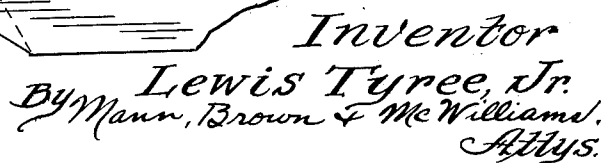


L. TYREE, JR
RECIPROCATING PUMP

Filed Feb. 8, 1963

2 Sheets-Sheet 1



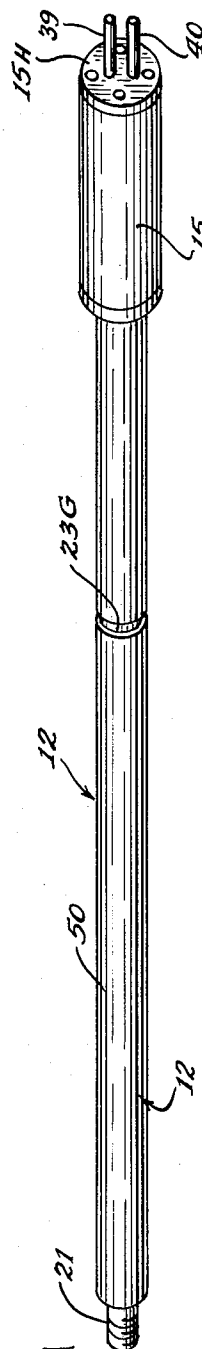
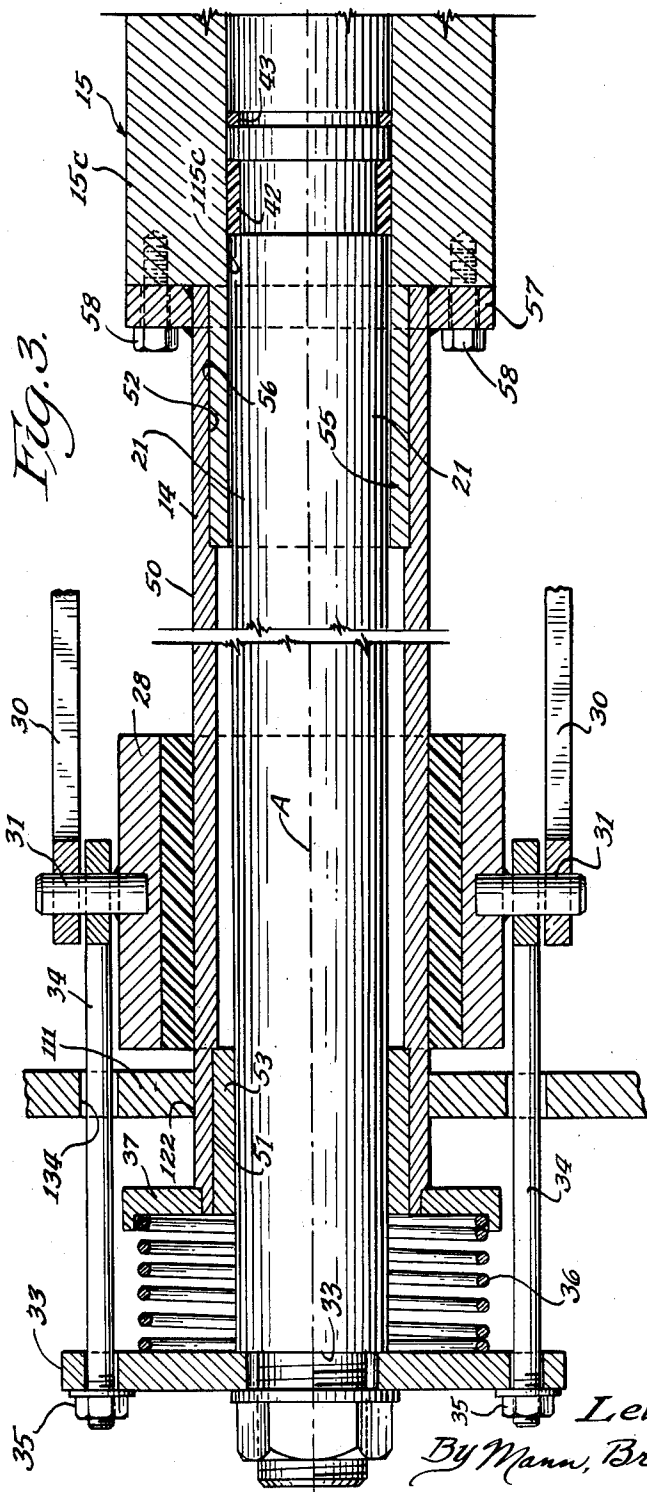
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L. TYREE, JR
RECIPROCATING PUMP

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2 Sheets-Sheet 2



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3,150,602

RECIPROCATING PUMP

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14 Claims. (Cl. 103—153)

This invention relates to reciprocating pumps and particularly to the manner of association of the piston and cylinder elements of the pump with each other and with the pump-driving mechanism.

In conventional piston pumps, the piston rod or the projecting end of the piston is connected to a slidably guided reciprocating cross head, so as to be actuated and guided by the cross head along a reciprocating path, and the inner end of the piston is slidably guided within the pumping chamber by cooperation with the cylinder walls. The cross head is usually actuated from a rotating drive shaft by an eccentric or crank type of connection which by its very nature imparts a substantial component of force laterally of the reciprocating path of the cross head and this lateral component of force tends to produce wear in the cross head guides or bushings and to produce rocking or lateral displacement of the cross head with relation to the desired path of movement of such cross head. An operating cam acting directly on the cross head has a similar action.

Desirably in such pump structures, the reciprocating axis of the cross head and of the pumping end of the piston should coincide because any parallel or angular misalignment results in undesired side thrusts on the cross head and its bearings and on the piston and its bearings. Such side thrusts of course cause excessive wear and produce excessive heat, and this is particularly undesirable in cryogenic liquid pumps.

In view of the foregoing it is the primary object of the present invention to provide a pump and pump drive mechanism wherein undesirable side thrusts on the piston rod are eliminated, and an object related to the foregoing is to accomplish this in a manner that is determined by the assembly and relationship of the parts in such assembly rather than by adjustments performed after the original assembly. More specifically it is an object of this invention to enable accuracy of alignment of the reciprocating parts to be attained through the use of accurately controlled machining operations in respect to the several parts that are to be assembled to make up the pump and its drive mechanism, and to accomplish this in such a way that the required machining operation may be performed on commercially available machine tools within the limits of accuracy that are required.

Another important object related to the foregoing is to provide a pumping structure wherein the pumping cylinder and a remote piston bearing are mounted on opposite ends of an elongated rigid support tube so that the axes of the remote bearing and the cylinder coincide and to mount an operating cross head for the piston in slidable relation on an exterior guide surface of the support tube so that the cross head reciprocates on this same main axis and the side thrusts imparted to the cross head by its driving mechanism are isolated from the drive end of the piston by connecting the cross head with the drive end of the piston to exert the actuating forces in a balanced relation longitudinally of such axis.

Another important object of the present invention is to provide a pump driving structure of the aforesaid character wherein the power train is in effect pre-loaded and has a constant resilient tension so that there can be no pounding or knocking due to excessive bearing tolerances and the like, and a related object is to provide such a pump drive structure in which the driving piston rods act in tension as the piston is being actuated through its pumping or discharge stroke.

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Other and further objects of the present invention will be apparent from the following description and claims, and are illustrated in the accompanying drawings, which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof, and what is now considered to be the best mode in which to apply these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the invention.

In the drawings:

FIG. 1 is a perspective view showing the pumping apparatus embodied in the features of the invention;

FIG. 2 is a fragmentary sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged longitudinal cross sectional view of the assembly shown in FIG. 2 and showing the details of a structure whereby alignment of the parts is attained; and

FIG. 4 is a perspective view of the pump and the support tube of the apparatus.

For purposes of disclosure the invention is herein illustrated as embodied in a pumping mechanism 10 that includes a relatively large frame structure 11 in the nature of a housing within which certain elements of the pump drive are enclosed, as will be described, and a pumping unit 12 comprising an elongated rigid support tube 14 and having a piston and cylinder pump 15 rigid with one end thereof is mounted on and extended through the housing or frame 10 to support the pump cylinder 15 externally of the housing 11 while the pump driving or actuating means are enclosed to a large extent within the housing.

In the present instance the support tube 14 is disposed at an angle so as to slope in a downward direction toward the pump 15 and within the housing and substantially midway between the ends of the support tube 14, a horizontal drive shaft 18 is supported by bearings 19 so as to extend transversely of and closely beneath the support tube 14. The drive shaft 18 is, in the present instance, operated from a drive motor 20 that is secured to the housing 10 exteriorly thereof.

It will be noted that the support tube 14 extends entirely through the housing 10 so that portions of the pump actuating mechanism may be located outside of the housing, and an elongated piston 21 is located within the support tube 14 so that the pump end thereof extends into the cylinder 15C of the pump 15 while the other or drive end of the piston 21 extends beyond the other or left end of the support tube 14 for connection with the drive mechanism.

The support tube 14 is, in the present instance, supported at spaced points by opposite walls of the housing 11. At one point that is approximately midway between its ends, as shown in FIG. 4, the tube 14 extends through a close fitting support opening 22 in a relatively thick wall 11W of the housing. A split ring 23 recessed into a groove 23G at the outer circumference of the tube 14 fits into a rabbeted groove 22R in the wall 11W, and clamping plates 24 are secured by cap nuts 25 against one side of the ring 23 to hold the assembly in position. Near its other end the tube 14 extends through an opening 122 in the opposite side wall 111W.

For purposes that will be described in detail hereinafter, the present invention provides a cross head 28 in the form of an internally bushed sleeve that surrounds and is slidable longitudinally of the support tube 14 in that portion that is located between the drive shaft 18 and the uppermost or left end of the tube 14, and the cross head 28 has a balanced drive imparted thereto by means including a pair of eccentrics 29 and connecting rods 30 that are associated with diametrically aligned wrist pins 31 that are provided on the cross head 28.

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The projecting or drive end of the piston 21 has a transverse yoke 33 secured thereto, and on opposite sides of the cross head 28, pull rods 34 are extended from the respective wrist pins 31, through relatively large clearance openings 134 in the wall 111W, and then through opposite ends of the yoke 33. Nuts 35 on the pull rods 34 enable the cross head 28 to impart right hand motion to the piston 21 for actuating the piston through a discharge or pumping stroke. The return or suction stroke is imparted to the piston 21 by an expansive coil spring 36 that surrounds a projecting end of the piston rod and which acts between the yoke 33 and a spring seat plate 37 that is removably mounted on the shouldered adjacent end of the support tube 14.

As will become apparent as the description proceeds, the specific internal structure of the pump 15, except for the guiding of the piston 21 within and longitudinally of the cylinder, is immaterial to the present invention. Thus, the pump might take the form shown in my prior Patent No. 3,023,710, patented March 6, 1962, but for simplicity of disclosure the pump 15 is herein indicated as having a check valved inlet 39 and a check valved outlet 40 both opening through a cylinder head 15H. So far as the guiding of the pump end of the piston 21 is concerned, attention is directed to FIG. 3 of the drawings wherein a plastic bearing 42 is shown recessed into the piston and engaging the cylinder wall, there also being a pump seal provided by a piston ring 43 recessed into the piston 21 adjacent to the bearing 42.

Under and in accordance with the present invention, objectionable side thrusts in the reciprocating parts of the pump and drive mechanism are eliminated by the cooperative action of a number of physical and functional relationships that include the particular location of the cross head 28 on the support tube 14 and the particular way in which this cross head is associated with the drive end of the piston 21, and these physical characteristics cooperate with an alignment of the axis of the cylinder 15, the axis of the tube 14, the axis of guide means for the drive end of the piston 21, and the axis of reciprocating movement of the cross head 28 in attaining trouble free pump operation. Under the present invention all the aforesaid axes are coincident, and this is accomplished by aligning and locating the drive end bearing means, the guide surfaces for the cross head 28, and the pump cylinder 15C on a common rigid structural member which in this instance is provided by the support tube 14. In accomplishing this, the various aligning surfaces that are required are formed as cylindrical surfaces so that use may be made of conventional lathes in assuring that the guide or aligning surfaces bear a definite and predetermined relationship one to the other.

Thus, with respect to the support tube 14, the outer surface thereof, at least in the region where the cross head 28 is to be mounted, is turned to provide a cylindrical surface 50 as indicated in FIG. 3, and this cylindrical surface 50 then defines an axis A for the support tube 14. The cylindrical surface 50 is then used to center and support the tube 14 in a lathe for rotation about the aforesaid axis A so that other cylindrical surfaces may be formed on the support tube 14 concentric with the axis A. Thus where the pump cylinder 15C is formed separately from the support tube 14, the tube 14 is counter-bored at its opposite ends to provide cylindrical internal surfaces 51 and 52 that are concentric with the aforesaid axis A.

The counterbore that provides the internal cylindrical surface 51 then has a bearing bushing 53 fitted therein. This bearing bushing 53 is of the conventional type with its inner and outer surfaces concentric, and the bushing 53 is arranged to embrace and slidably support the drive end of the piston 21 with the axis of the piston 21 coincident with the axis A of the support tube 14.

The other counterbore which forms the internal cylindrical surface 52 is utilized as aligning means for the

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separately formed pump cylinder 15C, and as will be evident in FIG. 3 of the drawings, the adjacent or left hand end as viewed in FIG. 3, has a projecting aligning sleeve 55 formed thereon, the internal cylindrical surface of the projecting sleeve 55 forming a continuation of the internal side wall 115C of the cylinder 15C. The internal surface of the cylinder is utilized in such an operation as the mounting and centering surface for the cylinder 15C, and hence when the cylinder is turned down to form the projecting sleeve 55, an outer cylindrical surface 56 is provided which is centered on the longitudinal axis of the cylinder or pumping chamber. The sizing of the surfaces 52 and 56 is such that a snug sliding fit is provided for the sleeve-like portion 55 within the cylindrical surface 52, and hence when the sleeve 55 is in the position shown in FIG. 3, the axis of the cylinder or pumping chamber coincides with and constitutes an extension of the axis A of the support tube 14. A flange 57 fixed as by welding on the right hand end of the support tube 14 is secured by cap screws 58 to the end of the cylinder 15C, thus to hold the parts in their assembled relationship.

When the cylinder 15C and the tube 14 have thus been assembled, and with the bushing 53 in position as shown in FIG. 3, the piston 21 of the pump is centered and guided within the cylinder 15C by the bearing 42, and the drive end of the piston 21 is centered on the axis A of the tube 14 by the bearing 53. The reciprocating movement of the piston 21 is therefore along the axis A of the support tube 14, and because the cross head 28 reciprocates on and is guided by the surface 50 above described, which is also centered on the axis A, the piston 21 and the cross head 28 both reciprocate on a common axis and there is no binding or excessive friction due to misalignment of the relatively moving parts.

It is noted of course that where an eccentric or crank type drive is associated with the cross head 28 in the manner hereinabove described to impart reciprocating movement thereto, there is necessarily a lateral component of force applied to the cross head 28, but with the parts arranged as above described, any lateral forces thus applied are dissipated and absorbed by the rigid support tube 14, and the reciprocating movement of the cross head 28 is transmitted to the yoke 33 in a balanced and centered relationship such that no transverse forces or side thrusts are imposed upon the drive end of the piston 21.

In practice the pump unit 12 has the alignment of the cylinder, the bushing 53 and the guide surface 50 established by conventional machining and production processes so that the axes of these elements are coincident, and the unit 12, including the piston 21 thus forms a sub-assembly which, in original factory assembly of the apparatus 10, or in subsequent field repairs, may be quickly and easily associated with the pump driving mechanism. Such assembly is accomplished by inserting the pump unit 12 endwise through the opening 22, through the cross head 28, and then through the housing opening 122. After putting the clamping plates 25 in position as shown in FIG. 2, the spring 36, the spring holder 37 and the yoke 33 are put in place as shown in FIGS. 1 and 3. Such assembly, of course, does not require either factory or field adjustment of the cross head mechanism because the cross head 28 is, in effect, free floating so that it may conform with the path established by guide surface 50 of the pump unit 12. Thus the cross head is guided and centered on a path that is coincident with the axis of reciprocation of the piston 21.

From the foregoing description it will be apparent that the present invention provides an improved reciprocating piston pump in which the form and relationship of the elements of the pump and its drive cooperate to eliminate objectionable side thrusts that tend to produce objectionable wear and frictional heat.

It will also be apparent that the present invention pro-

vides a pump and its related driving mechanism that are so related that the most frequently required repair or replacement operation may be readily accomplished in the field without requiring delicate readjustments of the mechanism.

Thus, while a preferred embodiment of the invention has been illustrated herein, it is to be understood that changes and variations may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim:

1. In a pumping mechanism, an elongated support tube having an external cylindrical surface defining the axis of the tube, a pumping cylinder, having a predetermined axis and rigidly related to one end of said support tube with its axis coinciding with the axis of said support tube, a piston having a pumping end slidably guided in said cylinder and said piston extending through said support tube and outwardly beyond the other end of said support tube to provide a drive end for the piston, a bearing bushing fixed to said other end of the support tube to locate said drive end of said piston with its axis coinciding with the axis of said support tube, a cross head slidable on and surrounding said outer cylindrical surface of said support tube and reciprocable along a path parallel to said tube axis, means acting in a plane passing through the axis of the tube and connecting said cross head with said drive end of said piston for actuating said piston.

2. In a pumping mechanism, an elongated support tube having an external cylindrical surface defining the axis of the tube, a pumping cylinder, having a predetermined axis, and secured on one end of said support tube with its axis coinciding with the axis of said support tube, a piston having one end slidably guided in said cylinder and said piston extending through said support tube and outwardly beyond the other end of said support tube, a bearing bushing fixed to said other end of the support tube to locate said other end of said piston rod with its axis coinciding with the axis of said support tube, a cross head slidable on and surrounding said outer cylindrical surface of said support tube and reciprocable along a path parallel to said tube axis, means acting between said support tube and said other end of said piston rod to yieldingly urge said piston through a suction stroke, means acting in a plane passing through the axis of the tube and connecting said cross head with said other end of said piston for moving said piston in the opposite direction, and means for reciprocating said cross head.

3. In a pumping unit, a pump cylinder having a predetermined longitudinal axis, an elongated rigid support having one end thereof rigidly related to one end of the cylinder and having a central clearance space longitudinally through said support, a guide bushing mounted on the other end of said support with its axis coincident with the axis of said cylinder, a piston having a pumping end disposed in said cylinder and guided therein for reciprocating movement, said piston being extended through said clearance space and through and beyond said bushing to provide an exposed driving end that is supported and guided by said bushing for reciprocation in centered relation on the axis of the cylinder, and an elongated guide surface on said support for supporting and guiding a cross head for reciprocation along and in centered relation to said axis.

4. In a pumping unit, a pump cylinder having a predetermined longitudinal axis, an elongated support tube having an internal diameter greater than the internal diameter of the cylinder and having one end thereof rigidly related to one end of the cylinder, a guide bushing mounted on the other end of said support tube with its axis coincident with the axis of said cylinder, a piston in said cylinder and guided therein for reciprocating movement, said piston being extended through and beyond said tube and said bushing to provide an exposed driving end that is supported and guided by said bushing for reciprocation

tion in centered relation on the axis of the cylinder, and an external guide surface on said support tube for supporting and guiding a cross head for reciprocation along and in centered relation to said axis.

5. In a pumping mechanism, a mounting frame, a pumping unit comprising a pump cylinder having a predetermined longitudinal axis, an elongated rigid support having one end thereof rigidly related to one end of the cylinder and having a central clearance space longitudinally through said support, a guide bushing mounted on the other end of said support with its axis coincident with the axis of said cylinder, a piston having a pumping end disposed in said cylinder and guided therein for reciprocating movement, said piston being extended through said clearance space and through and beyond said bushing to provide an exposed driving end that is supported and guided by said bushing for reciprocation in centered relation on the axis of the cylinder, and an elongated guide surface on said support for supporting and guiding a cross head for reciprocation along and in centered relation to said axis, a drive shaft supported in said mounting frame, means for mounting said pumping unit on said mounting frame at right angles and closely adjacent to said drive shaft, a cross head mounted on said guide surface of said elongated support and guided thereby for reciprocation along said elongated support, means operatively relating said drive shaft to said cross head for reciprocating the cross head, and means connecting said cross head and the driving end of said piston for actuating the piston.

6. A pumping mechanism according to claim 5 wherein said elongated guide surface is an external surface of the elongated rigid support and is so related as to enable the pump unit to be inserted endwise into and through said cross head in the assembly of the pumping mechanism.

7. In a pumping unit, a pump cylinder having a predetermined axis, an elongated rigid support tube having an external cylindrical surface providing a guide upon which a cross head may be reciprocably supported and defining the axis of the tube and having one end thereof rigidly related to said cylinder with said tube axis and said cylinder axis in coincident relation, said tube having an internal cylindrical surface formed thereon adjacent the other end thereof concentric with said axes, a bearing bushing fixed within and positioned thereby with the axis coinciding with the axes of the tube of the cylinder, a piston having a pumping end slidably guided in said cylinder in centered relation in the cylinder and said piston extending through said support tube and outwardly beyond the other end of said support tube to provide a drive end for the piston.

8. In a pump unit mechanism, an elongated support tube having elongated external cylindrical surface upon which a cross head may be supported and defining the axis of the tube and having internal cylindrical surfaces formed thereon adjacent opposite ends concentric with said axis, a pumping cylinder having a predetermined axis and having a centering and locating surface on said cylinder engaging the internal cylindrical surface at one end of the tube to locate the cylinder with its axis coinciding with the axis of the support tube, means securing the cylinder to the tube, a piston having a pumping end slidably guided in said cylinder and said piston extending through said support tube and outwardly beyond the other end of said support tube, and a bearing bushing fixed within and centered by the internal cylindrical surface at the other end of the support tube and embracing the other end of said piston to guide the same with its axis coinciding with the axis of said support tube.

9. In a pumping mechanism, a mounting frame, a pumping unit comprising a pump cylinder having a predetermined longitudinal axis, an elongated rigid support having one end thereof rigidly related to one end of the cylinder and having a central clearance space longitudinally through said support, a guide bushing mounted on

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the other end of said support with its axis coincident with the axis of said cylinder, a piston having a pumping end disposed in said cylinder and guided therein for reciprocating movement, said piston being extended through said clearance space and through and beyond said bushing to provide an exposed driving end that is supported and guided by said bushing for reciprocation in centered relation on the axis of the cylinder, and elongated guide surfaces on said supporting and guiding a cross head for reciprocation along and in centered relation to said axis, a drive shaft supported in said mounting frame, mounting means on said frame into which said pumping unit may be inserted endwise for mounting said pumping unit on said mounting frame at right angles and closely adjacent to said drive shaft, means for securing the pumping unit rigidly in position on said mounting means, a cross head through which said pumping unit may be inserted endwise as said pumping unit is being put in place on said mounting means, said cross head having surfaces engaging said guide surfaces of elongated support to guide said cross head for reciprocation along said elongated support, means operatively relating said drive shaft to said cross head for reciprocating the cross head, and means connecting said cross head and the drive end of said piston for actuating the piston.

10. In a pumping mechanism, an elongated support tube having an external cylindrical surface intermediate its ends defining the axis of the tube and having second and third cylindrical surfaces formed thereon adjacent opposite ends concentric with said axis, a pumping cylinder having a predetermined axis and having a cylindrical aligning surface at one end concentric with said axis of the cylinder, said cylinder being secured on one end of said support tube with said cylindrical aligning surface snugly fitted in telescoped relation to said second cylindrical surface of said support tube thereby positioning said cylinder with its axis coinciding with the axis of said support tube, a piston having one end slidable in said cylinder and said piston extending through said support tube, a guide bushing fixed to said other end of the support tube in a centered and aligned relation determined by said third cylindrical surface to thereby locate said other end of said piston with its axis coinciding with said axis of said support tube, a cross head slidable on and surrounding said external cylindrical surface of said support tube and reciprocable along a path parallel to said tube, means acting between said support tube and said other end of said piston rod to yieldingly urge said piston through a suction stroke, means connecting said cross head with said other end of said piston for moving said piston in the opposite direction, and means for reciprocating said cross head.

11. In a pumping mechanism, an elongated support tube having an external cylindrical surface defining the axis of the tube and having internal cylindrical surfaces formed thereon adjacent opposite ends concentric with said axis, a pumping cylinder having a predetermined axis and having a projecting integral locating sleeve at one end thereof with an external cylindrical surface on said locating sleeve concentric with said axis of the cylinder, said cylinder being secured on one end of said support tube with said locating sleeve snugly fitted within the internal cylindrical surface at that end of said support tube to thereby position said cylinder with its axis coinciding with axis of said support tube, a piston having one end slidably guided in said cylinder and said piston extending through said support tube and outwardly beyond the other end of said support tube, a guide bushing surrounding said piston and fixed in said other end of the support tube and within and centered by the internal cylindrical surface at that end of said support tube to thereby locate said other end of said piston rod with its axis coinciding with said axis of said support tube, a cross head slidable on and surrounding said external outer cylindrical surface of said support tube and reciprocable

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along a path parallel to said tube, means acting between said support tube and said other end of said piston to yieldingly urge said piston through a suction stroke, means connecting said cross head with said other end of said piston for moving said piston through a pumping stroke in the opposite direction, and means for reciprocating said cross head.

12. In a pumping mechanism, a pump cylinder having an elongated pumping chamber having a predetermined axis, and said cylinder having an integral sleeve projecting from one end thereof and having an annular cylindrical positioning surface formed on said sleeve concentric with the axis of said pumping chamber, a piston reciprocally mounted in said pumping chamber and having bearing contact with the chamber to maintain the piston concentric with the axis of said pumping chamber in the region of such bearing contact, said piston extending for a substantial distance outwardly of and beyond said sleeve, a support tube surrounding said extended portion of said piston throughout substantially its entire length and being spaced from said piston, said support tube having an external surface, the center of which defines the axis of said support tube, said support tube having internal cylindrical surfaces adjacent opposite ends thereof concentric with said axis, the internal cylindrical surface at one end of said tube snugly surrounding said projecting sleeve of said pump cylinder to locate said pump cylinder with its axis coinciding with and constituting an extension of the axis of said support tube, a bearing bushing fixed within the other end of said support tube and engaging said piston rod and the other internal cylindrical surface of said tube to locate said other end of said piston with its axis coinciding with the axis of said support tube, a yoke on the projecting end of said piston, spring means acting between said yoke and the adjacent end of said support tube to urge said piston through a suction stroke with respect to said cylinder, a cross head surrounding said support tube and slidably guided on said external cylindrical surface and having pull rods connected between said cross head and said yoke and disposed on opposite sides of said support tube in a plane passing through the axis of the support tube, an operating shaft extending transversely with respect to said support tube and closely adjacent thereto, eccentrics mounted on said shaft on opposite sides of said support tube and having piston rods connecting the respective eccentrics to said cross head for actuating said cross head and said piston in opposition to said spring means.

13. In a pumping mechanism, a mounting frame, a pumping unit comprising a pump cylinder having a predetermined longitudinal axis, an elongated rigid support having one end thereof rigidly related to one end of the cylinder and having a central clearance space longitudinally through said support, a guide bushing mounted on the other end of said support with its axis coincident with the axis of said cylinder, a piston having a pumping end disposed in said cylinder and guided therein for reciprocating movement, said piston being extended through said clearance space and through and beyond said bushing to provide an exposed driving end that is supported and guided by said bushing for reciprocation in centered relation on the axis of the cylinder, and elongated guide surfaces on said support for supporting and guiding a cross head for reciprocation along and in centered relation to said axis, a drive shaft supported in said mounting frame, mounting means on said frame engaging and supporting said rigid support at points spaced longitudinally of said rigid support to mount said pumping unit on said mounting frame at right angles and closely adjacent to said drive shaft, a cross head mounted on said guide surfaces of said elongated support between said points and guided on said guide surfaces for reciprocation along said rigid support, means operated by said drive shaft and including connecting rods associated with said cross head to act in tension to actuate said cross head toward the

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cylinder, means connecting the cross head and the drive end of said piston for transmitting movement therebetween, and spring means acting on said piston to maintain the actuating connections under tension and impart return movement to said piston.

14. In a pumping mechanism, a mounting frame, a pumping unit comprising a pump cylinder having a predetermined longitudinal axis, an elongated rigid support having one end thereof rigidly related to one end of the cylinder and having a central clearance space longitudinally through said support, a guide bushing mounted on the other end of said support with its axis coincident with the axis of said cylinder, a piston having a pumping end disposed in said cylinder and guided therein for reciprocating movement, said piston being extended through said clearance space and through and beyond said bushing to provide an exposed driving end that is supported and

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guided by said bushing for reciprocation in centered relation on the axis of the cylinder, and elongated guide surfaces on said support for supporting and guiding a cross head for reciprocation along and in centered relation to said axis, mounting means on said frame engaging and supporting said rigid support at points spaced longitudinally of said rigid support to mount said pumping unit on said mounting frame, a cross head mounted on said guide surfaces of elongated support between said points and guided on said guide surfaces for reciprocation along said rigid support, and means connecting said cross head and the driving end of said piston for transmitting movement therebetween.

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