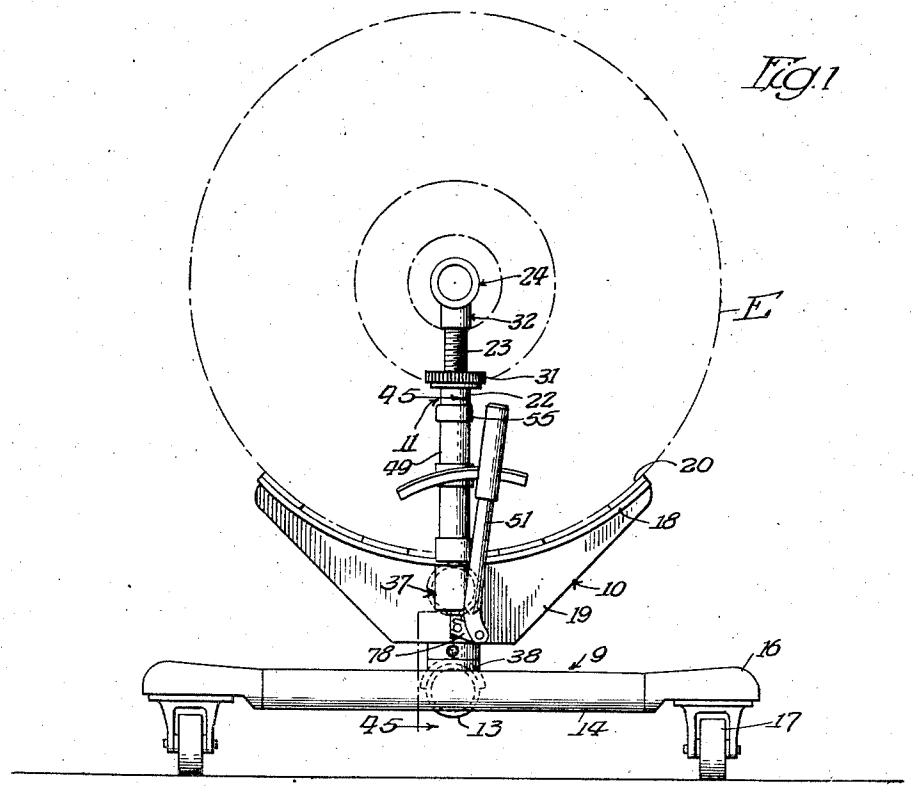
Oct. 15, 1946. G. E. BOCK 2,409,468

ENGINE WORKSTAND

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Fig. 1



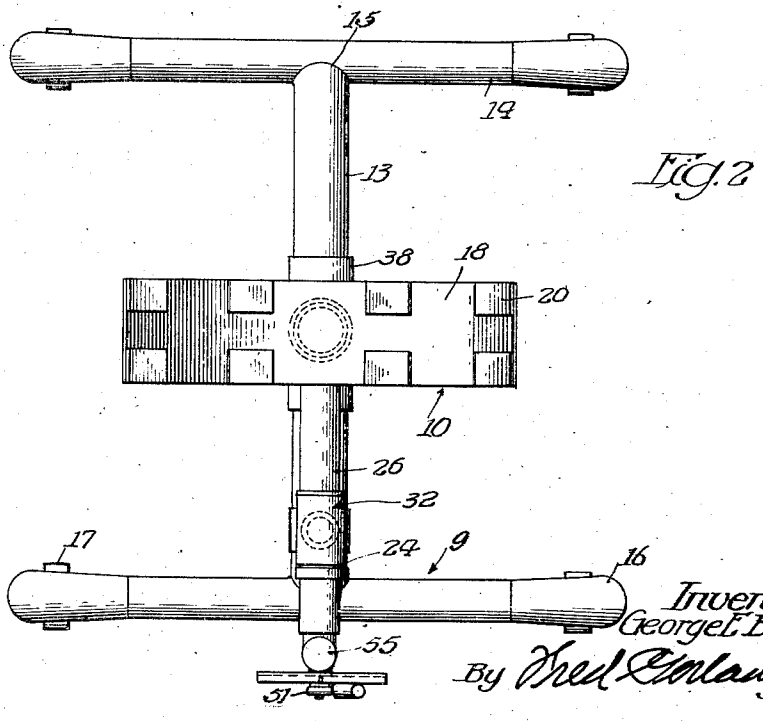




Fig. 2

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ENGINE WORKSTAND

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Fig. 3

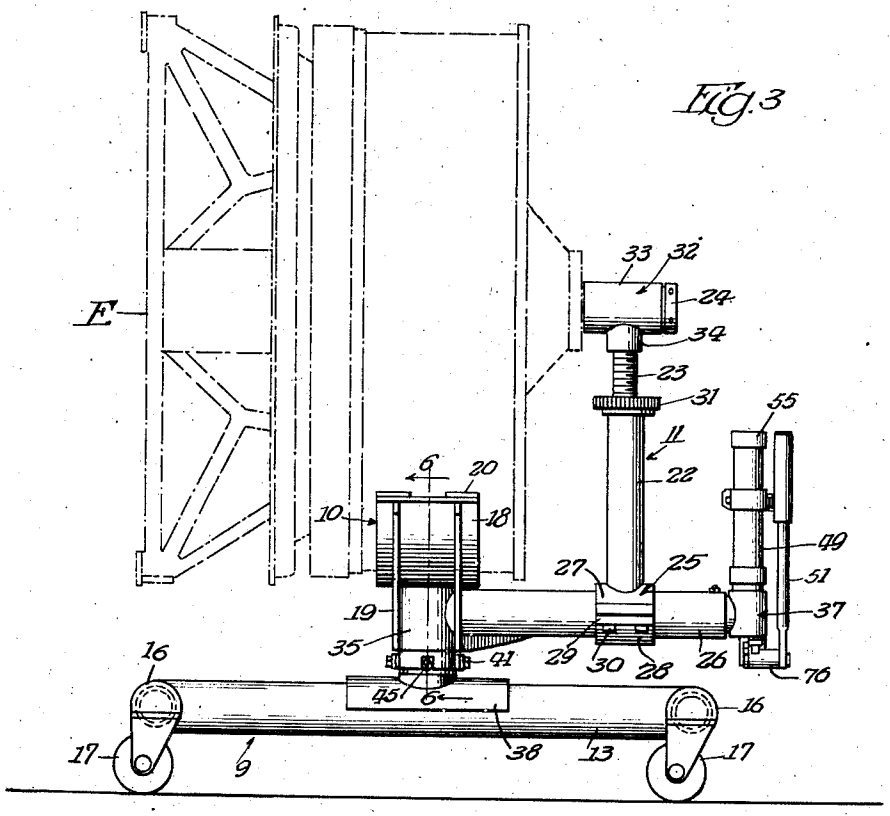
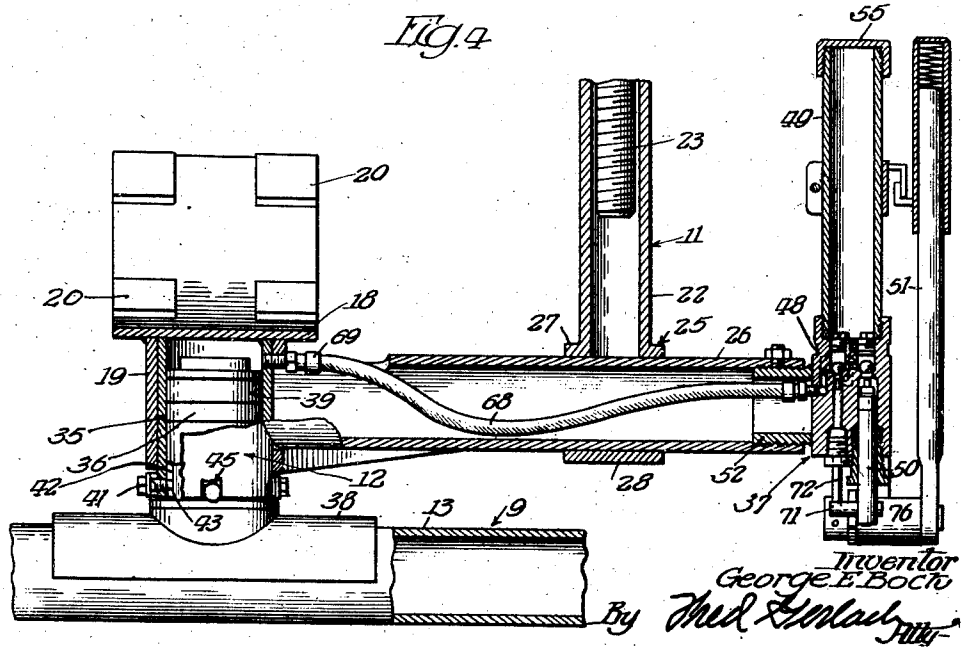



Fig. 4




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Oct. 15, 1946. G. E. BOCK 2,409,468

ENGINE WORKSTAND

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Fig. 5

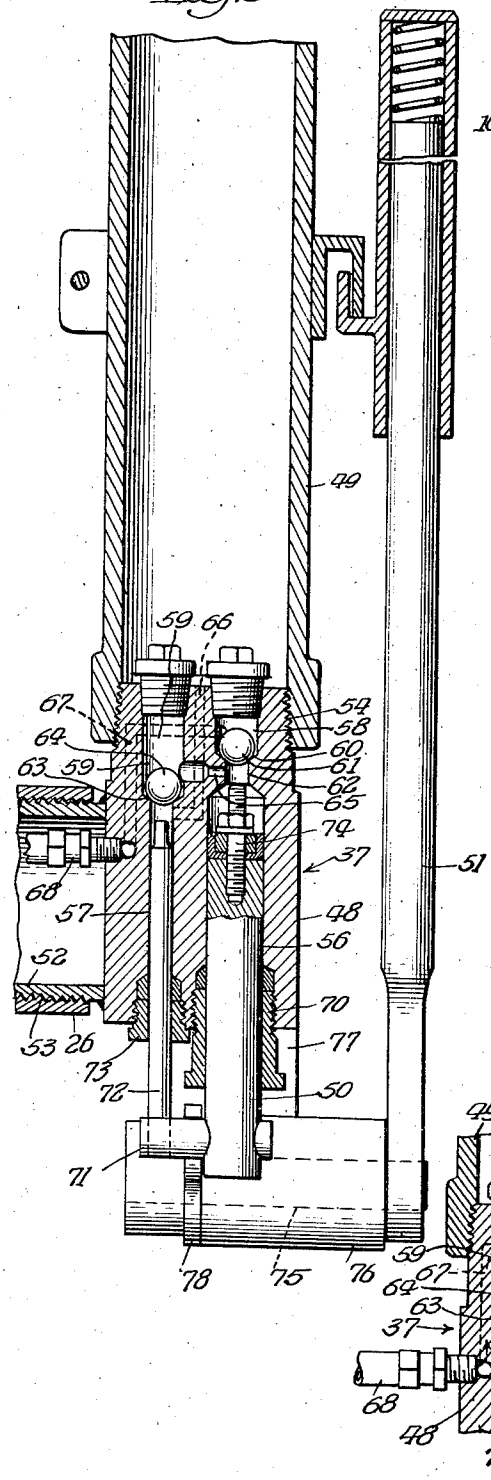



Fig. 6

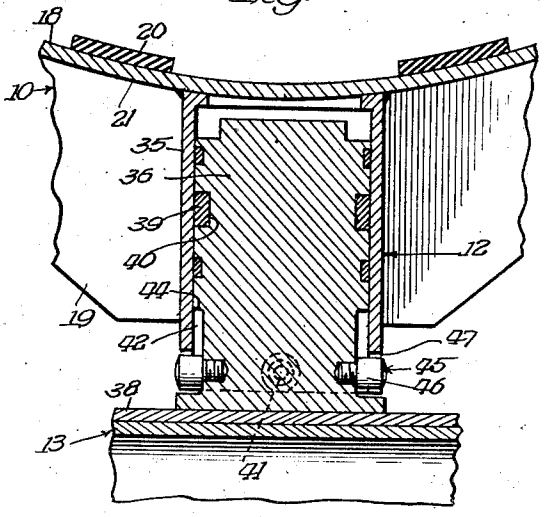



Fig. 7

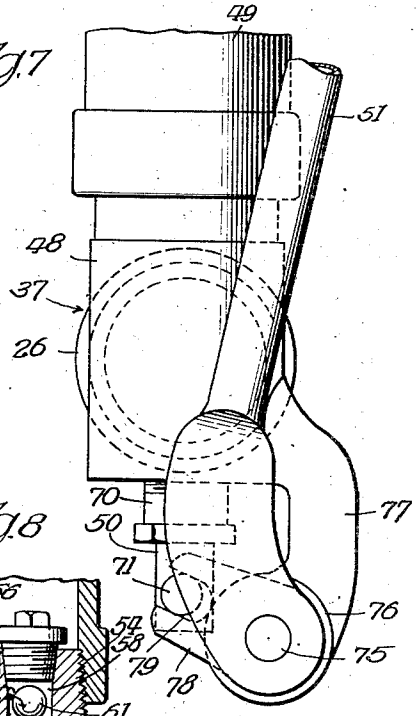
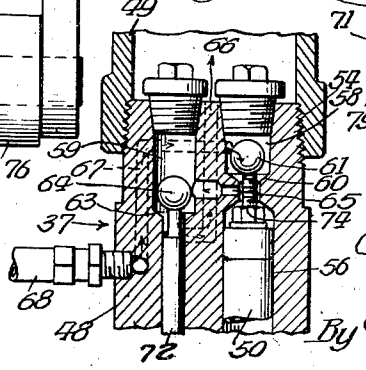



Fig. 8




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Patented Oct. 15, 1946

2,409,468

# UNITED STATES PATENT OFFICE

2,409,468

## ENGINE WORK STAND

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Application October 20, 1943, Serial No. 506,937

5 Claims. (Cl. 29—289)

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In general the invention relates to workstands for supporting internal combustion engines during installation or mounting thereon of auxiliary equipment, such, for example, as magnetos, pumps, and fuel and oil lines. More particularly the invention relates to that type of engine workstand which is designed primarily for use in supporting or handling radial variety aircraft engines and embodies a horizontal base frame and an engine supporting member on the base frame together with an upstanding strut which is mounted over the base frame in opposed relation with the engine supporting member and is provided at its upper end with a bearing for receiving and supporting the exposed end of the drive or crank shaft of the engine that is supported by way of the workstand.

One object of the invention is to provide an engine workstand of this type which is an improvement upon, has certain advantages over, and has greater capabilities of use than, previously designed workstands, including that which is disclosed in, and forms the subject matter of, United States Letters Patent No. 2,329,613, granted on September 14, 1943.

Another object of the invention is to provide an engine workstand of the type under consideration in which the engine supporting member and the upstanding bearing equipped strut are mounted on the horizontal base frame so that they may be conjointly raised and lowered in order to vary the elevation of the engine.

Another object of the invention is to provide an engine workstand of the last mentioned character in which the mounting means for the engine supporting member and the strut permits the engine to swivel or turn about a vertical axis and comprises relatively movable cylinder and plunger elements.

A further object of the invention is to provide an engine workstand of the last mentioned type and character which includes a simple manually operated pump unit for introducing fluid under pressure into the cylinder element when it is desired to raise the supporting member and strut, and for releasing the fluid under pressure in the cylinder element when it is desired to lower the member and strut.

A still further object of the invention is to provide an engine workstand of the aforementioned character which includes means between the cylinder and piston elements for locking them against relative rotation when the engine supporting member and strut are lowered to their fullest extent, and in addition includes means

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whereby the strut may be adjusted to and from the engine supporting member in order to adapt the workstand as a whole to receive and support engines of different sizes.

An additional object of the invention is to provide an engine workstand which is generally of new and improved construction and is characterized by the fact that it is both compact and rugged and so simple in design that it may be manufactured or produced at a comparatively low cost.

Other objects of the invention and the various advantages and characteristics of the present workstand will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a front view of an engine workstand embodying the invention;

Figure 2 is a plan view;

Figure 3 is a side view illustrating in detail the manner in which the supporting member and strut serve to retain an engine;

Figure 4 is an enlarged vertical longitudinal section taken on the line 4—4 of Figure 1 and illustrating in detail the manner in which the engine supporting member and the bearing equipped strut are mounted with respect to the horizontal base frame;

Figure 5 is an enlarged section showing the structural details of the pump unit for controlling the supply of fluid under pressure to and from the cylinder element constituting part of the mounting means for the engine supporting member and the strut;

Figure 6 is an enlarged vertical transverse section taken on the line 6—6 of Figure 3 and illustrating the construction and arrangement of the relatively movable cylinder and piston elements;

Figure 7 is an enlarged front view of the lower end of the pump unit; and

Figure 8 is a detailed section showing the manner in which the pump unit is controlled to release the fluid under pressure in the cylinder element when it is desired to lower the supporting member and strut.

The workstand which is shown in the drawings constitutes the preferred form or embodiment of

the invention. It is preferably of the portable type or variety and serves as described hereafter more in detail as a medium or means for supporting a radial engine E during installation or mounting thereon of auxiliary equipment. The engine E, as outlined by dotted or broken lines in Figures 1 and 3, is of the airplane type and comprises in addition to a crank case an annular series of radially extending cylinders, rocker boxes at the ends of the cylinders, and a drive or crank shaft which projects forwards from the crank case. Preparatory to installation of the engine E on the airplane for which it is designed or selected for use it is necessary to mount on the engine the auxiliary equipment including the mounting structure or supporting means and the various engine accessories, such as the carburetor, magneto, pumps, and fuel and oil lines. The present workstand serves as a medium for retaining the engine in a position wherein the drive shaft extends horizontally and enables the person or worker operating on the engine to install the auxiliary equipment and engine accessories while assuming a standing or upright position. As its principal parts the workstand comprises a horizontally elongated base frame 9, an engine supporting member 10, an upstanding strut 11 in opposed relation with the supporting member 10, and a vertically adjustable mount 12 for supporting the supporting member 10 and strut 11 so that they are conjointly vertically movable with respect to the base frame 9.

The base frame 9 is H-shaped and consists of a horizontal longitudinally extending central or intermediate member 13 and a pair of horizontal transversely extending end members 14. Such members are preferably formed of steel tubing or pipe. The intermediate member 13 may, if desired, be formed of heavier stock than the end members 14 and has curved or arcuate seats 15 at its ends. The central portions of the end members 14 fit within the seats 15 and are welded or otherwise fixedly secured to the ends of the intermediate member 13. The ends of the end members are provided with fittings 16 and these, as shown in Figures 1, 2 and 3 of the drawings, carry depending swivel type casters 17. The latter support the base frame 9 in an elevated position with respect to the subjacent floor or supporting surface and permit the workstand as a whole to be shifted bodily from place to place.

The engine supporting member 10 overlies the central portion of the intermediate member 13 of the base frame 9 and consists of an arcuate or curved metallic plate 18 and a pair of parallel, laterally spaced, depending metallic plates 19. The plate 18 forms a cradle for the engine E and has on the upper surface thereof cushion type pads 20 for engaging or contacting the rocker boxes on the outer ends of the lower cylinders of the engine E. Preferably the pads are formed of vulcanized rubber or like resilient material. The supporting member 10 is adapted when the workstand is in its normal operative position to support the engine E so that the drive or crank shaft thereof extends substantially horizontally. In mounting the engine E on the workstand it is positioned in a vertical position and then lowered until the rocker boxes on the lower cylinders are brought into engagement and supported relation with the pads 20 on the curved plate 18. Such plate is sufficiently long so as to prevent the engine from rocking in a sidewise manner when it is in place on the workstand. The upper margins of the depending plates 19 of the engine supporting member 10 are shaped to form seats 21 and these are curved conformably to the plate 18. The latter fits in the seats 21 and is welded or otherwise fixedly secured to the upper margins of the plates 19. Said plates serve to reenforce the plate 18 and prevent downward bending of the latter.



The strut 11 comprises a vertically extending tubular lower part 22, a vertically extending upper part 23 and a cylindrical bearing 24. The tubular lower part 22 of the strut 11 is provided with a split cylindrical clamp 25 and this, as best shown in Figure 4 of the drawings, surrounds a horizontally extending tubular arm 26. The latter extends at right angles to the arcuate plate 18 of the engine supporting member 10 and has one end thereof fixedly secured to the central portion of one of the depending plates 19. The split clamp 25 which, as previously pointed out, surrounds the arm 26, constitutes an adjustable mount whereby the strut 11 is supported on the arm 26 so that it is movable to and from the engine supporting member 10. It comprises an upper semi-cylindrical section 27 and a lower semi-cylindrical section 28 and these embody outwardly extending lugs 29 and are clamped together by way of bolts 30, which extend through the lugs. When the bolts are tightened the strut 11 is maintained in fixed relation with the arm 26 and the engine supporting member 10. By loosening the bolts the strut may be adjusted longitudinally of the arm, i. e., to and from the engine supporting member 10. The upper clamp section 25 is welded or otherwise fixedly secured to the lower end of the tubular lower end 22 of the strut. The vertically extending upper part 23 of the strut is in the form of a screw shaft and fits slidably in the lower part 22. A nut 31 is mounted on the upper strut part 23 and rests on the upper end of the lower strut part 22. By turning this nut in one direction or the other while the upper strut part 23 is held against rotation relatively to the lower strut part 22 the upper strut part may be raised or lowered. The upper end of the upper part 23 of the strut is provided with a T fitting 32 consisting of a cylindrical horizontal branch 33 and a vertical depending branch 34. The last mentioned branch surrounds and is fixedly secured to the upper end of the upper part 23 of the strut. The bearing 24 is rotatably mounted in the horizontal branch 33 of the T fitting 32 and is adapted to receive the outer or exposed end of the drive or crank shaft of the engine E. It is suitably held against axial displacement with respect to the horizontal branch 33 of the T fitting and serves when the exposed end of the drive or crank shaft of the engine is mounted therein, to hold the engine against fore and aft tilting with respect to the engine supporting member 10. By raising or lowering the upper strut part 23 with respect to the lower strut part 23 in response to turning of the nut 31 the bearing 24 may be properly positioned to receive the exposed end of the drive or crank shaft of the engine E in connection with mounting of the engine on the supporting member 10 of the workstand. Due to the fact that the strut 11 is mounted on the arm 26 by way of the split cylindrical clamp 25 it is adjustable to and from the engine supporting member 10. It is possible to support or mount on the workstand engines of different sizes. The nut 31 constitutes simple means for adjusting the upper part 23 of the strut 11 relatively to the lower part 22 and the arm 26 and the split clamp 25 exemplifies

simple means for supporting the strut so that it is adjustable bodily to and from the engine supporting member 10.

The mount 12 serves not only to support the engine supporting member 10 and the strut 11 so that they are conjointly vertically adjustable, but also to permit the member and strut to rotate or turn about a vertical axis in order to provide for angular displacement of the engine on the member 10. It consists of a cylinder 35 and a plunger 36 and has associated with it a pump unit 37. The cylinder 35 extends vertically and fits between, and is welded to, the central portions of the depending plates 19 of the engine supporting member 10. The upper end of the cylinder abuts against, and is sealed or closed by, the central portion of the curved plate 18 of the member 10. Preferably it is welded to the superjacent or superencumbent portion of the plate 18 so that the cylinder as a whole is in fixed connected relation with the plate. The lower end of the cylinder 35 is open. The plunger 36 extends vertically and fits slidably within the cylinder. The lower end of the plunger is fixedly secured to the central portion of a saddle 38 which overlies and is secured to the central portion of the member 13 of the base frame 9. When fluid under pressure is introduced into the upper end of the cylinder it causes the cylinder together with the engine supporting member 10, the horizontally extending arm 26 and the strut 11 to move upwards. When the upper end of the cylinder is vented so as to release the fluid under pressure therein the cylinder together with the engine supporting member, arm and strut moves downwards. The plunger is provided with sealing rings 39 and these fit in annular grooves 40 and serve to prevent leakage of fluid under pressure between the slidably engaging surfaces of the plunger and cylinder. A pair of cap screws 41 in the lower end of the cylinder 35 and an annular groove 42 in the lower end of the plunger coact to limit raising and lowering of the cylinder with respect to the plunger while at the same time permitting the cylinder together with the parts associated therewith to rotate or swivel about the plunger. The cap screws are positioned one diametrically opposite the other as shown in Figure 4. They extend through internally threaded holes in the lower end of the cylinder and have at the inner ends thereof cylindrical reduced stems 43 which project into the groove 42. The upper end of the groove is defined by a downwardly facing shoulder 44. When in connection with raising of the cylinder with respect to the plunger the stems 43 are brought into abutting relation with the shoulder 44 further raising of the cylinder and the parts associated therewith ceases. A pair of pin and notch connections 45 serves to lock the cylinder and piston against relative rotation when the cylinder together with the engine supporting member 10 and the strut 11 is lowered to its fullest extent. These connections comprise outwardly or radially extending pins 46 on the lower end of the plunger and downwardly facing notches 47 in the lower end of the cylinder 35. The pins are disposed one diametrically opposite the other and are positioned at right angles to the cap screws 41. They are located in the lower end of the annular groove 42 and are fixedly secured in any suitable manner to the lower end of the plunger. The notches 47 are disposed one diametrically opposite the other and are adapted when in vertical alignment with the pins 46 and the cylinder is lowered to receive the pins and interlock therewith in such manner as to prevent the cylinder and associated parts from swinging or turning about the plunger. When the cylinder is raised so that the notches 47 are out of interlocking relation with the pins 46 rotation of the cylinder with respect to the plunger is permitted. It is contemplated that the engine E after mounting thereof with respect to the supporting member 10 and the bearing 24, be raised by introducing fluid under pressure into the upper end of the cylinder 35. When the engine is in its raised position the auxiliary accessories may be readily mounted thereon and rotation of the engine about a vertical axis is permitted. After the auxiliary equipment has been applied to the engine the cylinder 35 is lowered preparatory to moving the engine in connection with installation thereof. As soon as the cylinder is lowered to its fullest extent the pin and notch connections 45 come into play and prevent the engine from turning or swivelling. By providing the pin and notch connections 45 the engine after being lowered cannot swivel or swing in connection with transportation thereof by propulsion of the workstand.

The pump unit 37 is located at the outer or distal end of the arm 26 and serves as a medium for supplying fluid under pressure into the upper end of the cylinder 35 to effect raising of the assembly of cylinder, engine supporting member, arm and strut. It also serves as a medium for releasing the fluid under pressure in the cylinder when it is desired to lower the assembly in connection with downward displacement of the engine E. As its main or principal parts the pump unit comprises a casing 48, a reservoir 49, a vertically extending plunger type piston 50, and a piston actuating lever 51. The casing 40 is vertically elongated and has at one side thereof a laterally extending nipple 52 which extends into the outer end of the arm 26 and is attached thereto by way of a screw thread connection 53. The reservoir is in the form of a vertically elongated tube, the lower end of which is sleeved over the upper end of the casing 48 and is attached thereto by a screw thread connection 54. It is adapted to hold a column or body of fluid, such as oil, and has a removable cap 55 at its upper end. When the cap is removed the receptacle may be charged with fluid. The casing 48 of the pump unit is provided with a vertically extending bore 56 in which the piston 50 is slidable. The upper end of the bore terminates adjacent the central portion of the casing 48 and the lower end of the bore is open. In addition to the bore 56 the casing 48 is provided with a second bore 57 and a pair of side by side chambers 58 and 59. The bore 57 extends vertically and is disposed at one side of the bore 56. The chamber 58 is located directly above the bore 56 and the chamber 59 is located directly above the bore 57. The lower end of the chamber 58 is provided with a seat 60 for a ball valve 61 and communicates with the upper end of the bore 56 by way of a port 62 of reduced diameter. The lower end of the chamber 59, as shown in Figure 5, terminates beneath the lower end of the chamber 58 and is provided with a seat 63 which communicates with the upper end of the bore 57 and has associated with it a ball valve 64. A cross port 65 is formed in the upper portion of the casing 48 and extends, and establishes communication, between the port 62 and the central portion of the chamber 59. Also formed in the upper portion of the casing

48 are ducts 66 and 67. The duct 66 extends, and establishes communication, between the lower end of the reservoir 48 and the upper end of the bore 57. The duct 67 leads from the central portion of the chamber 58 to one end of a pipe 68. Such pipe, as shown in Figure 4, extends through the tubular strut supporting arm 26 and is connected by a fitting 69 to the upper end of the cylinder 35 of the mount 12. When the piston 50 is slid downwards in the bore 56 suction is created in the upper end of such bore with the result that oil or fluid flows from the reservoir 49 first through the duct 66, then into the upper end of the bore 57, then upwards into the chamber 58 past the seat 63, then through the cross port 65, then into the port 62 and the upper end of the bore 56. During the down stroke of the piston 50 the ball valve 61 is in seated relation with its seat 60 and the ball valve 65 is out of seated relation with its seat 63. When the piston 50 is shifted or slid upwards the fluid in the upper end of the bore 56 is forced into the upper end of the cylinder 35 via the port 62, the chamber 58, the duct 67 and the pipe 68. During up stroke of the piston the ball valve 61 is shifted out of seated relation with its seat 60 and the ball valve 64 is maintained in seated relation with its seat 63 as the result of the pressure which is built up within the chamber 59. By reciprocating the piston up and down in the bore 58 fluid under pressure is supplied to the upper end of the cylinder 35 from the reservoir 49 and the assembly of cylinder, engine supporting member, arm and strut is caused to raise. The lower end of the plunger type piston 50 projects beneath the lower end of the casing 48 of the pump unit 37. It extends through a stuffing box 70 and is provided at its lower extremity with a laterally extending pin 71. A vertically slidable rod 72 is slidably mounted in the bore 57. The lower end of this rod extends through a stuffing box 73 and is rigidly connected to the pin 71. The upper end of the piston 50 is provided with a vertically extending screw type stem 74 which is of less diameter than the port 62. The stem 74 and the rod 72 are so arranged and designed that they are adapted when the piston 50 is shifted upwards beyond its normal pumping position to unseat the ball valves 61 and 64, respectively. When the two ball valves are unseated by the stem 74 and the rod 72, as shown in Figure 8, the fluid under pressure in the cylinder 35 is released and flows back into the reservoir 49 by way of the pipe 68, the duct 67, the chamber 58, the port 62, the cross port 65, the chamber 59, the upper end of the bore 57 and the duct 66. Release of the fluid under pressure from the upper end of the cylinder 35 results in lowering of the cylinder and the parts associated therewith in response to the action of gravity. During normal reciprocation of the piston 50 the stem 74 and the rod 72 are inoperative and fluid under pressure is supplied to the cylinder 35 from the reservoir. However, as previously pointed out, upward shift of the piston beyond its normal pumping position brings into play the stem and rod and results in venting of the upper end of the cylinder 35 and lowering of the assembly of cylinder, engine supporting member, arm and strut. The lever 51 extends upwards and is located adjacent the casing 48 and the reservoir 49. It serves as a medium for reciprocating the piston 50 and is provided at its lower end with a stub shaft 75. The latter is journalled in a horizontal bearing 76 which is supported by a depending bracket 77 on the lower end of the casing 48. The lever 51 is operatively connected to the piston 50 by way of an arm 78 which is fixed to, and extends radially from, the shaft 75 and is provided at its outer end with a fork 79 which straddles the pin 71. Rocking or oscillating of the lever 51 serves to reciprocate the piston 50. When it is desired to lower the cylinder in connection with downward displacement of the engine E the lever 51 is swung in one direction to a greater extent than it is normally swung in connection with normal oscillation for pumping purposes.

When it is desired to use the workstand as a medium for supporting the engine E in connection with application of auxiliary equipment to the engine the engine is mounted on the supporting member 10 and is so positioned that the exposed end of the drive or crank shaft thereof is disposed in the bearing 24 at the upper end of the upper part 23 of the strut 11. After the engine is mounted in place it may be raised by oscillating the lever 51. As previously described, oscillation of the lever results in the pump unit supplying fluid under pressure from the reservoir 49 into the upper end of the cylinder 35 of the mount 12. When the engine is raised to the desired extent oscillation of the lever is stopped. When it is desired to lower the engine the lever 51 is swung to such an extent as to cause the stem 74 and the rod 72 to unseat the ball valves 61 and 64. Unseating of such valves, as hereinbefore described, results in venting of the cylinder 35 and lowering of the assembly of cylinder, engine supporting member, arm and strut. When the cylinder is lowered to its fullest extent after application of the auxiliary equipment to the engine E the pin and slot connections 46 and 47 are brought into play and cause the cylinder and engine to be locked against rotation relatively to the plunger 36. The bearing 24 may be raised or lowered to bring it into proper position with respect to the exposed end of the drive or crank shaft of the engine by turning the nut 31. By adjusting the strut 11 to and from the engine supporting member 10 the workstand may be adapted for use in connection with engines of different sizes.

The herein described workstand is essentially simple in design and construction and hence may be manufactured at a low and reasonable cost. It is both compact and rugged and effectively and efficiently fulfills its intended purpose. By reason of the fact that the base frame 9 is provided with casters 17 the workstand is portable and hence may be readily moved from place to place. The construction and design of the supporting member 10 and the strut 11 permit the workstand to be used in connection with engines of different shapes and sizes.

Whereas the workstand has been described as being particularly adapted for use in connection with radial engines of the airplane type it is to be understood that it may be used in connection with other engines. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A workstand adapted to support an engine having a drive shaft with an exposed end, and

comprising a base frame, a unitary assembly over the base frame embodying a member for supporting the engine and an element in opposed relation with the member and provided with a bearing for receiving and supporting the exposed end of the engine drive shaft when the engine is on the member, means between the base frame and assembly for supporting said assembly so that it together with the engine may be conjointly raised and lowered to a limited extent relatively to the base frame and also rotated about a vertical axis, and means for locking said assembly against rotation relatively to the base frame when it is lowered to substantially its fullest extent.

2. A portable workstand adapted to support an internal combustion engine with radial cylinders and a drive shaft with an exposed end, and comprising a horizontal caster equipped base frame, a unitary assembly over the base frame embodying a member for supporting the engine in an upright or vertical position and an upstanding vertically extensible strut in opposed relation with the member and provided at its upper end with a bearing for receiving and supporting the exposed end of the drive shaft when the engine is on the member, and means between the base frame and the assembly for supporting said assembly so that it together with the engine may be raised and lowered relatively to the base frame and also rotated relatively to said base frame about a substantially vertical axis.

3. A portable workstand adapted to support an engine having a drive shaft with an exposed end, and comprising a caster equipped base frame, an assembly over the base frame embodying a member for supporting the engine and an element in opposed relation with the member and provided with a bearing for receiving and supporting the engine drive shaft when the engine is on the member, a vertically adjustable mount extending between the base frame and assembly and embodying a cylinder connected to, and depending from, the assembly and having the lower end thereof open and an upstanding plunger mounted fixedly on the base frame and extending into the



cylinder through the latter's open lower end, and means mounted on, and movable vertically with, the assembly for delivering fluid under pressure to the cylinder for assembly raising purposes and from the cylinder for assembly lowering purposes.

4. A workstand adapted to support an engine having a drive shaft with an exposed end, and comprising a base frame, an assembly over the base frame embodying a member for supporting the engine and an element in opposed relation with the member and provided with a bearing for receiving and supporting the exposed end of the engine drive shaft when the engine is on the member, a vertically adjustable mount extending between the base frame and assembly and embodying relatively slidable cylinder and piston elements, a fluid reservoir on the assembly, and a pump unit mounted on said assembly and adapted to deliver fluid under pressure to the cylinder element from the reservoir for assembly raising purposes and further adapted to deliver fluid from the cylinder element to the reservoir for assembly lowering purposes.

5. A workstand adapted to support an engine having a drive shaft with an exposed end, and comprising a base frame, an assembly over the base frame embodying a member for supporting the engine in a position wherein the drive shaft extends horizontally, a horizontal arm connected fixedly to, and projecting from, the member, and an upstanding strut having its lower end connected to the arm and provided at its upper end with means for receiving and supporting the exposed end of the engine drive shaft, a vertically adjustable mount extending between the base frame and assembly and embodying relatively slidable cylinder and piston elements, a fluid reservoir on the outer end of the arm, and a pump unit mounted on said outer end of the arm and adapted to supply fluid under pressure to the cylinder element from the reservoir for assembly raising purposes and also to deliver the fluid from the cylinder element to the reservoir for assembly lowering purposes.

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