May 5, 1964 C. A. DAVIS 3,131,558

VALVE TESTING AND FIXTURE THEREFOR

Filed Aug. 22, 1960 2 Sheets-Sheet 1

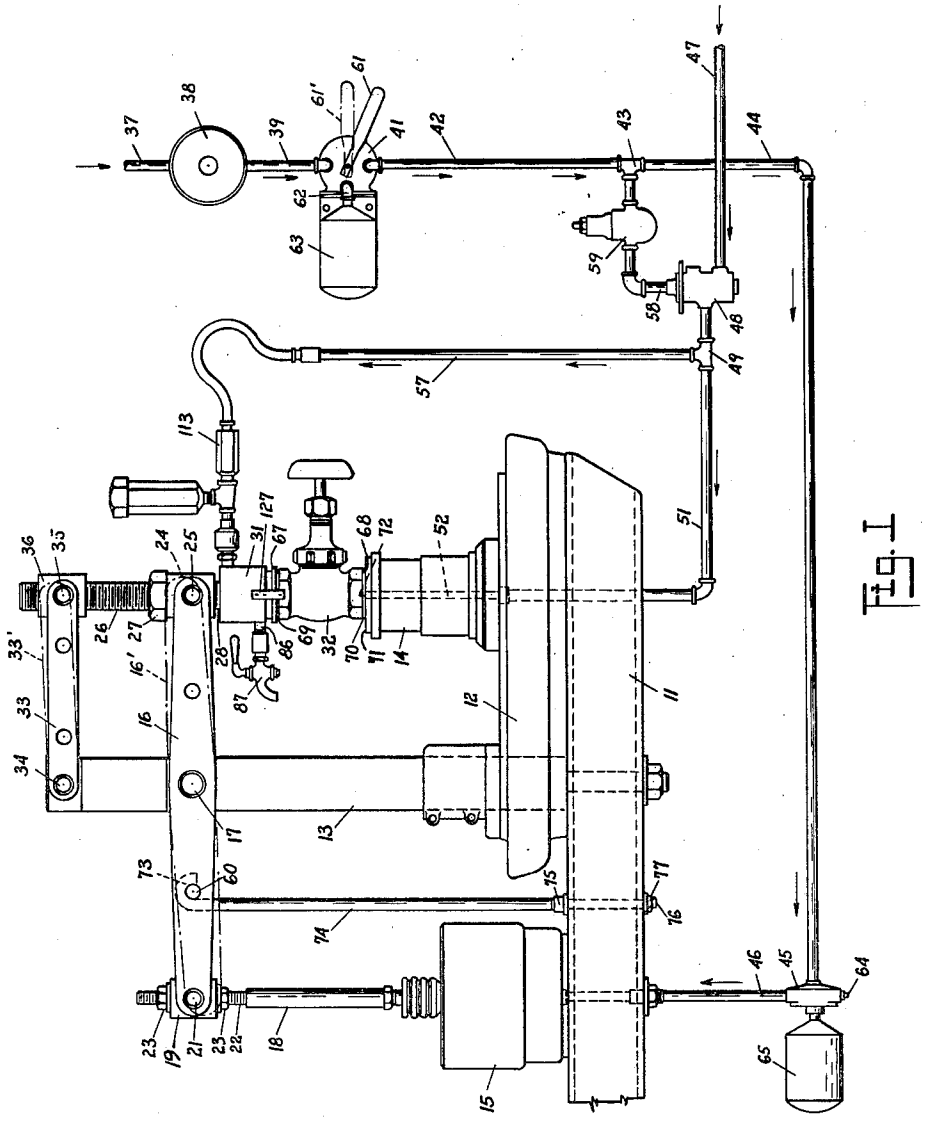


Fig. 1

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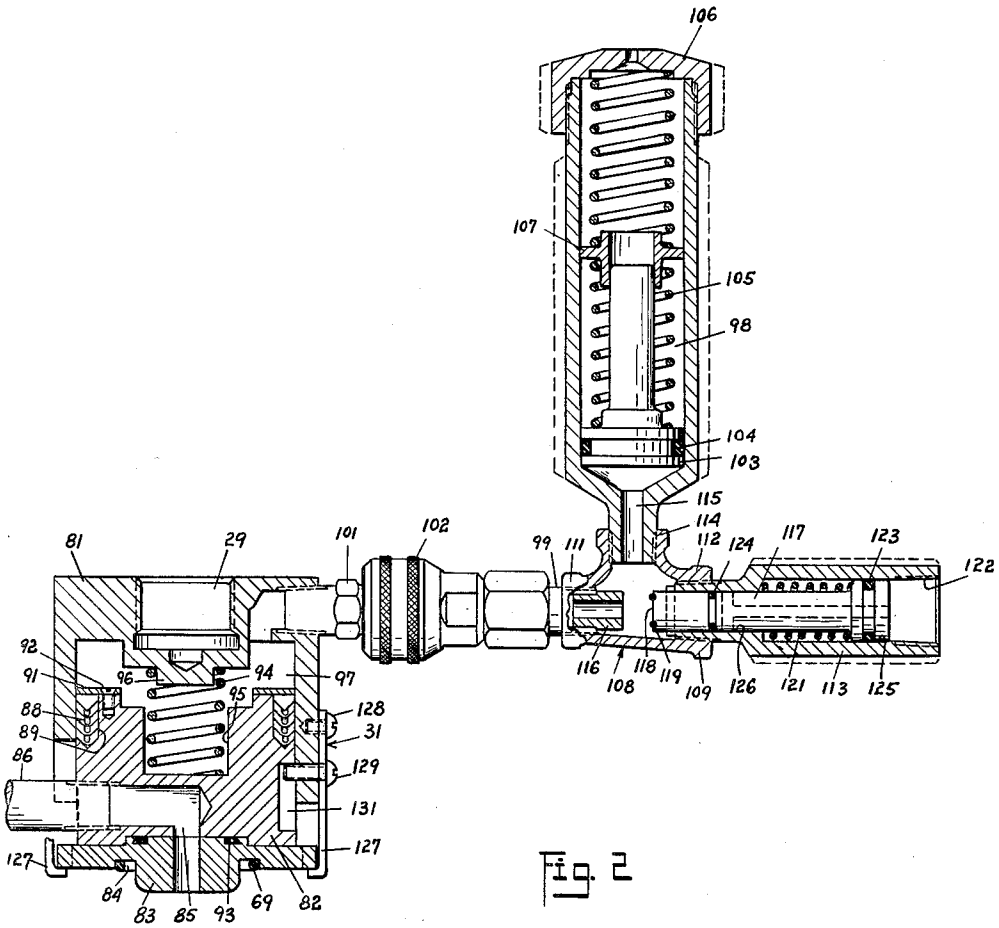



Fig. 2

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# VALVE TESTING AND FIXTURE THEREFOR

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This application relates to clamping apparatus and apparatus for facilitating the manufacture and testing of hydraulic and pneumatic devices.

An object of the invention is to hold work pieces or articles which are to be tested firmly but without subjecting them to more than nominal mechanical pressure.

A further object of the invention is to test valves, joints and other hydraulic and pneumatic devices under substantial fluid pressure without distorting the articles mechanically. Another object of the invention is to test valves without subjecting the material of the valve to stresses different or greater than those normally occurring in the use of the valve.

Other and further objects, feature and advantages will become apparent as the description proceeds.

In carrying out the invention in accordance with a preferred form thereof, there is a source of hydraulic pressure for the fluid pressure test and a pair of clamping jaws are provided, one of which has a bore for supplying the fluid pressure. In addition, an extensible and compressible hydraulic lock unit is interposed between one of the jaws and the article being clamped for testing or such a lock unit is secured to or forms one of the clamping jaws. The lock unit is provided with means such as a light spring for resiliently biasing the unit to the extended position so as to bring the clamping jaws in close contact with the valve or other article being clamped and under test without subjecting the test article to any distortion forces or any mechanical force other than the negligible force of the biasing spring.

The apparatus is so arranged that when the clamping jaws are closed upon the article the lock unit is compressed against the force of the biasing spring. A valve mechanism for admitting the hydraulic pressure fluid for testing is so synchronized with the clamping operation that, after close contact has been made between the clamping jaws and the article being tested, the lock unit is locked and hydraulic pressure is applied.

The lock unit is in the form of relatively movable piston and cylinder members with the cylinder connected through a conduit to a reservoir of incompressible fluid so that the space within the cylinder, defined by the position of the piston, is filled with incompressible fluid at all times. Simultaneously with the application of hydraulic pressure for test purposes to the test article, the conduit from the cylinder to the reservoir is closed so that the hydraulic lock unit cannot be compressed any further due to the incompressibility of the fluid contained therein. In this manner the article being tested is held firmly without subjecting it to appreciable mechanical force.

A better understanding of the invention will be afforded by the following detailed description considered in conjunction with the accompanying drawing, in which:

FIG. 1 is a view in elevation partially schematic with respect to arrangement of pneumatic and hydraulic fluid supply lines of an embodiment of the invention; and

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FIG. 2 is a view in longitudinal section of the hydraulic lock unit employed in the apparatus of FIG. 1 together with the reservoir, connecting conduit and conduit-closing mechanism employed in conjunction therewith, certain outlets being rotated into the plane of the paper for easier pictorization.

Like reference characters are utilized throughout the drawing to designate like parts.

As illustrated in the drawing there is a clamping fixture supported by a fragmentarily represented table 11, a platform 12 secured thereto, and a center post 13 and a stationary clamp jaw or base member 14 secured to the platform. A conventional diaphragm-type air cylinder 15 is also secured to the table 11.

The center post 13 is situated between the air cylinder 15 and the base member 14 and has a clamping movement transmitting lever or arm 16 pivotally secured thereto by means of a pivot 17. A thrust bar 18 is interposed between a movable member (not shown) of the air cylinder 15 and a pivot block 19 pivotally secured by means of a pivot 21 to the left hand end of the arm 16. For adjustment purposes, suitable means such as a threaded portion 22 of the bar 18 engaging the block 19 and lock nuts 23 are provided.

A movable clamping jaw in the form of a pivot block 24 may be pivotally secured to the opposite end of the arm 16 by means of a pivot 25. Preferably, however, a bar 26 is threaded into the pivot block 24 and secured by a lock nut 27, the bar 26 having a lower end or foot portion 28 received in a socket 29 (FIG. 2) in an hydraulic lock unit 31 which may be thought of as an extensible and compressible upper or movable clamping jaw or as being interposed between an article 32 to be tested and the foot 28 constituting a clamping jaw portion of the bar 26.

As illustrated, the center post 13 and the threaded bar 26 each extend upward to provide means for maintaining the vertical alignment of the hydraulic lock unit 31. There is an alignment-maintaining linkage comprising a horizontal link 33 pivotally secured at the left end by a pivot 34 to the upper end of the post 13 and pivotally secured at the right hand end by means of a pivot 35 and a pivot block 36 to the bar 26 which is threaded into the block 36.

Although the invention does not exclude the use of pneumatic pressure for testing and hydraulic pressure for clamp actuation or the use of either a gaseous or liquid pressure medium for both purposes, in the specific arrangement illustrated, hydraulic pressure is employed for testing the article 32 and pneumatic pressure is employed for effecting movement of the clamping mechanism. There is an air supply input pipe 37 for supplying pneumatic pressure through a filter 38, a length of pipe 39, a three-way control valve 41, a length of pipe 42, a T-joint 43, a length of pipe 44, a quick exhaust valve 45 and a length of pipe 46 to the diaphragm-type air cylinder 15.

There is also a water-supply input pipe 47 leading from a source of hydraulic pressure (not shown) through a control valve 48, a T-joint 49 and a length of pipe 51 to a bore 52 in the base member or fixed clamping jaw 14. From the T-joint 49 there is also a branch hydraulic pressure line 57 leading to mechanism which will be described in greater detail hereinafter for controlling the hydraulic lock unit 31 so as cause it to lock.

In order that the application of hydraulic pressure

may take place automatically upon the actuation of the clamping mechanism by the pneumatic control valve 41, the hydraulic pressure control valve 48 is preferably in the form of a pilot valve of conventional type having a pneumatic pressure actuator (not shown) supplied with pneumatic pressure through a branch line 58 leading from the T-joint 43 in the pneumatic line through a conventional sequence valve 59, which is of the spring loaded type, so that air from the T-joint 43 does not flow through the line 58 until the air pressure in the pipe length 42 has reached a predetermined maximum value.

The pneumatic control valve 41 is of the conventional three-way type, having a handle 61 which opens a connection between the pipe lengths 39 and 42 when the handle 61 is moved to the downward position illustrated and which closes the pipe 39 and opens an exhaust port 62 from the valve 41 when the valve handle 61 is moved upward to the dotted position 61'. Preferably an exhaust muffler 63 of conventional type is connected to the exhaust port 62.

If desired, the quick exhaust valve 45 may be interposed between the pipe lengths 44 and 46 having an actuating stem 64 operable by a foot lever or other means (not shown) when it is desired to dump air from the cylinder 15 for speeding unclamping motion. Preferably, as shown, the quick exhaust valve 64 is also provided with an exhaust muffler 65.

The article 32, which is to be tested or to be clamped for other purposes, is shown by of illustration as a hand operated globe or gate valve designed for connection to two aligned pipes so that it has two opposite ends preferably having relatively smooth annular surfaces or faces 67 and 68 adapted to serve as seats for cooperation with O-ring seals 69 and 70 respectively. The O-ring seal 69 is carried at the lower surface of the hydraulic lock unit 31 and the O-ring seal 70 is mounted upon an upper face or planar surface 71 formed on the base member or fixed clamping jaw 14, so as to surround the orifice 72 of the bore 52 for admitting pressure to the interior of the valve 32. It will be understood, however, that the invention is not limited to the pressure testing of hollow articles and does not exclude the pressure testing of relatively flat devices, such as those in the form of a diaphragm for example, which may be clamped to the base member face 71 by interposing a suitable spacing ring between such a tested article and the upper jaw or hydraulic lock unit 31.

Preferably means are provided for positively limiting the travel of the arm or lever 16 and therefore of the bar 26 carrying the movable clamp jaw. To this end a cross pin 60 is provided on the lever 16 cooperating with a hook 73 formed at the upper end of a rod 74 which is secured to the table 11 in any suitable manner, for example, by the formation of a shoulder 75 resting against the upper surface of the table 11 and having a threaded lower end 76 carrying a nut 77 tightened against the lower surface of the table 11.

The hydraulic lock unit 31 comprises a cylinder element 81, having a threaded socket 29 by which it is secured to the foot 28 of the threaded rod or bar 26, and a piston element 82. In order that the apparatus may be used for testing various sizes of valves or clamping various sizes of other articles, the piston 82 is preferably provided with removable interchangeable bottom pieces, such as the removable shoe or adapter 83 carrying the O-ring seal 69 in a suitable groove 84. If desired, the piston 82 and adapter 83 may be formed with a bore 85 connected to a pipe 86 to a stop valve 87.

For forming a hydraulic pressure-tight seal between the piston 82 and the cylinder 81, means such as Garlock Chevron packing rings 88 are held in an annular recess 89 in the upper portion of the piston 82 by a retaining ring 91, and secured as by means of a flat head machine screw 92. Suitable means such as an O-ring 93 is provided for maintaining a seal between the adapter 83 and the piston 82.



For lightly biasing the elements of the lock unit 31 to the extended position, a light biasing spring 94 is mounted within the unit 31 taking the form, as shown, of a compression coil spring resting in a socket 95 in the piston 82 and embracing a boss 96 on the inner surface of the cylinder 81.

For keeping the space 97 within the cylinder 81 above the piston 82 filled with an incompressible fluid such as water or oil, a reservoir 98 is provided connected to the interior space 97 of the cylinder 81 by a supply and escape conduit 99. For convenience in assembly and disassembly, if desired, the conduit 99 may be in two parts easily connectable and disconnectable by means of a Hansen push-tite plug 101 and a Hansen push-tite socket 102.

For varying the capacity of the reservoir 98 as needed, it is provided with a piston 103 with an O-ring seal 104 pressed downward by a coil spring 105 with ends impinging upon the piston 103 and a reservoir cap 106. The spring 105, if desired, may be provided with a spring guide 107.

Interposed between the outer end of the conduit 99 and the reservoir 98 is a shut-off valve 108 for preventing expulsion of fluid from the space 97 in the lock unit 31 to the reservoir 98. The valve 108, as shown, takes the form of a pipe T 109 having an end 111 receiving the end of the conduit 99 and end 112 receiving a lock body 113 and a side connection 114 to the inlet 115 of the reservoir 98. A lock seat 116 is mounted in the end of the conduit 99 within the portion 111 of the T 109. Within the lock body 113 is a lock piston 117 having an end face 118 carrying an O-ring seal 119 adapted to fit against the lock seat 116 for closing the outlet of the conduit 99 and preventing flow of liquid from the space 97 into the reservoir 98 when the lock piston 117 is moved to the left. For normally biasing the lock piston 117 to the right hand position, a biasing spring 121 is provided.

The lock body 113 has internal pipe thread 122 connected to the end of the branch hydraulic pressure line 57 shown in FIG. 1. The arrangement is such that pressure applied to the line 57 and the lock body 113 at 122 tends to cause the lock piston 117 to move to the left for closing the lock seat 116. For preventing the fluid in the line 57 from entering the cylinder space 97 and the reservoir 98 O-rings 123 and 124 are preferably provided, fitting respective larger and smaller cylindrical bores 125 and 126 in the body 113.

Preferably, adaptor retaining clips 127 are removably secured to the cylinder 81 by suitable means, such as round head screws 128 and 129, to enable adaptors of different sizes to be mounted on the piston 82. The screw 129 is preferably made long enough to cooperate with a slot 131 cut into the side of the piston 82 for limiting relative motion of the cylinder and piston elements 81 and 82.

When the apparatus illustrated is employed for subjecting valves, or other hollow bodies or bodies having cavities, to hydraulic pressure for test purposes, the pneumatic pressure line 39 is initially cut off so as to unload pressure from the air cylinder 15 and leave the arms 16 and 33 in the dotted positions 16' and 33' with the pivot block 24 in the upward position to permit mounting of the test device 32 upon the base member 14 between the O-ring seals 69 and 70.

The hand-control lever 61 is then moved down to the position illustrated in full lines so as to admit pressure through the lines 42, 44 and 46 to the diaphragm type air cylinder 15. This raises the pivot 21 of the arm 16 and lowers the pivot 25 so as to bring the lock unit 31 and the O-ring seal 69 on the adapter portion 83 thereof down upon the upper surface 67 of the tested article 32 and form a fluid-tight seal. In so doing, the cylinder 81 moves downward against the nominal force of the biasing spring 94 and close contact of the O-ring

seals 69 and 70 with the surfaces 67 and 68 of the article 32 is assured.

As soon as the pneumatic pressure from the line 37 has reached a predetermined maximum build-up value, pneumatic pressure travels from the branch line 58 to the control element of the pilot valve 48 admitting hydraulic pressure from the line 47 through the lines 51 and 57. The hydraulic pressure from the line 51 acts in the valve 32 subjecting it to test pressure. Simultaneously the hydraulic pressure from the branch line 57 acts in the lock body 113, to move the lock piston 117 to the left closing the lock seat 116. This prevents any expulsion of incompressible fluid from the space 97 in the lock unit 31, so that the unit 31 is no longer compressible but acts as a solid body.

Consequently, the valve 32 is held firmly between the adapter 83 of the lock unit 31 and the face 71 of the base member 14. The hydraulic pressure to which the article 32 is subjected cannot dislodge it from the position in which it is firmly held; nevertheless the article 32 is subjected to no distortion and no appreciable mechanical pressure acts thereon to interfere with the significance of the response or resistance to the hydraulic pressure to which it is subjected.

While a specific embodiment of the invention has been described, it should be understood that the invention is not limited thereto, and various modifications may be utilized without departing from the spirit of the invention.

It is, therefore, particularly pointed out and distinctly claimed as the invention:

1. Fluid pressure testing apparatus having a fixed jaw and a compressibly yieldable jaw with means for moving the yieldable jaw towards the fixed jaw for closely contacting opposite sides of a hollow object to be held, means for locking the yieldable jaw against compression thereof for firmly securing the object without applying substantial mechanical pressure thereto and test pressure means separate from either of the foregoing means for subjecting the interior of the hollow object to fluid pressure while the object is so secured, said locking means comprising hydraulic cylinder and piston means containing an incompressible liquid with a liquid supply and escape conduit and means coacting with the test pressure means for closing the supply and escape conduit responsive to fluid pressure of the test pressure means.

2. Fluid pressure testing apparatus comprising in combination yieldable means for clamping the body of a valve to be tested against a base having a bore for admitting test fluid under pressure for testing the valve, the clamping means comprising relatively movable, hollow, variable-internal-volume means, a liquid supply line, incompressible liquid in said line and filling said variable-internal-volume means, the latter being closed except for connection to the liquid supply line, a valve in said liquid supply line for trapping the liquid and means coacting with said valve responsive to test fluid pressure for closing said valve and locking the clamping means to avoid applying mechanical pressure to the valve body during fluid pressure tests.

3. Fluid pressure testing apparatus for hollow articles comprising a line for supplying test fluid under pressure to the interior of an article being tested, relatively movable piston and cylinder elements, clamping jaws for holding an article to be tested, one of the clamping jaws being carried by said piston, a biasing spring tending to produce relative movement of the element for extension of the one jaw into engagement with the article to exert clamping pressure thereon, a conduit communicating with the interior of said cylinder element, said element being closed except for connection to said conduit, a reservoir connected to said conduit, an incompressible liquid in the cylinder element, conduit and reservoir, a valve in the conduit for trapping liquid in the cylinder and means responsive to test fluid pressure coacting with the valve and the test fluid line for closing the valve to hold the article against fluid pressure within the article.

4. A pressureless valve clamp for use during hydraulic pressure testing of valves having first and second annular faces at opposite ends of a valve body, a base having an annular surface against which the first valve end face is adapted to rest during clamping for testing, an extensible and contractible lock unit comprising relatively movable piston and cylinder elements, one formed with an exterior face adapted to rest against the second valve end face for closing it, means for positioning said lock unit against said second valve end face to clamp the valve upon the said base, means for resiliently biasing the lock unit toward an extended position, the base having a bore for admitting hydraulic pressure fluid to the valve unit for testing it, a conduit communicating with the interior of the lock unit cylinder element, a reservoir connected to said conduit, an incompressible fluid in the cylinder, conduit and reservoir, a valve interposed in said conduit, having hydraulic pressure connections for actuating the valve to closed position in response to hydraulic pressure, an hydraulic pressure supply pipe having branch output connections to said bore and said valve actuating pressure connection, and means for synchronizing admission of hydraulic pressure through said pipe with the means for contracting said lock unit against the second valve end seat, whereby, upon clamping the valve to be tested, hydraulic pressure is admitted thereto for testing and the lock unit valve is closed to prevent escape of incompressible fluid from the cylinder element thereof, rendering the lock unit incompressible and holding the valve under test firmly between said base and said lock unit without applying mechanical pressure thereto.

5. A pressureless valve clamp as in claim 4, wherein a pneumatic actuator is provided for positioning the lock unit against the valve end face, there is a pneumatic pressure line for said pneumatic actuator, a pilot valve is interposed in the hydraulic pressure supply pipe and the pilot valve has a pneumatic actuator, a branch pneumatic line being connected between the pneumatic pressure line and said pneumatic pilot valve actuator.

6. A pressureless valve clamp as in claim 5, wherein a sequence valve is interposed in the branch pneumatic line to the pilot valve actuator for delaying opening of the hydraulic pressure supply pipe until after the pneumatic pressure has actuated the pneumatic actuator.

7. In combination with a member having first and second seats at opposite ends, a base having an annular surface adapted to be sealed to the first of said seats and having a bore for admission of hydraulic pressure fluid to said member, an hydraulic lock unit movably mounted having a surface adapted to bear against the second seat, pressure-controlled means for moving said lock unit against said second seat, the lock unit comprising relatively movable piston and cylinder elements to permit extending and contracting the lock unit with means for biasing it to the extended position, a conduit communicating with the interior of the cylinder element for admitting hydraulic pressure, a reservoir connected to said conduit, a valve interposed in said conduit comprising a lock seat and a lock piston relatively movable between positions closing the conduit and opening it, biased to the latter position, a cylinder for the lock piston with an hydraulic pressure connection for subjecting it to pressure to move the piston to the closed position, an hydraulic pressure supply pipe connected to the bore of said base and to the pressure connection of said lock piston cylinder, a valve interposed in said pipe for controlling admission of hydraulic pressure fluid and means synchronized with said latter valve for actuating said pressure-controlled means to actuate the lock unit and apply fluid pressure to the hydraulic pressure pipe, whereby clamping of the member between the base and the

lock unit is accompanied by application of hydraulic pressure thereto and closing of the lock piston to restrict relative movement of the elements of the lock unit for maintaining hydraulic seal between the base and the member seat while hydraulic pressure is applied thereto.

8. The combination of claim 7, wherein the synchronized means for actuating the pressure control means comprises a sequence valve for opening the valve in the hydraulic pressure supply pipe subsequent to actuation of the pressure-controlled means.



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