar 107 which is anchored by means of a connecting member 108 to the framework 32.

The spring 106 will exert the variable load pull required, in the same manner as the spring 71 of Fig. 8, in order to properly counterbalance the loading arm 21 in any of its various positions. The additional idler pulley 101 is provided to reduce by one-half the travel of the loading arm 21 and cable 44 as applied to the spring 106.

- It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material ad-

vantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. The combination of a stationary supporting structure, a loading arm mounted thereon for vertical movement, a drum revolvably mounted on said structure, a cable secured at one end to said loading arm, and at the other end to said drum, and adapted to be wound thereon, and a torsion spring rigidly secured at one end to said structure and at the other end to said drum, whereby the changing effective weight of said loading arm applied upon said cable as it is moved vertically will be properly balanced by the changing force exerted by said spring as the drum is revolved by said cable.

2. The combination of a stationary supporting structure, a loading arm mounted thereon for movement in a vertical plane, a drum revolvably mounted on said structure, a cable secured at one end to said loading arm and at the other end to said drum and adapted to be wound thereon, and a torsion spring rigidly secured at one end to said structure and at the other end to said drum, said drum having a variable radius arm, whereby the variable effective weight of said loading arm will be properly counterbalanced by the force exerted by said spring as said arm is moved in said vertical plane.

3. The combination of a stationary supporting structure, a loading arm pivotally mounted on said structure for vertical and lateral movement relative thereto, a supporting frame mounted for lateral movement on said structure, a guide pulley revolvably mounted on said frame, a drum revolvably mounted on said structure, a cable secured at one end to said arm, passing over said pulley and secured at the other end to said drum, and a torsion spring secured at one end to said structure and at the other end to said drum for winding said cable on said drum and properly counterbalancing the changing effective weight of said arm on said cable in its vertical movements, said guide pulley insuring alignment of said cable between said arm and said drum in any laterally adjusted position of said arm, thereby enabling uniform counterbalancing of said arm in any of its laterally adjusted positions to allow said arm to stay in any such position.

4. The combination of a stationary supporting structure, a loading arm pivotally mounted on said structure for vertical and lateral movement relative thereto, a supporting frame mounted for lateral movement on said structure, a guide pulley revolvably mounted on said frame, a variable radius arm drum revolvably mounted on said structure, a cable secured at one end to said arm, passing over said pulley and secured at the other end to said drum, and a torsion spring secured at one end to said structure and at the other end to said drum for winding said cable on said drum and properly counterbalancing the variable effective weight of said arm in its vertical movements, said guide pulley being axially slidable to insure alignment of said arm and cable with the variable radius arm of said drum, and with said frame insuring freedom of vertical operation of said arm in any of its laterally adjusted positions while allowing said arm to stay in any such position.

5. The combination of a stationary supporting structure, a loading arm pivotally mounted on said structure for vertical and lateral movement relative thereto, a motor spring pivotally mounted on said structure for lateral movement relative thereto, a rotatable member

connected to said motor spring, and a cable connected to said member and said loading arm, whereby said arm will be maintained in static balance in any of its adjusted positions.

radius arm, whereby said loading arm will be maintained in static balance in any of its adjusted positions.

7. The combination of a stationary supporting structure, a loading arm pivotally mounted on said structure for vertical and lateral movement relative thereto, a guide pulley pivotally mounted on said structure, a coil spring fastened at one end to said structure, a second pulley pivotally connected to the other end of said spring, and a cable secured at one end to said loading arm, passing over said first pulley and around said second pulley, and secured at the other end to said structure, whereby said loading arm will be maintained in static balance in any of its adjusted positions.

5 6. The combination of a stationary supporting structure, a loading arm pivotally mounted on said structure for vertical and lateral movement relative thereto, a guide pulley pivotally mounted on said structure, a shaft rotatably mounted on said structure, a drum rigidly secured to said shaft, a cable secured at one end to said drum and passing over said guide pulley and secured at its other end to said arm, a second drum rigidly secured to said shaft, a second cable secured at one end to and wound around said second drum and having a weight attached to the free end thereof, one or both of said drums having a variable

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