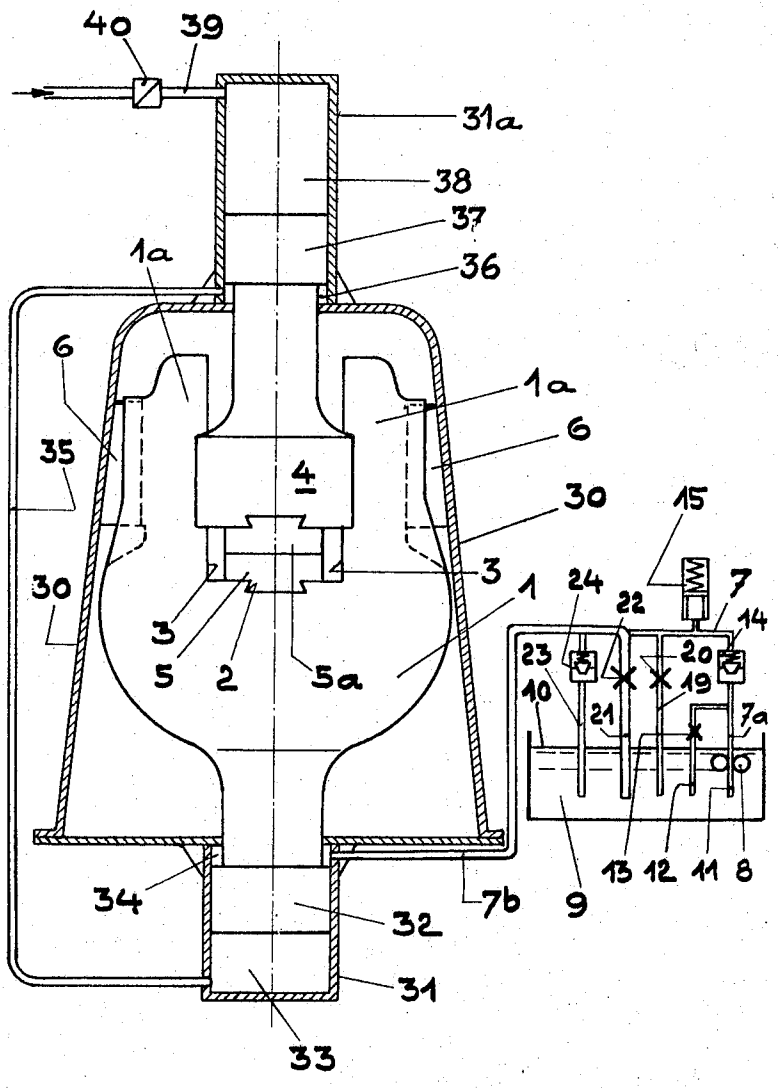
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SWAGING HAMMERS

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SWAGING HAMMERS

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ABSTRACT OF THE DISCLOSURE

A swaging hammer in which the hammer blow is caused by pneumatic expansion against a piston, the control and operation of the hammer being by hydraulic fluid.

This invention relates to a swaging or back-lash hammer, the upper tup of which can be lowered by the application of an expansive or elastic fluid to a piston connected with it, and, during this lowering, raises the lower tup by means of a hydraulic clutch, the lowering of the lower tup being positively effected by the action of a controllable pressure fluid upon a piston connected with it. With a known swaging hammer of this kind, the expansive or compressible pressure medium acting upon the piston of the upper tup is compressed air or steam, the admission of which to the cylinder, and its exhausting therefrom, are controlled. The pressure medium that positively lowers the lower tup is compressed air or steam, that is a compressible medium, which is likewise controlled.

The object of the present invention is to drive a swaging hammer of the kind set forth hydraulically instead of by means of compressed air or steam, and to do this in as simple a manner as possible. The invention enables this to be done by the feature that the pressure medium acting upon the piston of the upper tup is enclosed in a closable pressure space, in such a way that it is compressed during the ascent of the upper tup, and that the pressure medium compelling the lowering of the lower tup is a liquid, preferably oil under pressure. In this way it is possible to operate the swaging hammer merely by actuating the piston of the lower tup with liquid. This also gives rise to a simple control. The possibility is also of importance that existing swaging hammers of a known kind can in a simple manner be converted to oil driving.

The controllable pressure medium for lowering the lower tup may be furnished by an accumulator. It is however more advantageous to have this pressure medium delivered directly by a pump, the control preferably being carried out according to the constructional example hereinafter described.

The pump may be controllable in such a way that it delivers pressure liquid only during the lowering of the lower tup, and that this liquid, during the ascent of the lower tup, flows away through a non-return closure member to be opened. A substantially simpler control is however yielded if the annular space of the cylinder containing the piston of the lower tup is connected with a storage tank for pressure liquid by way of a non-return closure member which can be opened at will, and which can preferably be opened even while the pump is delivering, and the cross-sectional area of which is then so great that it permits at the same time the escape of the liquid compressed by the ascending lower-tup piston and the liquid passed on unaltered by the pump, without considerable rise of pressure.

The controlling may moreover be further simplified by providing the reflux or withdrawal closure valve with a device which automatically closes it immediately after the execution of a blow, in dependence upon the impact of the upper tup upon the work piece. In this case the said valve is preferably constructed as a relieved sleeve valve.

A particularly rapid sequence of hammer blows can be

obtained if from the pressure-liquid piping connecting the pump and cylinder of the lower-tup piston, a by-pass pipe which leads into the liquid-storage tank is branched off, and which can be throttled and shut off by a controllable valve, and if, furthermore, in the pressure liquid pipe, between the branching point of the by-pass pipe and the cylinder, a non-return valve is provided.

Further features of the invention will be gathered from the following description of one embodiment, which is diagrammatically illustrated by way of example in the accompanying drawing.

The lower tup **1** is U-shaped, and carries, in the bottom of the U-shape, with the aid of an ordinary dovetail-shaped recess **2**, the lower die or bottom swage (tool) **5**. In the limbs **1***a* of the U-shaped lower tup are provided guides **3** for the upper tup **4**, which carries a tool **5***a* in a similar manner. The outer sides of the U-shaped limbs **1***a* slide in guides **6** in a hammer standard **30**, which is rigidly connected below with a cylinder **31** and is rigidly connected above with a cylinder **31***a*.

In the cylinder **31** slides a piston **32**, which is rigidly connected with the lower tup **1**. In the cylinder space **33** of the cylinder **31** there is liquid under pressure, which acts upon the lower end face of the piston **32**. In an annular space **34**, which is adjacent to the rear or upper side of piston **32**, there is likewise pressure liquid, which may be furnished by piping **7***b*, **7**, **7***a* from a pump **8**. The pressure space **33** is connected by way of a pipe **35** with an annular space **36** in the cylinder **31***a*, so that the same pressure liquid that is located in the space **33** acts from below upon the piston **37** of the upper tup **4**. Above the piston **37** in the cylinder **31***a* there is a pressure space **38**, into which there opens a pipe **39**, which can be closed by a valve **40**. When the valve **40** is open, compressed air can be supplied through the pipe **39** to the space **38**.

Means for controlling the admission of liquid under pressure to the annular space **34** and its exhaust therefrom corresponds substantially to that of German Patent No. 974,854. The pump **8** may be constructed as a geared pump, and is arranged in a storage tank **9**, which contains pressure liquid, oil for example, up to a level **10**. The pump **8** sucks in pressure liquid through a pipe **11**, and impels it into the pipe **7***a*, to which is connected a by-pass pipe **12**, which can be throttled and shut off by means of a valve **13**, which is controllable at will. To the delivery pipe **7***a* a pressure pipe **7** is connected by way of a non-return valve **14**, which is subject to the action of a spring or the like, and which opens upon a comparatively small rise of pressure in the pressure pipe **7***a*, and then allows the liquid under pressure to pass into the pressure piping **7**, **7***b*. To the pressure pipe **7** are connected a shock-absorber **15**, and also a return pipe **19** of small cross-sectional area, which can be shut off by means of a by-pass valve **20** of small cross-sectional area, and which serves to let small quantities of liquid out of the annular space **34** when the distance between the tups is to be reduced. Moreover a further return pipe **21** of large cross-sectional area is provided, which connects the pressure pipe **7***b* with the storage tank **9**, and comprises a valve **22** of large cross-sectional area, which can be opened at will, and which is so constructed that it closes automatically when the upper tup reaches the work-piece, or immediately thereafter. Finally, between the pipe **7***b* and the storage tank **9** a pipe **23** is provided, which is closed by a suction valve **24**, which opens when a partial vacuum or fall of pressure occurs in the pressure pipe **7***b*.

Before striking a blow, the swaging hammer is located in the open position. The closure member **40** is closed, and, by the pump **8**, liquid under pressure has been delivered into the annular space **34**, so that the lower tup **1** is forced downwards and at the same time the

upper tup **4** is pushed upwards, so that the upper-tup piston **37** has compressed the air contained in the pressure space **38**. The hammer is therefore ready to strike. The blow is released by relieving the annular space **34** of pressure. This is effected by opening the valve **22**, which can be opened at will. The quantity of liquid in the annular space **34** then falls quickly into the storage tank **9**, whereupon at the same time the quantity of liquid further delivered by the pump **8** passes back through the closure valve **22** and the pipe **21** into the storage tank **9**. The blow of the upper tup **4** is therefore effected by expansion of the pressure fluid enclosed in the pressure space **38**. As soon as the blow has been struck, the recoil closure valve **22** closes, in a manner which is known from German Patent No. 970,878, so that the pump **8** again builds up the full pressure in the piping **7***a*, **7**, **7***b* and the annular space **34**, and pushes the lower tup **1** down again, as a result of which the upper tup **4** is pushed upwards, so that the pressure fluid in the space **38** is compressed. The hammer is now ready for the next blow.

The striking power can be regulated either by admitting or discharging air to or from the cylinder **31***a*, or by varying the quantity of liquid that is supplied each time to the annular space **34**, because the extent of the reduction in the volume of the compression space **38** is thereby determined, that is to say, the stroke becomes shorter, and the energy of the blow becomes smaller (provided the charge in the space **38** is not altered), and the number of blows increases, which is very desirable for quick racking and rolling.

Provision may be made for connecting the compression space **38**, in a manner which is not shown but is known from German Patent No. 1,095,631, with a pressure chamber filled with gas of adjustable pressure, whereby an enlargement of the compression space is obtained, provided the connection is effected by way of a valve which is of such large cross-sectional area of passage that the fall of pressure in the open position is only a fraction of the pressure in the pressure chamber. In order that the hammer may itself be able to establish the desired pressure in the compression space **38** and in the said pressure chamber, the pressure chamber and the compression space **38** above the piston **37** may be connected, additionally, by way of a non-return valve, which allows air from the compression space **38** above the piston **37** to flow into the pressure chamber, but not to flow back, whilst in a manner known in itself the compression space **38** above the piston is connected with the atmosphere by way of a second non-return valve, which allows air to flow into the compression space **38**, but not to flow back.

I claim:

1. A forging hammer including a hammer frame, an upper tup and a lower tup arranged opposite each other, each tup being movable upwards and downwards toward or away from each other, hydraulic coupling means including an upper cylinder on said frame and an upper piston connected to said upper tup by an upper piston rod forming an upper annular space below said piston about said piston rod, a lower cylinder on said frame and a lower piston connected to said lower tup by a lower piston rod, a lower annular space within said lower cylinder about said piston rod, a lower cylinder space below said lower piston within said lower cylinder, a connecting pipe between said upper annular cylinder space and said lower cylinder space, and a liquid in the two aforesaid cylinder spaces and in the connecting pipe, the space above the upper piston in said upper cylinder being filled with compressible fluid, the lower annular space within said lower cylinder above said lower piston being filled with liquid, a liquid supply and exhaust pipe connected to said lower annular space within said lower cylinder, pump means having a suction and discharge connected to supply liquid under pressure to said liquid supply and exhaust pipe, and controllable valve means to discharge liquid from said liquid supply and exhaust pipe.

2. The forging hammer of claim **1** in which a check valve is provided between said pump means and said liquid supply and exhaust pipe, and a bypass is provided from the pump means discharge to the pump means suction.

3. The forging hammer of claim **1** in which the lower tup is of U-shaped construction and the upper tup is arranged between the U-shaped limbs of the lower tup and is guided along the U-shaped limbs.

4. The forging hammer of claim **1** in which the lower tup is many times heavier than the upper tup, and the lower tup is of U-shaped construction and the upper tup is arranged between the U-shaped limbs of the lower tup and is guided along the U-shaped limbs.

5. The forging hammer of claim **1** in which said frame is formed with guides, said lower tup is provided with spaced upwardly extending arms engaging said guides, guide surfaces on said upwardly extending arms, and means on said upper tup engaging said guide surfaces to guide said upper tup.

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