ABSTRACT OF THE DISCLOSURE

A linkage assembly for driving a pair of reciprocable elements conjointly, including means for selectively varying the stroke ratio between the elements, comprising two lever arms each connected at one end to a respective reciprocable element and at the other end to a support, mechanism coupling the lever arms together for swingable movement about a common vertically slidable pivot while permitting slight longitudinal shifting between the arms, and motor means connected to one of the arms and operable to swing the arms to reciprocate the elements.

BACKGROUND OF THE INVENTION

The invention is concerned with the provision of linkage for connecting together a pair of reciprocable members for conjoint operation wherein it is desired to maintain a definite ratio between the stroke lengths of the two elements, and further to provide means for selectively varying the stroke ratio of the elements. While the disclosure specifically relates to mechanism for controlling the operation of two pumps utilized to pump plural components in determined relative proportions, it will be apparent to one skilled in the art that the invention is useful for controlling the operation of any two reciprocable members.

This invention constitutes an improvement over prior Patent No. 3,207,378 in which there is shown a metering pump for each of two materials in containers, with the pumps being supported on and extending into the containers. In the referenced patent, the pumps are interconnected so as to simultaneously pump the materials from the containers and the interconnection is so arranged that the delivery from each of the two pumps may be varied relative to each other to vary the relative proportions of the materials pumped from the respective containers.

While the linkage assembly interconnecting the pumps shown in the above patent is functional to a certain degree, it has been determined that the mechanism does not provide a constant ratio of pumped material between the two pumps. This is so because the central pivot point interconnecting the pair of lever arms swings in an arc about the point of pivotal connection of the lever arm to the stationary support. As the axes of the two pumps are stationary and parallel to each other, the distance between the pivot point and each pump varies, and therefore the ratio of the pump strokes also varies, resulting in disproportionate amount of materials supplied to the device to which they are fed being.

The present invention is concerned with providing a linkage assembly for interconnecting a pair of reciprocating pumps or other elements for conjoint operation so as to provide a constant ratio of material delivered from the pumps, and with the interconnection being such that the relative proportion of material pumped may be selectively varied. The linkage assembly comprises a pair of lever arms each of which is slidable connected at one end to a respective reciprocating member and the opposite end of which is pivotally connected to a stationary support. The lever arms are coupled together intermediate their ends by means providing a common pivot which is vertically slidable during operation to maintain a constant distance between the pivot and the axes of reciprocation of the members, while at the same time permitting slight relative longitudinal movement of the lever arms with respect to the pivot point.

Other objects, advantages and meritorious features will more fully appear from the following description, claims and accompanying drawings, wherein;

FIG. 1 is a front elevation of a linkage system embodying the invention shown for connection to a pair of reciprocable piston pumps;

FIG. 2 is an enlarged end view of the mechanism for interconnecting the lever arms of the linkage system, taken along line 2-2 of FIG. 1, with some portions broken away to show details of construction more clearly; and FIGS. 3 and 4 are cross-sectional views of the interconnecting mechanism taken along lines 3-3 and 4-4 respectively of FIG. 2.

In FIG. 1 there is shown a system embodying the invention comprising a linkage assembly for controlling the operation of a pair of pumps or the like. While the description will be specifically concerned with pumps, it will be apparent to those skilled in the art that the invention has equal applicability to controlling the operation of other types of reciprocating members, and is not limited to pumps per se. The pumps are of a positive displacement type including a cylinder with a piston shiftable therein, and are preferably immersed within a container of fluid material so that the material may be pumped directly from the container within which it is shipped. The pumps may be of the character described in the above mentioned Patent No. 3,207,378.

A pair of metering pumps are provided, the upper ends of which as shown respectively at 20 and 22 in FIG. 1. A pump supporting platform 24 serves as a mounting means for the pumps 20 and 22, and also supports the linkage assembly to be described. Each pump extends downwardly from the platform 24 into a suitable container of material to be pumped, and has a suction end disposed in the material in the container. The support 24 may be secured to the upper ends of the pumps 20 and 22 in any convenient fashion.

Upstanding from the support 24 and secured thereto by means of bolts 26 is a bracket 28, atop which is mounted an air motor 30 for driving the pumps. Such air motor is of conventional design, and incorporates a reciprocating piston therein having a depending piston rod 32 axially aligned and connected to the pivot rod of pump 22 to drive the same. Mounted on the air motor 30 is mechanism 34 for selectively varying the stroke of the air motor 30, and thereby varying the stroke of the pump 22. The construction of the air motor 30 and the mechanism 34 are substantially identical to similar structure disclosed in U.S. Patent No. 3,207,378, and therefore details of construction of these elements are not set forth herein, as they do not relate to the invention here involved.

The linkage assembly for controlling the operation of the two pumps 20 and 22 is indicated generally in FIG. 1 by the numeral 36, and comprises a pair of lever arms 38 and 40, and means indicated generally at 42 for coupling the arms together intermediate opposite ends of their lengths. Arm 38 is pivotally connected at 44 to a bracket 46 upstanding from support 24, while its opposite end is delivered forwardly from a pump 20 extending laterally from piston rod 32, which is rigidly connected to and forms an extension of the piston rod of pump 22. Lever arm 40 is pivotally connected at one end on a pivot 52 affixed to bracket 28, while its opposite end is slotted as at 54 for engagement with pivot 56 projecting laterally from piston rod extension 58 of pump 20.

The means 42 providing a common pivot for the pair of lever arms 38 and 40 comprises a pair of upstanding,
parallel ways 60 and 62 connected rigidly together by spacer plates 64 and 66 at their lower and upper ends respectively, to the frame 68. As shown in Fig. 4, the ways 60 and 62 are generally U-shaped in cross section, and positioned for slidably vertical movement within each way is a rectangular slide shown respectively at 70 and 72. The slides are fixedly connected together and are held in contact with the ways by spacer blocks 74 and 76 which are screwed to the slides as by the screws 78. Pivoted mounted on each of the slides 70 and 72 is a roller carrying plate 80 and 82 respectively, each of which carries a plurality, in this case, four, of rollers 84.

The plates 80 and 82 are mounted to the slides 70 and 72 in identical fashion, and therefore only one will be described. As seen in Fig. 2, the slide 72 is counterbored at 86 to accept a bushing or sleeve 88, and is also threaded to be engaged by the threads of a shoulder bolt 90 extending through the sleeve 88, with the head of the bolt bearing against the outer end of the sleeve. The roller plate 82 is recessed as at 92 to accept the head of the bolt 90 and has an aperture 94 extending therethrough, the relationship of the parts being such that the plate 82 is free to pivot about the axis of the bolt 90.

Each of the roller plates 80 and 82 is provided with a pivot, preferably, with a pivot, preferably a pivot, etc., for rotation of the plate to embraceably support the lever arms 38 and 40. The arrangement of the rollers 84 with respect to the plate and the respective lever arm is shown most clearly in Fig. 3. Each of the rollers 84 is secured to its respective plate by a stub axle 96 extending through the plate and threaded at its outer end to secure a lock washer 98 for retaining the roller rotatably on the plate.

The entire assembly 42 is supported for selective longitudinal movement along the lever arms 38 and 40 on two shafts or columns 100 and 102, the latter of which is provided with external threads to form a lead screw 103, Fig. 6, for adjustment of the assembly therealong. Supports 104 and 166 are provided at opposite ends of the structure, and shaft 100 is press-fitted therein, while shaft 102 is provided with smooth end portions 108 and 110 suitably journaled in bearings 112 and 114. Shaft 102 is provided with an extension 116 engaging beyond the support 104 and beyond the platform 24, and on the free end of the shaft there is mounted a hand wheel 118 for rotating the lead screw 103 to adjustably position the assembly therealong. A pointer 120 may be affixed to a part of the moving assembly as shown in Figs. 2 and 5 for a suitable scale 122 extending thereon, the support 24 to provide indicating means for properly selectively positioning the movable pivot along the lead screw 103.

As can be seen from the above description, the lever arms 38 and 40 are free to swing about an intermediate point defined by the common axis of the two screws 90, which axis is vertically slit-faced by the sliding movement of the slides in their ways. As each of the lever arms is secured for swingable movement at a fixed pivot adjacent one of its ends and is slidably connected to the vertically slit-faced pump piston rod at its opposite end, any given point on either lever arm will describe an arc swinging movement of the arm on its pivot. In other words, while the lever arms swing in an arc, the members forming the assembly providing the pivot for the arms are constrained to shift linearly in a vertical direction, and so relative movement between the lever arms and the point of pivotal movement defined by the screws 90 must occur. This relative movement is permitted by the lever arms being embraceably supported on the rollers 84.

The provision of the slides and ways insures that the distance between the screws 90 and the connection of the respective arm to the reciprocating pump piston rod remains constant throughout the swinging movement of the arms.

If the pivot point 90 were fixed with respect to the arms, during swingable movement of the arms the pivot would define arcs of travel for the piston rod, inversely, the distance between the pivot and the reciprocating pump would vary, thereby varying the ratio of the pump strokes. This was essentially the situation presented by the construction shown in Pat. 3,207,378, and while such structure is satisfactory for many materials, it has proved unreliable in pumping materials which must be very accurately metered.

As an illustration of how the apparatus functions, we assume that the parts are in the position indicated in Fig. 1, and that the motor 30 has started its down stroke carrying lever arm 38 in a clockwise swingable movement about its fixed pivot 44, the arm being carried by its connection with the pin 50 projecting from the piston rod 32. Because the pivot 44 about which the arm 38 swings is fixed, the points on the arm all move in an arc about the pivot 44, while upon swingable movement about the arm the associated assembly comprising the slide 72, the roller plate 82 and pivot 90 shifts slightly vertically, the assembly shifts longitudinally along the arm 38 as the arm swings. During the downward stroke of piston rod 32, lever arm 38 swings clockwise about pivot 44, while lever arm 40 being secured at fixed pivot 52, is caused to swing in a counterclockwise direction about its pivot, depressing piston rod 58 of pump 20. Upward movement of piston rod 32 under the influence of motor 30 will swing the arms in the opposite directions.

By virtue of the fact that the point of the pivotal coupling together of the lever arms 38 and 40 is constrained to shift in a strictly vertical direction along the line labeled C in Fig. 1 which is parallel to the center lines of the pumps 20 and 22 defined by the piston rods 58 and 32 respectively, the distance between the line C along which the pivot shifts and the pump center lines remains constant throughout the pump strokes, and hence the effective lever arms defined by the levers 38 and 40 remain constant throughout the strokes of the pump. Thus the effective lever arm for pump 22 is the distance from the center line C to the center line of the piston rod 32, which effective lever arm remains constant throughout the entire range of the pump stroke. Correspondingly, the effective lever arm of pump 20 is the distance between the center line C and the center line of the pump piston rod 58, which also remains constant throughout the pump stroke.

The adjustability of the assembly 42 along the lead screw 103 provides adjustment of the ratio of effective lever arms of the two pumps 20 and 22. Shifting of the assembly 42 to the left as shown in Fig. 1, correspondingly shifting the center line C to the left, results in shortening the effective lever arm of the pump 20. Thus the shifting of the center line C to the left in Fig. 1 will cause a comparatively lesser quantity of material to be pumped from pump 20. Conversely, shifting the assembly and the center line C to the right will result in a relatively larger amount of material to be pumped from pump 20 on each stroke. Furthermore, as the stroke of drive motor 30 can be selectively varied by the adjustment mechanism 24, the total output of the two pumps may be varied by adjusting the stroke of the drive motor 30. The pumps 20 and 22 may be either single-acting or double-acting, and with the structure shown for controlling their operation, both the amount of material pumped during each stroke and the ratio of materials pumped may be effectively varied. If single-acting pumps are employed, material is pumped only on the pump stroke in one direction, and discrete quanta or "shots" of material are supplied. If double-acting pumps are employed, a substantially continuous flow of material is supplied, as such pumps are of the negative stroke point of use.

What is claimed is:

1. Apparatus for pumping materials from two separate sources in determined relative proportions by a positive
displacement piston pump for each material extending into the container and having a piston rod extending vertically beyond the upper container end, comprising: a support for said pumps, a pair of pump-driving lever arms each pivotally connected at one end to said support and coupled at its opposite end to a pump piston rod, a base mounted for adjustable movement along said support, a pair of ways extending vertically from said base, a slide positioned for vertical sliding movement in each of said ways, means pivotally mounted on each slide having a plurality of cam rollers rotatably mounted thereon embracing one of said lever arms, means rigidly coupling said slides together for conjoint movement, and motor means coupled to one of said lever arms and operable to swing the arms to reciprocate the pumps.

2. Ratio linkage apparatus for driving a pair of reciprocable elements conjointly, comprising: means providing a support for said elements; a pair of lever arms each pivotally connected at one end to said support and coupled at its opposite end to a reciprocable element for limited longitudinal movement with respect thereto; a base on said support having means coupling said lever arms together intermediate their opposite ends for swingable movement about a common axis while permitting relative independent longitudinal movement between each lever arm and said axis, said coupling means including a pair of ways upstanding from said base in parallel spaced apart relation on opposite sides of said lever arms, slides positioned in the ways and fixed together for conjoint movement in the ways, a pivot plate pivotally connected to each of said slides, and a plurality of rollers rotatably mounted on each pivot plate in engagement with a respective lever arm and embracing the arm for permitting relative movement between an arm and the pivot plate pivot; and motor means connected to one of said arms and operable to swing the arms to reciprocate said elements.

3. Ratio linkage apparatus characterized in that said base is selectively shiftable along said support longitudinally of said lever arms to vary the effective lever arm lengths and thus vary the stroke ratio between said reciprocable elements.

4. Ratio linkage apparatus as defined in claim 3 characterized in that said base is coupled to a lead screw threadably engaged with an aperture in the base, and means for rotating the lead screw to shift the base along the support.

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CERTIFICATE OF CORRECTION


Inventor(s)  Fred M. Wood

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 20, change "resective" to "respective";

Column 6, line 9, following "aperture" insert "as defined in claim 2--.

Signed and sealed this 29th day of February 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.  ROBERT GOTTSCALCh
Attesting Officer  Commissioner of Patents