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PUMPING MECHANISMS

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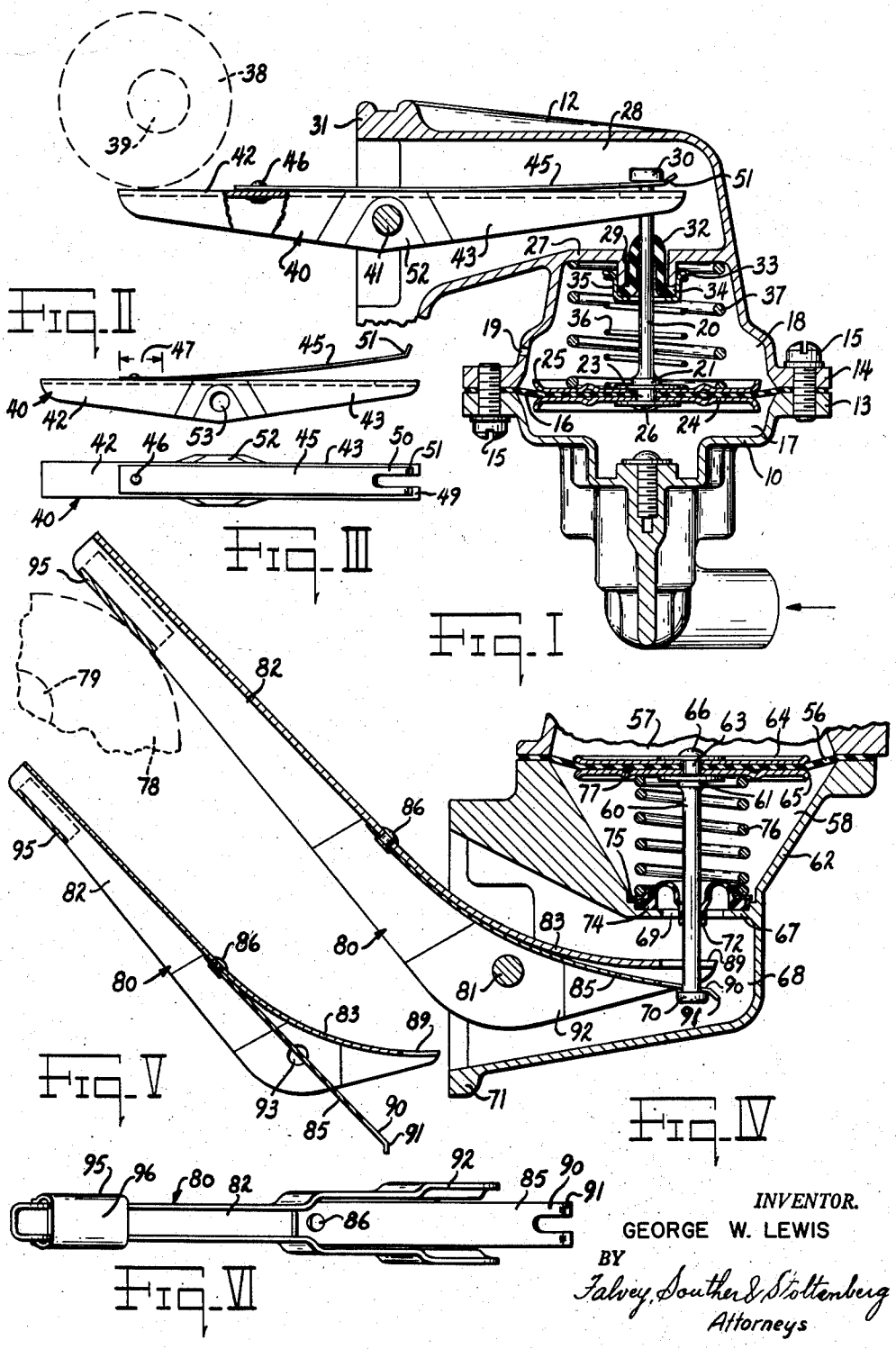



FIG. II

FIG. III

FIG. I

FIG. V

FIG. IV

FIG. VI

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# PUMPING MECHANISMS

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This invention relates to pumping mechanisms adapted to be used in fuel transfer as well as vacuum supply systems for self-propelled vehicles, more particularly to pumping mechanisms of the reciprocable type operated by driving means having a constant stroke while the pumping element may have strokes of variable magnitude.

The invention comprehends a pump in which the shock of engagement due to relative movement of the pumping element with respect to its driving mechanism is reduced to a minimum by providing automatic take-up means for damping the various inertia or suddenly applied forces which are encountered both in starting the pumping element from rest or after back pressure in the pumping chamber has been released.

The invention comprises a mechanism whereby a driving connection is established between a continually operated part having a uniform throw and a pumping element through its handling member permitting a change in the operative range or the length of the stroke of the pumping element without the interruption of the driving connection.

The invention contemplates an arrangement whereby a rolling metallic contact is provided for the actuating mechanism of a pumping element, providing elastic means to keep the actuating mechanism in constant engagement with the power driving part as well as the pumping element, and wherein the reaction forces on the actuating mechanism fulcrum pin are in one direction thereby eliminating possible noise at the various points of engagement.

The invention embraces power transmitting composite lever means having a yielding acting component in alignment therewith to provide a rolling metallic contact therebetween, which rolling contact is obtained in practice by forming to a curved section either the lever proper or the yielding acting component, so that there is separation therebetween, which separation, and thereby the yielding of the composite lever means, is gradually decreased upon the transmission of power.

According to the foregoing summary of the invention indicating its nature and substance, one of the main purposes is the provision of a novel force and motion-transmitting mechanism wherein a constant communication is established between the power-driving member and the pumping element which mechanism automatically takes up looseness of the components and relative motion caused by pressure in the pumping chamber, as well as suppressing wobbling, uncontrolled movements and objectionable vibration, to secure thereby a pump of high efficiency in operation, very quiet in action. and having long life under service conditions in self-propelled vehicles.

In conventional pumping devices, particularly diaphragm pumps in present use, a lost motion connection is provided between the operating lever actuated by an engine-driven part having a uniform throw and the reciprocable pumping element or diaphragm in order to



permit a change in the stroke of the pumping element when pressure is built up within the pumping chamber. The presence of the lost motion connection results in undue stresses and objectionable noises on account of the shock of engagement of the components; in addition, the use of such connection permits wobbling, uncontrolled movements and objectionable vibrations of the diaphragm which contribute to loss of pumping efficiency and cause performance failures after a comparatively short time in use.

It is one of the objects of the invention to overcome the objectionable features and suppress the contributing factors for the performance failures of conventional pumping devices by providing an actuating assembly which may be termed an elastic coupling interposed between the power-driving part and the pumping element, the composite assembly not only transmitting force and motion but also functioning in a four-fold manner (1) as means to take up any shock caused by the engagement of the lever means with the handling member of a pumping element, insuring thereby quiet operation by suppressing uncontrolled movements and undesirable vibrations, particularly in the critical speed range, (2) as means to effectively guide the handling member and thereby the pumping element during its operative range, (3) as means to provide a uni-directional force for keeping under tension the pumping element and applying a force in only one direction on the fulcruming means, and (4) as means to to constantly urge one component of the assembly into engagement with the continually power-driving part.

One object of the invention is to provide a motion and force-transmitting mechanism constantly connecting the power-driving member and a pumping element but permitting changes in the amplitude of the motion transmitted by the use of spaced members in alignment, one yielding into engagement with the other, whereby the rigidity of the mechanism constantly increases as the separation between the members decreases.

Another object of the invention is to provide a lever mechanism in which a rigid lever arm is provided with a divergent yielding acting member attached thereto for engagement therewith upon the transmission of force to a pumping element, and said rigid arm and member being curved with respect to the other so that their contacting engagement is in an asymptotic line relationship whereby the rigidity of the lever mechanism increases as the force transmitted to the pumping element increases.

Another object of the invention is the provision in a pump of a power-transmitting mechanism having a section formed by rigid primary and yielding secondary aligned arms having forked ends which straddle the handling member of the pumping element for guiding and applying a constant predetermined tensioning force, said arms being constructed and arranged so that a yielding action of the secondary arm decreases when said arms are urged into engagement whereby the rigidity of the section increases upon the transmission of power.

A further object of the invention is to provide a power-transmitting mechanism including a rigid lever arm with a yielding acting cantilever arm attached thereto arranged in spaced alignment therewith being adapted to be placed into contact with the rigid arm upon the transmission of force and one of said arms being curved with respect to the other whereby the point of contact established therebetween may be varied as a function of the force being transmitted.

A further object of the invention is the improvement of a pump of the type disclosed in U. S. Patent No. 2,625,113 of January 13, 1953 to K. I. Robinson et al.

Other objects and advantages of this invention relating to the arrangement, operation and function of the re-

lated elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. I is a median vertical sectional view of a pump illustrating the invention;

Fig. II is a side view of the motion and force-transmitting mechanism showing the relationship of the parts under no load condition;

Fig. III is a top plan view of the mechanism shown in Fig. II;

Fig. IV is a median vertical sectional view of a pump illustrating a modified form of the invention;

Fig. V is a cross-sectional view of the force and motion-transmitting mechanism illustrated in Fig. IV showing the relationship of its components under no load condition;

Fig. VI is a bottom plan view of the mechanism shown in Fig. V.

Although the present invention is herein described with particular reference to a diaphragm pump similar to the one disclosed in U. S. Patent No. 2,625,113, it should be clearly understood that the principles of the invention are believed to be applicable to other types of reciprocable pumps in which provision is made for a change in the pumping stroke when pressure is built up within the pumping chamber. It should be further understood that the invention should not be limited to the particular forms shown and that it is contemplated to use the same whenever the invention may be found to be of utility.

Referring to the drawings, and particularly to Fig. I, in which the pumping mechanism of the invention is illustrated, it can be seen that the main support or housing is formed of two hollow members or complementary sections **10** and **12** provided with uniplanar mating flanges **13** and **14** formed at the periphery of their corresponding recessed portions. The housing sections **10** and **12** are joined together by suitable fastening means such as threaded members **15** clamping therebetween the pumping element which is shown in the form of a flexible diaphragm **16** spanning their recessed portions providing a movable wall therefor and, by its cooperative relationship, producing opposed closed chambers **17** and **18**. The lower closed chamber **17**, which is beneath the diaphragm **16**, constitutes the pumping chamber, while the upper closed chamber **18**, defined by the upper surface of the diaphragm and the recessed portion of member **12**, forms a distendable compartment suitably vented to the atmosphere by opening **19**.

Suitable inlet and outlet valves are provided in the respective passages leading to and from the pumping chamber **17** which are of a construction similar to the one illustrated in the patent herebefore mentioned. The diaphragm **16** is provided with a handling member or its equivalent which is directly connected or attached to its central portion in leak-proof relation. In the form shown, the handling member is illustrated as a headed pull rod or slidable stem **20** formed at its lower end with a stepped portion providing a shoulder **21**, from which projects a reduced end section **23**. The end section **23** snugly projects through aligned openings provided in the oppositely disposed, shallow cupped discs or reenforcing plates **24** and **25**, as well as in the diaphragm **16** and, by spinning the end of the reduced section **23**, as at **26**, clamps the diaphragm between the reenforcing plates, providing thereby a fluid-tight connection.

The transverse wall **27**, which acts as a partition of the housing section **12** forming the open compartment **28**, and the top section of the closed chamber **18** is pierced by flanged aperture **29**, through which extends the enlarged head **30** of the handling member **20**. The compartment **28** is provided at its open end with peripheral flange **31**, by means of which the pump is adapted to be detachably connected to the crankcase of the engine or other prime mover supplying the power for operating the mechanism which reciprocates the diaphragm.

In order to prevent the ingress of oil or foreign matter into the distendable chamber **18** from the open compartment **28** by the aperture **29**, the reciprocable member **20** is provided with a flexible sealing member having a central nipple **32** which sealingly fits the shank of the handling member **20** projecting through the aperture **29** slightly above the surface of the transverse wall **27**. The nipple of the sealing member terminates into a horizontally disposed peripheral flange **34** arranged to overlie the lip of the flanged aperture **29** and is resiliently urged thereagainst through the metal retainer **35** by helical spring **36** compressed between the diaphragm reenforcing plate **25** and the horizontally disposed flange **33** of the retainer **35**. This sealing arrangement effectively prevents oil seepage and the ingress of foreign matter into the chamber **18** without interfering with the freedom of movement of the handling member **20**.

The compartment **18** is arranged to house the resilient means for conditionally effecting the motion of the pumping element or diaphragm in one direction. In the form shown, the compartment **18** is designed to enclose and retain under a predetermined force the resilient member in the form of a compressible helical spring **37** which serves as resilient means for conditionally urging the diaphragm downwardly to collapse the pumping chamber **17** to effect the expulsion or discharge stroke of the pump. The spring **37** is held in position, avoiding any possibility of interference with the movement of the handling member **20** and with the seal retainer spring **36** by means of the concentric corrugations provided on the reenforcing plate **25** for engagement with the bottom end of the spring and by the inner surface of the lateral wall defining the top of the compartment **18** for the top end of the spring **37**.

In the form of the invention shown in Fig. I, a cam **38** rotated by a shaft **39** which may be, for example, a crankshaft or camshaft or the like of a prime mover, is intended as a representative of a continually reciprocating or rotating part having a suitable uniform throw which constitutes the power driving part used to impart movement to the handling member **20** for actuating the pumping element.

One of the important features of the invention deals particularly with a motion and torque-transmitting mechanism interposed as an elastic coupling between the power driving part, such as the cam **38**, and the handling member **20** attached to the reciprocable but pressure-responsive pumping element. The power-transmitting mechanism, providing automatic take-up and noise-suppressing means, according to the preferred form of the invention, is inclusive of lever means fulcrumed or pivoted on a stationary part, such as the casing **12**. The lever means extends on each side of its pivotal axis forming a rigid outer arm adapted to engage and be operated by the power driving cam **38** and a composite inner arm structure which includes a rigid section and a yielding acting part spaced from and aligned for engagement therewith, which part is in constant engagement with the handling member, whereby the lever means forms a constant connection for the transmission of motion and force which is substantially rigid under certain conditions of operation and provides a decrease in rigidity under other operating conditions.

In the embodiment of the invention shown in Figs. I to III inclusive, the power-transmitting mechanism comprises a lever **40** pivoted at its median section on suitable means, such as by the pin **41**, carried by the lateral walls of the casing section **12**. The lever **40** is shown as formed with a uniplanar top surface extending at each side of its pivotal axis **41** which forms a rigid outer arm **42** adapted to contact the continually operating part or cam **38** and a composite inner arm structure, including the rigid section **43**, which is a continuation of the lever proper and a yielding acting part **45**, which may take the form of a thin

plate inherently elastic fixed to the top surface of the outer arm 42 at a point located rearwardly of its pivotal axis.

The yielding acting part 45 of the lever 40, as particularly illustrated in Fig. II, is shown in the form of a leaf spring having one of its ends riveted as at 46 to the top surface of the lever at a point rearwardly of its pivot and is arranged to be biased toward an angular relationship to the longitudinal axis of the lever or divergent to its uniplanar top surface. The leaf spring 45 is properly biased to serve as an elastic finger of the lever 40 constantly engaging the enlarged head 30 of the pull rod or handling member 20 even at times when a pressure built up within the pumping chamber 17 serves to hold the handling member in its uppermost position so as to render the rotation of the cam 38 temporarily ineffective to impart further reciprocatory movement to the diaphragm. In order to secure the proper biased relationship and preferably produce mutual contacting engagement in an asymptotic line between the members 45 and 43, the leaf spring 45 is formed with a flat end section 47 and the remainder of the body portion is curved whereby not only the angular relationship is accomplished but a rolling contacting engagement is provided between the leaf spring 45 and the uniplanar top surface of the lever 40.

cam 38 and a composite inner arm structure which in-

As particularly shown in Figs. II and III, the inner arm of the lever 40 is in the form of a composite bifurcated structure which includes divergent arms 43 and 45 of substantially the same length and in vertical alignment, wherein the arm 43 is formed with a forked end section 49 and the yielding acting arm 45 is also formed with a forked end section 50. Both of the forked end sections 49 and 50 are adapted to straddle the shank or the handling member 20, as particularly shown in Fig. I. The yielding acting arm or leaf spring 45 is arranged so that its forked end 50 is in constant engagement with the bottom surface of the enlarged head 30 of the handling member snugly straddling its shank and with the end of the forked section abruptly bent, as at 51, so that the furcations are also in engagement with the side walls of the head 30 of the handling member, thereby providing a constant pull on the diaphragm and also constantly guiding the handling member 20 during the operation of the pumping mechanism.

In the form of the invention shown in Figs. I to III inclusive the rigid component of the actuating assembly, which is shown as a pivoted lever 40, may be of any suitable non-yielding material. However, it is contemplated, for sake of lightness and in order to attain the optimum strength/weight ratio, to use a sheet metal member having a channel or U-shaped configuration. The lever is preferably fabricated from a sheet steel blank bent or shaped into a channel having back and side walls substantially at right angles with the back or web of substantially uniform width throughout its length. The side walls are substantially parallel while their median sections 52 are offset or struck out forming an enlarged portion with aligned apertures 53 to accommodate the pivot pin 41 and the remainder gradually decreasing in height or tapering from their median sections 52 toward their respective extremities.

The operation of the form of the invention hereinbefore described is such that whenever the cam 38 is rotated, a rocking motion is imparted to the pivoted arm 40 whereby its rigid inner portion 43 is moved or cycled clockwise and counter-clockwise to effect the reciprocatory movement of the diaphragm 16 through the yielding acting member 45 constantly connected to the handling member 20. Assuming the parts are in the position shown in Fig. I, and that the rigid portion 43 of the lever 40 is moved counter-clockwise by rotation of the cam 38, motion will be imparted through the yielding acting member 45 to lift or flex the diaphragm upwardly to produce the intake stroke of the pumping mechanism. During the intake stroke, when



there is no back pressure in the pumping chamber 17, the rigid arm 43 of the lever will be in contact throughout its full length with the leaf spring or yielding acting member 45 on account of the opposition offered to such movement by the springs 36 and 37. Thus, the inner bifurcated sections 43—45 of the lever 40 is substantially unyielding, so that its working stroke corresponds to the full travel of arm 43 whereby the diaphragm 16 will be positively moved upwardly compressing the springs 36 and 37 storing energy therein during the full length of its travel in a counterclockwise direction.

Further rotation of the cam 38 will change the movement of the bifurcated section 43—45 from counter-clock to clockwise direction whereby the energy stored in the springs 36 and 37 during its movement in a counter-clockwise direction will be released to push the diaphragm 16 downwardly as the bifurcated section is moving in the same direction. The downward movement of the diaphragm 16, conditionally produced by the resilient members 36 and 37, decreases the volume of the pumping chamber 17, bringing about the discharge or expulsion stroke of the pump. This mode of operation wherein the working stroke of the lever is equal to substantially the full length of its travel in a counter-clockwise direction will continue as long as pressure is not present within the pumping chamber.

As before pointed out, the presence of pressure within the pumping chamber 17 pushes up the diaphragm compressing the springs 36 and 37 moving upwardly its handling member 20 with the aid of the constantly pulling leaf spring 45 relative to the rigid section 43 of the lever 40. This relative movement decreases the length of engagement changing the spacing or longitudinal angular relationship of the leaf spring 45 with respect to the rigid arm 43 of the lever whereby the rigid member 43 has a sliding non-working motion with respect to the handling member 20. The extent of such non-working motion is dependent upon the position to which the diaphragm is pushed up in response to the amount of built-up pressure within the pumping chamber. It should be noted that the length of the working stroke of the lever decreases as the length of the contacting engagement of leaf spring 45 with the rigid arm 43 decreases in the same ratio, and that the length of their engagement is dependent upon the amount of pressure built up within the pumping chamber and is a function thereof. Notwithstanding the fact that the rigid arm 43 has a non-working motion when pressure occurs within the pumping chamber, this invention obviates contact noise and provides a slap-preventing means as the load imposed on the lever means in further compressing the springs 36 and 37 is gradually taken up by increasing the length of engagement of the arm 43 with the leaf spring 45.

The increase in the length of the contacting engagement of the rigid lever section 43 with the cantilever spring 45 occurs gradually as the load imposed by the resilient members 36 and 37 is taken up by the actuating lever because this increase is the result of forcing together into rolling point contact the spring and lever section from a divergent position into a full length engagement condition to produce a substantially rigid lever arm for positively transmitting the additional force to further move the diaphragm 16. Thus, the resiliency, and therefore the length of the cantilever of the spring 45, decreases as the force transmitted increases to effect the transmission of force in a substantially rigid condition as it is contemplated that the rigid portion 43 of the lever is slightly longer than the effective length of the spring 45 when full length engagement takes place.

In the form of the invention shown in Figs. IV to VI inclusive, in which only the lower portion of a composite housing of a pumping mechanism is illustrated, the flexible diaphragm 56, fixed at its periphery, constitutes the movable wall of the pumping chamber 57 located thereabove and defines, with the recessed portions of the housing member 62 located therebeneath, a distendable

compartment 58 suitably vented to the atmosphere. The flexible diaphragm 56 carries, at its central portion, a handling member or pull rod 60, which is formed at its other extremity with a stepped section providing a shoulder 61 and a reduced end section 63. The reduced end section 63 of the pull rod 60 projects through the diaphragm and the oppositely disposed reinforcing plates 64 and 65 and has the same riveted as at 66 forming a fluid-tight connection between the diaphragm and the pull rod.

The housing 62 is formed with a horizontally disposed wall 67 which acts as a partition forming the open-ended chamber 68 and the bottom wall of the distendable compartment 58 is formed with an aperture 69, through which extends the enlarged head 70 of the pull rod 60. The chamber 68 is provided at its open end with a peripheral flange 71, by means of which the pumping mechanism may be secured to an internal combustion engine, or other power supply means, for actuating the mechanism which reciprocates the diaphragm.

The pull rod 60 is provided with a sealing boot, preferably a rubber-like material, having a central tubular section 72 which snugly fits the shank of the pull rod and from which depends a flared conical section terminating into a horizontally disposed flange 74 arranged to span the aperture 69. The flange 74 is urged into tight engagement with the top surface of the wall 67 through the retainer 75 by the helical spring 76 held under compression in the distendable compartment 58. This sealing arrangement prevents the ingress of oil or other foreign matter from the open-ended chamber 68 into the distendable compartment 58 without interfering in any way with the freedom of movement of the handling member 60. The helical spring 76 in the modified form of the invention performs the double function of holding the sealing boot in position as well as conditionally producing the discharge stroke of the pump and is held in concentric relation with respect to the pull rod by having one end surrounded by corrugations 77 provided in the reinforcing plate 65 and its other end snugly fitting the upstanding section of the retainer 75. In this embodiment of the invention, the continually operated cam 78 rotated by shaft 79 constitutes the power driving part having a uniform throw used to impart movement to the handling member 60 for reciprocating the diaphragm 56.

The power-transmitting mechanism, acting as an elastic coupling which functions as automatic take-up means for damping the various inertia and uncontrolled vibratory motions of the diaphragm in this form of the invention, is inclusive of an actuating lever 80 pivoted adjacent one of its ends on a pin 81 journaled on the lateral walls of the open-ended chamber 68 of the housing section 62.

The actuating lever 80, preferably made of sheet steel of channel-shaped cross section, comprises an outer arm 82 having a uniplanar longitudinal surface located rearwardly of its pivotal axis for contacting engagement with the continually-operated cam 78 and an inner composite bifurcated section. This section is formed by the rigid curved section 83 which is continuation of the lever proper and a yielding acting part which is shown as a flat spring 85, one end of which is fixed to the arm 82 rearwardly its pivotal axis.

As particularly shown in Fig. V, the leaf spring 85 has one of its ends riveted as at 86 to the bottom surface of the actuating lever and in its non-operative position forms a continuation of the uniplanar section 82 of the lever. In this form of the invention the rigid inner section 83 is curved and arranged to provide a predetermined angular relationship with the longitudinal axis of the lever, so that the leaf spring 85 is inherently biased to serve as an elastic finger of the actuating lever 80. As a result of this angular relationship, the spring 85 is in constant engagement with the enlarged head 70 of the pull rod 60, even at times when pressure is present within the pumping chamber 57 which pushes the diaphragm placing the pull rod 60 in the position shown in Fig. IV so as to render rotation of the cam 78 temporarily ineffective to impart full reciprocatory movement to the diaphragm. The curvature of the inner section 83 of the lever provides a suitable configuration whereby a rolling point contact occurs when the leaf spring 85 is forced into full engagement with the curved section 83, producing a substantially rigid unit for the transmission of force to pull the diaphragm 56.

In the modified form of the invention, as particularly shown in Figs. V and VI, the inner composite bifurcated section of the actuating lever includes the divergent arms 83 and 85 of substantially the same length and in vertical alignment when in operating position. The arms 83 and 85 are formed with forked end sections 89 and 90 adapted to straddle the shank of the handling member 60, as particularly shown in Fig. IV. The yielding acting arm or leaf spring 85 is arranged with a predetermined preloading, so that its forked end 90 is in constant engagement with the bottom surface of the enlarged head 70 of the handling member snugly straddling its shank and with the end of the forked section 90 abruptly bent as at 91, so that the furcations are also in direct engagement with the side walls of the head 70 of the handling member, thereby providing a constant pull on the diaphragm and continuously guiding the handling member during its range of operation.

The rigid component of the actuating assembly, which has been identified as 80, is preferably fabricated from sheet steel and is formed so that its back and side walls are substantially at right angles with the back having a substantially uniform width throughout its length. The side walls, as particularly shown in Fig. VI, are struck out forming an enlarged section 92 adjacent to its pivotal axis and are provided with aligned apertures 93 to accommodate the pivot pin 81 and the remainder gradually decreasing in height from the enlarged section 92 toward their respective extremities. The outer extremity of the arm 82 is provided with a contacting shoe 95 formed with a curved arcuate face 96 for engagement with the cam or continuously rotating part 78.

The operation of the second form of the invention is similar in all respects to the one hereinbefore described, as illustrated in Figs. I to III inclusive. However, it should be noted that in the second form of the invention, the curvature is imparted to the rigid arm instead of the leaf spring which, as hereinbefore pointed out, is flat and forms a continuation of the uniplanar section of the lever proper.

The foregoing clearly shows that in the embodiments of the invention disclosed, the actuating assembly, which transmits motion and force from the continuously rotating part to the handling member of the diaphragm, acts as an elastic coupling which, not only transmits force and motion, but also functions in a four-fold manner as follows: (1) as means to take up any shock caused by the engagement of the lever means with the handling member of a pumping element, insuring thereby quiet operation by suppressing uncontrolled movements and undesirable vibrations, particularly in the critical speed range, (2) as means to effectively guide the handling member and thereby the pumping element during its operative range, (3) as means to provide a unidirectional force for keeping under tension the pumping element and applying a force in only one direction on the fulcruming means, and (4) as means to constantly urge one component of the assembly into engagement with the continually power-driving part.

In the operation of pumps of the character to which this invention is directed, various inertia forces are encountered, both in starting the diaphragm from rest or after back pressure in the pumping chamber has subsided. As the result of such conditions, the diaphragm must be started from rest and, with extreme rapidity, brought to a speed equal to that of its operating mechanism. These inertia forces are considerable and frequently cause stress

deterioration to the various components, especially after continuous operation. In accordance with the present invention, such inertial forces are damped as the actuating lever provides a composite arm as a basic component of the continuous elastic connection between the operating cam and the diaphragm. By the presence of the composite arm in such elastic connection sufficient pressure is exerted on the lever for holding its outer arm into constant contact with the cam, without additional springs, while permitting, and in fact aiding, the handling member to undergo changes in position as result of pressure in the pumping chamber.

It has been found that by the variable line or length of contact provided between the lever proper and the leaf spring, the delivery efficiency of the pump is greatly increased in the critical speed range and the pulsations caused by the fluid transfer are damped or suppressed, increasing thereby the diaphragm operating life as well as that of the seal for the handling member.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed:

1. A pump having a housing providing a pumping chamber, a diaphragm comprised in the pumping chamber as the movable wall thereof, a hermetically sealed freely movable handling member of light construction operably connected to said diaphragm by one end and having an enlarged head at its other end, an operating composite lever pivotally mounted on the housing adapting the composite lever to be given a rocking motion by a power-operated means, said composite lever having an outer end projecting outside of said housing and an inner end inside of the housing, the major part of said composite lever formed by a rigid arm and a secondary inherently elastic arm connected together and having a diverging relationship from a point rearwardly of the pivotal axis of the composite lever to their terminal ends, both of the arms of said composite lever having forked end sections which straddle said handling member, the secondary arm having its forked section abruptly bent at its end and dimensioned to snugly straddle the shank of the handling member and directly engage the bottom and side walls of the enlarged head of said handling member to provide thereby the sole guiding means therefor during its range of movement by placing said diaphragm under constant pull and concurrently urging the outer end of the composite lever into constant engagement with the power-operated means as well as constantly applied force in only one direction on the pivotal axis of said lever.

2. A pump comprising a reciprocable pumping element having resilient means for conditionally effecting its motion in one direction and a hermetically sealed freely movable handling member of light construction attached to said pumping element by one end and provided with an enlarged head at its other end, a composite actuating assembly operable by power means to impart motion in the opposite direction to said pumping element through said handling member distorting said resilient means, a rigid pivoted lever formed of sheet metal of channel-shaped cross-section forming a part of said composite assembly having sections extending in opposite directions from its pivotal axis with its outer end section operatively connected to the power means for imparting movement to said handling member, a leaf spring having one end secured to said lever and formed at its other end with a forked section terminating in upwardly directed portions dimensioned to snugly straddle the shank and directly engage the side walls of the enlarged head of the handling member forming thereby the sole guiding means for said handling member during its range of movement, and the said leaf spring secured to the lever at a point rearwardly of its pivotal axis and having its main portion spaced apart from the lever from a point rearwardly of its pivotal axis to the end of its inner section to thereby constantly apply a force in one direction on the pivotal axis of the level during its motion as well as providing a continuous pull on the pumping element by its direct engagement with the handling member.

3. For use in imparting motion providing a variable stroke from a continually driven part having a uniform throw to a reciprocable pumping element having a freely movable handling member of light construction attached thereto by one end and having an enlargement at its other end; a composite actuating assembly interposed between the continually driven part and the handling member which comprises a pivoted lever of sheet metal having a channel-shaped cross-section formed with an outer uniplanar surface for actuation by said constantly driven part and a noise-obviating resilient means operated by the lever, the noise-obviating means including a yielding acting member extending in spaced relation from the lever from a point rearwardly of its pivotal point to its inner end forming divergent arms one of which is curved while the other arm is an extension of the uniplanar surface of the said sheet metal lever, both arms having forked end sections which straddle the shank of the handling member, the forked section of the yielding acting member abruptly bent at its end and dimensioned to snugly straddle the shank of the handling member and directly engage the bottom and side walls of the enlargement of the handling member forming thereby the only guiding means for the handling member during its range of movement providing a continuous pull on the pumping element by its direct engagement with the handling member.

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