

TITLE: VALVE MECHANISM

The present invention relates to a valve mechanism, notably to a spool valve for use in an hydraulic ram.

BACKGROUND TO THE INVENTION:

In many forms of pile driver, a heavy weight is raised by means of an hydraulic ram and allowed to fall onto the top of the pile so as to drive it into the ground. Alternatively, as described in DE-A-2400925, the reciprocating piston of the ram can act directly on the pile or other item without the need for a weight.

Typically, as described in DE-A-2400925, the ram will comprise a piston reciprocated in a cylinder under the influence of high pressure hydraulic fluid whose flow to and from the cylinder is controlled by a sleeve valve. The sleeve valve is journalled for axial movement upon the cylinder wall to control the flow of fluid to and from the cylinder. One end of the sleeve valve extends into a position control chamber and provides a radially extending face upon which the pressure of the fluid in the chamber can act. The axial position of the sleeve valve is controlled by selectively feeding high pressure fluid to or venting fluid from the chamber.

In many cases, the operator needs to be able to move the pile driver over the ground so as to locate the driver at various positions where piles are to be driven. This is often done by mounting the weight upon a frame carried as a sliding fit upon a mast structure on a crawler or other mobile base, with the hydraulic ram located at or near the top of the mast or the frame so that it acts directly along the line of rise and fall of the weight. However, this layout means that the maximum length of pile which can be handled without an excessively tall mast is reduced by the combined length of the weight and the hydraulic ram, together with the length of the lift stroke of

the ram.

In order to reduce the combined length of the ram and weight, one could form the weight with an axial recess into which the lower end of the ram nests when the weight is fully raised. However, with the presently available forms of hydraulic ram, the overall diameter of the ram body and associated pipework for feeding hydraulic fluid to and from the cylinder of the ram is often 70 cms or more. This is typically the diameter of the hammer weight itself, so that this concept is impractical for many pile driver designs.

We have now devised a form of valve mechanism for a hydraulic ram which enables a ram of a reduced diameter for a given lift performance to be produced, thus enabling the ram to nest within the hammer weight.

SUMMARY OF THE INVENTION:

Accordingly, the present invention provides an hydraulic ram comprising a cylinder having journalled for axial movement therein a piston, the piston carrying a rod member extending through an end wall of the cylinder, preferably at a first end of the cylinder, and adapted to be connected to a hammer weight, said cylinder having means, preferably in the form of an annular jacket mounted substantially co-axially and externally about said first end of the cylinder, for achieving flow of fluid to and from the head space between the piston and said first end of the cylinder, a sleeve valve mechanism journalled in sealing engagement upon the cylinder wall and positioned at or adjacent the other end of the cylinder for controlling the flow of fluid into and out of the cylinder, and a position control chamber which encompasses one end of said sleeve valve member and which is adapted to be put selectively in fluid flow communication with either a low pressure zone or with a source of fluid at elevated pressure whereby one or more radial components of the end face of the sleeve valve member

are exposed selectively to high or low pressure so as to move the sleeve valve member axially so as selectively to control the flow of fluid to and from the cylinder; characterised in that:

a. the sleeve valve member is journalled within the cylinder in sealing engagement with the internal wall of the cylinder, said sleeve valve member having with the co-operating wall of the cylinder a circumferential gallery adapted to be in fluid flow communication with a supply of fluid at elevated pressure at all positions of the valve sleeve member;

b. the co-operating cylinder wall has one or more ports adapted to place said gallery in fluid flow communication with the said head space at a first axial position of said sleeve valve member and to place said head space in fluid communication with a port for discharging fluid from the cylinder at a second axial position of said sleeve valve member; and

c. the relative radial components of end faces of the portion of said circumferential gallery carried by said sleeve valve member and the end face of said sleeve valve member exposed to the fluid in said control chamber are such that the sleeve valve member is biased to said second axial position at which the said head space in the cylinder is in fluid communication with the port for discharging fluid from the cylinder when said control chamber is in communication with a low pressure zone, or said bias is overcome when the control chamber is in communication with a source of fluid at elevated pressure whereby the feed of fluid to said control chamber is adapted to move said sleeve valve member axially with respect to the cylinder to said first position so that said circumferential gallery is in communication with said head space.

The invention also provides a pile driver or hydraulic hammer assembly comprising a weight which is reciprocated by means of an hydraulic ram, characterised in that the ram is a ram of the invention.

Preferably the ram of the invention has its first end directed toward the weight, which is connected to the piston rod of the ram; and the weight is formed with an axial recess into which at least part of the cylinder is received, whereby the axial length of the contracted ram and weight is reduced.

The invention also provides a method of operating a ram of the invention, characterised in that fluid at a first pressure is fed to the said circumferential gallery; and in that said valve position control chamber is exposed to fluid at a second or third pressure, which second pressure is the same or lower than said first pressure and said third pressure is lower than said second pressure, whereby said sleeve valve member is caused to move axially with respect to said cylinder under the influence of said fluid at said second or third pressure to allow fluid at said first pressure to flow into said cylinder or to allow fluid in said cylinder to discharge from said cylinder according to the position of said sleeve valve member.

Preferably, the ram comprises a cylinder having an open first end or a circumferential series of radial ports at or adjacent the first end of the cylinder in fluid communication with a jacket located substantially co-axially with and externally around the cylinder whereby the cylinder is in free flow connection with the annular gap between the jacket and the cylinder to provide a flow path by which fluid can escape from the head space between the piston and the first end of the cylinder as the piston moves towards the first end of the cylinder during the fall stroke of the ram. This jacket and the cylinder are mounted upon a valve block forming a closed second end to the cylinder and the jacket. One or more transfer ports are provided in the cylinder and/or valve block walls for transferring the fluid from the annular gap between the jacket and the cylinder wall, preferably via the second end portion of the cylinder, so that all the flow within the ram is within the envelope of the jacket and not via external pipes or the like. The first end of the cylinder and the jacket are

closed by an end cap through which the piston rod carrying the hammer weight extends axially via a glanded bore.

The valve block is preferably formed as a separate component from the cylinder wall and the jacket surrounding the cylinder. The valve block is preferably formed with an axially extending annular recess adjacent the second end thereof, into which the end of the valve sleeve member adjacent the second end of the cylinder is received in sealing engagement to form the sleeve position control chamber. Preferably, the valve block is formed with an axially extending annular skirting wall which forms the radially inward wall of the control chamber upon which the radially inward face of the valve sleeve member is journaled in a sliding sealing fit, preferably upon the radially outward face of the skirting wall.

The control chamber is provided with one or more axial and/or radial control ports through the wall of the valve block, via which fluid can be fed to or discharged from the chamber to act on the radial end face of the valve sleeve member within the chamber. Typically, the chamber is fed with high pressure fluid from the high pressure feed line to the cylinder via a branch therefrom, in which case the said second pressure is the same as said first pressure. However, it may be possible to use fluid at a lower pressure, for example via a pressure reduction valve, where the dimensions of the end faces of the valve sleeve member and the circumferential gallery carried by the valve sleeve member are selected appropriately so that such lower pressure is sufficient to overcome the bias of the high pressure fluid acting on the radial walls of the circumferential gallery, as described below. In this case the said second pressure is less than the high or first pressure. The ability to use lower second pressure fluid for the control chamber feed, for example 70 to 100 bar as compared to the 150 to 350 bar often used for the main high first pressure operating fluid, reduces the pressure pulsing which may occur in the fluid feed lines as the valve member closes or opens the

flow of high pressure fluid into the cylinder and the attendant fatigue to the control feed pipes. When the fluid is discharged from the control chamber, the pressure in the fluid within the chamber reduces the said third pressure, which is typically ambient pressure. The force acting on the end face of the valve sleeve member is reduced and the bias force of the high pressure fluid in the circumferential gallery carried by the valve sleeve member then acts to move the valve sleeve member axially against this reduced force.

The flow of fluid to and from the valve sleeve position control chamber is controlled by a suitable external valve. This can be manually operated by the operator where individually controlled strokes of the cylinder are required. However, it is preferred that the operation of this valve be controlled automatically by conventional hammer weight position and other sensors so that the feed of fluid is interlinked automatically with the operation of the cylinder.

The valve block and/or the second end of the cylinder is provided with one or more axial and/or radial discharge ports for discharging fluid from the cylinder space between the piston and the second end of the cylinder as the piston moves within the cylinder. The discharge port(s) have as large an hydraulic diameter as is compatible with retaining the mechanical strength of the assembly so as to impose minimal flow restriction on the flow of fluid to and from the cylinder. The discharge port(s) can discharge the fluid, which is at a lower pressure than the high pressure fluid used to drive the cylinder, typically at ambient pressure, to a dump tank or to the tank from which the hydraulic pump used to generate the high pressure fluid draws its supply of fluid.

The flow of fluid through the discharge ports will be as a discharge of fluid from the ram during the lift stroke of the ram. During the initial part of the lift stroke, the head space at the first end of the cylinder is fed with high

pressure fluid and the transfer ports between the second end of the cylinder and the annular gap between the cylinder and the jacket are closed and the piston is moving towards the second end of the cylinder driving fluid through the discharge ports. However, it is usual to cut off the flow of high pressure fluid to the head space at the first end of the cylinder for the last part of the lift stroke of the ram and to allow the weight to rise to the apogee of its travel under the momentum generated during the initial part of the lift stroke. During this coasting part of the lift stroke, the transfer ports between the second end of the cylinder and the annular gap between the cylinder and the jacket are open and allow the flow of fluid from the second end of the cylinder to the head space as the piston moves axially in the cylinder. The swept volume at the second end of the cylinder is decreasing at a greater rate than the volume in the head space increases by virtue of the volume of the head space occupied by the piston rod. Thus, the fluid displaced by the movement of the piston in the second end of the cylinder can make up the fluid required to accommodate the increase in the volume of the head space. However, the flow through the discharge ports will reverse as the piston reaches the axial extent of its movement and the weight reaches the apogee of its travel and then begins to fall. At this point in the cycle of the piston movement within the cylinder, the flow of fluid from the head space into the second end of the cylinder is less than the swept volume which is being created by the movement of the piston towards the first end of the cylinder. Fluid from the discharge ports is therefore allowed to flow back into the second end of the cylinder to make up the deficiency and to minimise fluid drag on the movement of the piston. Preferably, one or more low pressure accumulators are provided on the fluid discharge lines from the ram to provide a positive feed of such fluid during the fall stroke of the ram.

Further removed axially from the second end of the valve block or the cylinder are one or more radial inlet ports for feeding

high pressure fluid from the hydraulic pump used as the source of fluid at typically 150 to 350 bar to operate the cylinder. The high pressure feed can incorporate one or more high pressure accumulators, as is conventional with hydraulic hammer or pile driver assemblies. The flow of fluid to the cylinder is via the inlet ports, the circumferential gallery carried by the valve sleeve member and the transfer ports to the annular gap between the exterior of the cylinder and the jacket surrounding it and thence to the head space between the piston and the first end of the cylinder. The hydraulic diameters of the inlet ports and the transfer ports is as large as is compatible with retaining the mechanical strength of the assembly. Usually, it will be preferred to provide a circumferential series of inlet or transfer ports so as to maximise the flow path for the fluid and to minimise distortion of the flow pattern within the assembly.

The sleeve member of the valve mechanism is typically a simple generally cylindrical sleeve journalled in axially sliding sealing engagement with the interior wall of the cylinder at said second end and carrying the necessary sealing rings to seal the sleeve to the interior of the cylinder and to the annular skirting wall forming the annular recess in the valve block for the control chamber. An advantage of the present design of valve mechanism is that it may be possible to reduce the number of circumferential seals carried by the sleeve member or by the opposing surfaces of the cylinder wall or valve block to three, one at each extremity of the circumferential gallery and one adjacent the free end of the annular wall forming the annular recess in the valve block to the control chamber. It is preferred that the wall of the cylinder carrying the valve sleeve member be recessed radially to provide an annular shoulder which acts as a stop for the axial movement of the valve sleeve towards the first end of the cylinder. Alternatively, one or more radial projections can be provided to act as such stops.

The sleeve member preferably carries the whole of the circumferential gallery, although part of the gallery can be cut into the opposed face of the internal face of the cylinder wall. The gallery or the part thereof carried by the sleeve member is not symmetrical and has one circumferential radial end face bigger than the other so that the high pressure fluid to which the gallery is exposed provides a net force biasing the sleeve axially against whatever force is applied to the sleeve through the end face of the sleeve member contained in the position control chamber. Typically, it is required for safety reasons that the hammer or pile driver fails safe into the weight lowered position, that is with low pressure applied to the head space between the piston and the first end of the cylinder. This will require that the sleeve member be moved axially towards the second end of the cylinder. This is achieved with the present design of valve mechanism by having the circumferential radial side wall of the gallery adjacent the second end of the cylinder of larger effective area than the circumferential radial side wall adjacent the first end of the cylinder. The relative proportions of the areas of the side walls of the gallery and the end wall of the valve sleeve member exposed to the fluid in the position control chamber can be varied over wide ranges depending on the pressures of the fluids acting on them and the degree of bias force required to overcome frictional and other forces resisting the free movement of the valve sleeve member. Typically, the effective area of the side wall of the gallery adjacent the second end of the cylinder will be from 105 to 150% greater than the effective area of the other side wall of the gallery and the effective area of the end wall of the valve sleeve member will be such as to achieve a force which is from 1.5 to 3 times the bias force when exposed to the high pressure fluid fed to the valve position control chamber. The optimum effective areas will depend upon the relative pressures to which the gallery and the control chamber are exposed and the forces required to move the valve sleeve member axially and can readily be calculated for any specific design of cylinder.

The term effective area is used herein to denote the radial component of the areas of the side walls of that portion of the gallery carried by the valve sleeve member and of the end wall of the valve sleeve member, since the faces of those wall may be inclined or stepped rather than simple radial flat surfaces.

The difference in effective area of the side walls of the gallery can be achieved by any suitable means, for example by forming the gallery as a tapered recess. However, it is preferred to form the gallery as an annular recess in the valve sleeve member, the recess having an axially oriented base face and radial side walls, but with the portion of the valve sleeve member adjacent the second end of the cylinder having a greater radial diameter. Such a sleeve requires that the portion of the cylinder wall upon which it is journalled also be stepped radially to accommodate the different diameters portions of the sleeve, in addition to any step which may serve as the stop described above. It is preferred that the step in the cylinder wall be in the form of a taper to aid assembly of the valve sealing rings upon the cylinder wall and to aid smooth flow of high pressure flow over the exposed surface of the cylinder wall.

The change in diameter of the valve sleeve member is conveniently achieved by forming a circumferential shoulder at the lip of the gallery adjacent the second end of the cylinder. This shoulder provides not only the increase in radial dimension for the radial side wall of the gallery but also provides an axially extending surface which bears against the wider diameter portion of the cylinder. This axially extending surface preferably carries one or more seal rings to provide the seal to prevent escape of high pressure fluid axially from the gallery. The lip of the gallery adjacent the first end of the cylinder can also carry a seal ring to prevent escape of fluid from that side of the gallery.

The circumferential gallery extends axially for such length

that it is in register at all positions of the sleeve member with at least one of the radial inlet ports through the wall of the valve block and/or the second end of the cylinder wall. The inlet ports are connected to a supply of high pressure fluid as described above so that the walls of the gallery are exposed at all times to this high pressure. Because of the difference in effective radial areas of the side walls of the gallery, the valve sleeve member is biased, preferably towards the second end of the cylinder.

The valve sleeve member extends axially so that in one extreme of the travel of the valve member the transfer ports between the cylinder space at the second end of the cylinder and the annular gap between the cylinder exterior and the jacket surrounding it or the other means for transferring fluid from the head space between the piston and the first end of the cylinder to the cylinder space at the second end of the cylinder are exposed to permit fluid to flow between the first and second ends of the cylinder and then to discharge via the discharge ports. In the other axial extreme of the travel of the valve sleeve member, the transfer ports are in register with the circumferential gallery and isolated from the second end of the cylinder. In this position high pressure flows from the inlet ports to the first end of the cylinder via the gallery and the transfer ports. The optimum axial lengths of the valve sleeve member, the gallery and the relative positions of the inlet and transfer points can vary over wide ranges. However, it will usually be desired to keep all flow paths to a minimum length and to keep the axial movement required for the valve sleeve member to a minimum to reduce the amount of fluid required to operate the valve mechanism.

In operation of the cylinder of the invention, high pressure fluid is fed to the inlet ports and acts upon the different effective radial areas of the side walls of the gallery to generate an axial bias force. This causes the valve sleeve member to move axially towards the second end of the cylinder

so that the flow of high pressure fluid to the head space at the first end of cylinder is shut off. The transfer ports between the first and second ends of the cylinder are exposed so that the piston falls to the first end of the cylinder under the load of the hammer weight, that is the fail safe position.

When high pressure fluid is fed to the sleeve position control chamber, this applies an axial force to the exposed end face of the valve sleeve member which, because of the relative sizes of the effective areas of the side walls of the gallery and the end face of the valve sleeve member, overcomes the bias due to the high pressure fluid in the gallery and causes the valve sleeve member to move axially towards the first end of the cylinder. This movement firstly shuts off the transfer ports, isolating them from the second end of the cylinder; and then puts them in communication with the high pressure fluid in the gallery of the valve sleeve member. High pressure fluid can now flow to the head space at the first end of the cylinder to lift the piston and the weight.

When the feed of high pressure fluid to the position control chamber is shut off, the force overcoming the bias due to the high pressure fluid in the gallery is reduced and the valve sleeve member then moves axially under the influence of the bias towards the second end of the cylinder. This shuts off the flow of fluid to the first end of the cylinder and puts the transfer ports in communication with the second end of the cylinder and the discharge ports. As described above, this is usually done before the weight reaches the apogee of its travel and the weight completes its upward travel under the momentum generated during the initial portion of the lift stroke of the ram. At this position of the valve member, fluid can flow from the second end of the cylinder to the head space at the first end of the cylinder to accommodate the increase in the volume of the head space as the piston completes its travel to the second end of the cylinder. When the weight reaches its apogee, fluid can flow back flow the head space to the second

end of the cylinder and from the discharge ports to make up any deficiency in that flow so that the weight can fall freely without any significant fluid drag for the impact stroke of the hammer weight.

DESCRIPTION OF THE DRAWINGS:

A preferred form of the cylinder of the invention will now be described by way of illustration only with respect to the accompanying drawings, in which Figure 1 is a diagrammatic axial section through the cylinder; and Figure 2 is a detailed view of the valve mechanism of the cylinder of Figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

An hydraulic hammer comprises a weight 1 powered by a ram 2 carried by a mobile base (not shown) carrying an hydraulic pump 3, which can be powered by an electric diesel or other engine. The ram comprises a cylinder 10 having a piston 11 journaled therein and connected to the weight by a piston rod 12 extending through a glanded bearing 13 at a closed first end 14 of the cylinder. The second end of the cylinder is closed by a valve block 20, optionally via an intermediate mounting annular member 21 for ease of machining the various parts. The block 20 is formed with an axially extending skirting wall 22 carrying a sealing ring 23 to form an annular axial chamber 24 with the second end of the cylinder wall. Valve block 20 is also provided with an axial bore 25 by which fluid can be fed to or discharged from the chamber 24. The flow of fluid to and from the chamber 24 is controlled by a multi way valve 26 fed via a pressure reduction valve 27 from the pump 3. Valve block 20 is also provided with a large bore discharge outlet port 28 and an axial bore 29 which communicates with the second end of the cylinder 1.

Valve block 20 or the member 21 is provided with one or more inlet ports 30 feeding a circumferential internal distribution

gallery 31. The ports 30 are connected to pump 3 for the receipt of high pressure hydraulic fluid, typically at about 180 to 300 bar. A high pressure accumulator 32 is provided to ensure that sufficient high pressure fluid is available to feed the cylinder on the lift stroke of the ram as is conventional. A circumferential series of radial ports 33 are provided in the wall of the second end of the cylinder 1 for the flow of high pressure fluid from the gallery 31 to the valve sleeve member 40.

Journalled in sliding sealing engagement upon the inner face of the second end of the cylinder 1 is a generally cylindrical valve sleeve member 40. One end 41 of the sleeve 40 is located in chamber 24 which carries a ring seal 23 to seal off chamber 24 against sleeve 40. The sleeve 40 is formed with a circumferential gallery 43 and has an annular shoulder 44 at the lip of the gallery adjacent the second end of the cylinder so that the side wall 45 of the gallery 43 is radially deeper than the other side wall 46 of the gallery. The difference in effective radial areas between the side walls of the gallery 43 is less than the total effective radial area of the end 41 of the sleeve exposed to fluid in chamber 24. The sleeve 40 also carries ring seals 47 and 48 which seal the sleeve 40 against the internal wall of the cylinder. The gallery 43 extends axially so that at all positions of the sleeve 40 it is in register with the inlet ports 33 and the gallery is exposed to high pressure fluid.

The interior of the cylinder wall is flared at 50 to accommodate the increase diameter of the sleeve 40 due to shoulder 44 and is provided with a radial shoulder 51 which acts as a stop restricting the axial travel of the sleeve 40 towards the first end of the cylinder 10.

Mounted externally upon and substantially concentrically with cylinder 10 is a cylindrical jacket 60 which forms with the exterior of cylinder 10 an annular passage 61 for transferring

fluid from the head space between the piston 11 and the first end of the cylinder to the cylinder space at the second end of the cylinder. Radial ports 62 are provided in the cylinder wall at the first end of the cylinder 10 and radial transfer ports 63 are provided in the cylinder wall at the end of the passage 61 adjacent the second end of the cylinder 10.

When the valve sleeve member 40 is in the lift position (as shown in the left hand portion of each Figure), high pressure fluid is fed to chamber 24 overcoming the bias due to the different areas of the side walls 45 and 46 of gallery 43. High pressure fluid flows through inlet ports 30, gallery 31, ports 33, gallery 43. ports 63, passage 61 and ports 62 into the head space at the first end of the cylinder and causes piston 12 to rise, thus lifting the weight 1. Due to the axial recess 3 in the weight, the lower portion of the ram 2 can nest into the weight 1, thus reducing the overall axial length of the ram and weight.

When the high pressure fluid to chamber 24 is shut off and the chamber allowed to discharge fluid to a waste tank 70 via valve 26, the bias due to the high pressure fluid in gallery 43 is no longer opposed and valve sleeve 40 can move axially towards the second end of the cylinder to adopt the fall position as shown in the right half of each of the Figures. The ports 63 now communicate with the discharge outlet 28/29 and the piston can fall within cylinder 10. The gallery 43 is out of register with ports 63 and high pressure fluid cannot flow beyond the gallery 43, thus maintaining the bias on valve sleeve 40.

After the initial portion of the lifting stroke, the weight will continue to rise under its own momentum, fluid being displaced from the full bore side of the piston to the head space, until the momentum of the weight is absorbed and the weight reaches the apogee of its travel. Excess fluid is discharged to a recycle tank 80, preferably via a low pressure accumulator 81. Thereafter, the weight will fall, during which

time fluid flows from the smaller head space to the larger full bore second end of the cylinder. The displacement of fluid from the head space is less than that required to make good the fluid demand in the full bore second end of the cylinder. This shortfall in the demand is met by fluid flowing from the low pressure accumulator 81.



CLAIMS:

1. An hydraulic ram (2) comprising a cylinder (10) having journalled for axial movement therein a piston (11), the piston (11) carrying a rod member (12) extending through an end wall (13, 14) of the cylinder (10) and adapted to be connected to a hammer weight (1), said cylinder (10) having means (60, 61, 62) for achieving flow of fluid to and from the head space between the piston (11) and said first end (13, 14) of the cylinder (10), a sleeve valve mechanism (40) journalled in sealing engagement upon the cylinder wall (10) and positioned at or adjacent the other end (20) of the cylinder (10) for controlling the flow of fluid into and out of the cylinder (10), and a position control chamber (24) which encompasses one end (41) of said sleeve valve member (40) and which is adapted to be put selectively in fluid flow communication with either a low pressure zone (80) or with a source of fluid at elevated pressure (3, 32) whereby one or more radial components of the end face (41) of the sleeve valve member (40) are exposed selectively to high (3, 32) or low (80) pressure so as to move the sleeve valve member (40) axially so as selectively to control the flow of fluid to and from the cylinder (10); characterised in that:

a. the sleeve valve member (40) is journalled within the cylinder (10) in sealing engagement with the internal wall of the cylinder (10), said sleeve valve member (40) having with the co-operating wall of the cylinder (10) a circumferential gallery (43) adapted to be in fluid flow communication with a supply of fluid at elevated pressure (3, 32) at all positions of the valve sleeve member (40);

b. the co-operating cylinder wall (10) has one or more ports (62, 63) adapted to place said gallery (43) in fluid flow communication with the said head space at a first axial position of said sleeve valve member (40) and to place said head space in fluid communication with a port (28, 29) for discharging fluid from the cylinder (10) at a second axial position of said sleeve valve member (40); and



c. the relative radial components of end faces (45, 46) of the portion of said circumferential gallery (43) carried by said sleeve valve member (40) and the end face (41) of said sleeve valve member (40) exposed to the fluid in said control chamber (24) are such that the sleeve valve member (40) is biased to said second axial position at which the said head space in the cylinder (10) is in fluid communication with the port (61, 62, 63, 28, 29) for discharging fluid from the cylinder (10) when said control chamber (24) is in communication with a low pressure zone (80), or said bias is overcome when the control chamber (24) is in communication with a source of fluid at elevated pressure (3, 32) whereby the feed of fluid to said control chamber (24) is adapted to move said sleeve valve member (40) axially with respect to the cylinder (10) to said first position so that said circumferential gallery (43) is in communication (63, 61, 62) with said head space.

2. A ram (2) as claimed in claim 1, characterised in that the said means for causing fluid to flow to and from said head space is in the form of an annular jacket (60) mounted substantially co-axially and externally about said first end of the cylinder (10) and in that said first end of the cylinder is in free flow connection (62) with said annular jacket (60).

3. A ram (2) as claimed in either of claims 1 or 2, characterised in that said cylinder (10) and said jacket (60) are mounted upon a valve block member (20) forming a closed second end (20) to the cylinder (10) and jacket (60); and ports (62, 63) are provided in said cylinder wall (10) for transferring fluid between said jacket (60) and cylinder (10) and said discharge port (28, 29) and ports (30, 31 and 33) are provided in said valve block for transferring fluid from a source of high pressure fluid (3, 32) to said cylinder (10) via said circumferential gallery (43) according to the axial position of said sleeve valve member (40).



4. A ram (2) as claimed in any one of the preceding claims, characterised in that said piston rod (12) extends axially through said second end (13, 14) of the cylinder (10).

5. A ram (2) as claimed in any one of the preceding claims, characterised in that the said valve position control chamber (24) is provided by an axially extending annular recess (24) within the valve block member (20) into which the end (41) of the sleeve valve member (40) is received in sealing engagement.

6. A ram (2) as claimed in any one of the preceding claims, characterised in that the sleeve valve member (40) carries the said circumferential gallery (43).

7. A ram (2) as claimed in and one of the preceding claims, characterised in that the relative effective areas of the circumferential radial side walls (45, 46) of the gallery (43) and of the radial end wall (41) of the sleeve valve member (40) exposed to fluid in the valve position control chamber (24) are such that when the said valve position chamber (24) is exposed to high pressure fluid (3, 32) the force exerted upon the sleeve valve member (40) is adapted to move the sleeve valve member (40) axially against the net opposing bias force exerted by the high pressure fluid (3, 32) fed to the said circumferential gallery (43).

8. A ram (2) as claimed in claim 7, characterised in that the force exerted upon the sleeve valve member (40) by the fluid (3, 32) in the said chamber (24) is from 1.5 to 3 times the net opposing bias force exerted by the fluid (3, 32) in said circumferential gallery (43).

9. A ram (2) as claimed in either of claims 7 or 8, characterised in that the effective area of the circumferential radial side wall (45) of the said gallery (43) adjacent said second end (20) of said cylinder (10) is from 105 to 150% greater than the effective area of the other circumferential



side wall (46) of the gallery (43).

10. A ram (2) as claimed in claim 1 substantially as hereinbefore described with respect to and as shown in the accompanying drawings.

11. A ram (2) as claimed in any one of the preceding claims, characterised in that the piston rod (12) carries a weight (1) having an axial recess (3) into which the end of the ram (2) can be received, whereby the axial length of the contracted ram (2) and weight (1) is reduced.

12. A pile driver having a weight (1) which is to be raised by means of an hydraulic ram (2) and allowed to fall onto the top of a pile so as to drive the pile into the ground, characterised in that the ram (2) is a ram (2) as claimed in any one of the preceding claims.

13. A method of operating a ram (2) as claimed in any one of the preceding claims, characterised in that fluid (3, 32) at a first pressure is fed to the said circumferential gallery (43); and in that said valve position control chamber (24) is exposed to fluid at a second (3, 32) or third pressure (80), which second pressure is the same or lower than said first pressure (3, 32) and said third pressure (80) is lower than said second pressure, whereby said sleeve valve member (40) is caused to move axially with respect to said cylinder (10) under the influence of said fluid at said second or third pressure to allow fluid at said first pressure to flow into said cylinder (10) or to allow fluid in said cylinder (10) to discharge from said cylinder (10) according to the position of said sleeve valve member (40).

14. A method as claimed in claim 11, characterised in that said first pressure (3, 32) is from 150 to 350 bar, said second pressure is from 70 to 100 bar and said third pressure (80) is ambient pressure.