Counter-blow hammer comprising a hammer frame in which are mounted an upper hammer and a lower hammer, hydraulic upper and lower piston and cylinder type hammer drives respectively and a further pressure fluid piston and cylinder device or devices which act on the lower hammer to impart a pushing effect on it.
COUNTER-BLOW HAMMER WITH A HAMMER DRIVE

The invention relates to a counter-blow hammer of the kind having an upper hammer tup and a lower hammer tup arranged in a hammer frame and a hammer drive, which works hydraulically with expanding pressurized fluid for the driving stroke and under the compression of the pressurized fluid for the return stroke, for which purpose there are provided piston-cylinder devices acting between the hammer tup and the hammer tup frame, of which, during operation, one pushes the hammer tup and the other pulls the hammer tup.

In a counter-blow hammer of this type known from the German Published U.S. Pat. No. 1,249,637, the hammer drive of the lower hammer tup has a piston-cylinder device which operates hydraulically for the return stroke and has a pulling action and a piston-cylinder device combined with the latter operating hydraulically for the driving stroke and with a pushing action. On the other hand, the hammer drive of the upper hammer tup has a piston-cylinder device operating with expanding pressurized fluid for the drive stroke with a pushing effect and a piston-cylinder device combined with the latter operating hydraulically for the return stroke and with a pulling effect.

One disadvantage of the known counter-blow hammer is that the hydraulically operating piston-cylinder devices for the hammer tup drive of the lower hammer tup normally lie below the ground and are, therefore, not readily accessible, which becomes an inconvenience with the relatively frequent repairs in the hydraulic piston-cylinder devices.

Thus, it is an object of the invention to provide a counter-blow hammer, which has an improved hammer drive, in particular an improved drive of the lower-hammer tup.

The invention provides a counter-blow hammer of the kind specified which is characterized in that the lower hammer is driven by a piston-cylinder device working with expanding pressurized fluid with a pushing effect, and a separate further hydraulically operating piston-cylinder device with a pushing effect.

According to the present invention, there is provided a counter-blow hammer comprising (1) a hammer frame, (2) an upper hammer tup and a lower hammer tup mounted separately on the hammer frame to be movable towards and away from each other, (3) a piston and cylinder device for moving the upper hammer tup, said device being fixedly connected between the hammer frame and the upper hammer tup, and (4) a hammer drive for moving the lower hammer tup, the hammer drive including (a) at least one gas pressure operated piston and cylinder device disposed between the frame and the lower hammer tup for urging the lower hammer tup towards the upper hammer tup, (b) at least one hydraulically operated piston and cylinder device for urging the lower hammer tup away from the upper hammer tup, each said hydraulically operated piston and cylinder device being disposed between the frame and the lower hammer tup and above the gas pressure operated piston and cylinder device, (c) means fixedly connecting the gas pressure-operated and hydraulically operated piston and cylinder devices to only one of the hammer frame and the lower hammer tup, (d) stop means for limiting the strokes of the gas pressure-operated and hydraulically operated piston and cylinder devices, and (e) control valve means for said hydraulically operated piston and cylinder device, said valve means being opened to effect movement of the lower hammer tup towards the upper hammer tup.

In a counter-blow hammer of this type, a counter-coupling of the lower hammer tup and upper hammer tup can be eliminated, so that a piston-cylinder device serving for the counter-coupling and engaging the lower hammer tup is eliminated. If the momentum of the lower hammer tup endures to move the lower hammer tup a greater distance than the prescribed recoil, then the momentum is not taken up by the frame through the impact, if the connection of the lower hammer tup and the hammer tup frame is broken by the piston-cylinder device effecting the recoil. The same thing occurs with regard to the drive stroke, if the connection of the lower hammer tup and the hammer tup frame can be broken by the piston-cylinder device effecting the drive stroke.

In a counter-blow hammer according to the invention there are no hydraulics in the lower hammer part and the entire hydraulic drive is located in the hammer head. Pressure fluid members and pipes are not necessary outside the hammer head. A simple protection which is reliable in operation and shock absorbent is provided for the excesses of the stroke which are always unavoidable without counter-coupling. An impact of the lower hammer tup on the hammer tup frame is neither possible with upward excesses of the stroke nor with downward excesses of the stroke.

A preferred embodiment of the invention is illustrated in the drawing. The drawing shows a counter-blow hammer in a cutaway side view.

The counter-blow hammer according to the drawing has in a hammer tup frame 1, an upper hammer tup 2, which is guided in a lower hammer tup 3 and principally during the stroke in the hammer tup frame 1 by means of projections. The upper hammer 2 is moved up and down by means of a piston 50 having a piston rod 5 and guided in a cylinder 4. The lower hammer tup 3 is guided in the hammer tup frame at 51 and 52. It is moved upwards by air or gas pressure in the cylinders 6, which contain pistons 8 supported on a base plate 7 of the frame 1 and is moved downwards by hydraulic pressure in the cylinders 34, which receive pistons 9 acting by means of piston rods 10 on the lower hammer tup 3. The entire counter-blow hammer is located with its lower part below the ground 54 and projects upwards with its remaining parts above the ground.

The force due to air or gas pressure in the cylinders 6 considerably exceeds the specific weight of the lower hammer tup 3. The piston rods 10 at the contact points 47 are not attached to the lower hammers, so that the lower hammer tup 3 can become disengaged from the piston rods 10 under the action of stops 45 and carry out an additional stroke 48. The pistons 8 are not connected at the pressure points 49 to the base plate 7, so that the lower hammer tup 3 can exceed its normal stroke limited by stops 46 in an upward direction, taking the piston 8 with it. The stops 46 are formed by the walls forming the cylinder volumes 6 and co-operate with the parts of the pistons 8 located in the cylinder volumes 6.
The drive conveniently takes place by means of two pumps 11, 12 with a constant delivery. They are respectively connected by means of valves 13, 14 to circulating pipes 15, 16. From the pumps 11, 12 flow takes place through respective non-return valves 17, 18 to a common pipe 19 to a control slide valve 20 and further, through a pipe 21, to a pressure fluid space 22 of an accumulator 53 loaded by pistons 23 by gas or air pressure in the cylinder space 24. From the piston 23 projects, in an upwards direction, a control rod 43, which can co-operate with a limit switch 44.

In addition, from one of the pumps 11, a pipe 26 leads through a non-return valve 25 to the control slide valve 20. The cylinder 4 is connected by means of pipes 20, 27 and a suction valve 28 to a reservoir 29, and by means of the pipe 40 and a pipe 30, as well as a non-return valve 31, to the pressure fluid space 22 of the accumulator 53. The annular cylinder 32 defined under the piston 50 is in constant communication with the space 22 by means of a pipe 33. Pipes 35 lead from the cylinders 34 through a common non-return valve 36 to the pressure fluid space 22. In addition a connection exists, through the pipe 35 and a pipe 37 and a non-return valve 38 with the reservoir 29. The control slide valve 20 is connected to the cylinder 4 by two pipes 39, 40. Furthermore, it can be connected by a slide valve 41 to the reservoir 29. It is connected directly to the latter by a pipe 42 and the pipe 27.

The method of operation of the counter-blow hammer illustrated is as follows:

Initially the upper hammer tup 2 and the lower hammer tup 3 are in the position shown, as are the control slide valve 20 and the slide valve 41. In response to the actuation of a foot switch which is not shown, the two valves 13, 14 are now closed, and the two pumps 11, 12 pump through the pipes 19 and 21 into the pressure fluid volume 22 of the accumulator 53. Due to this, the piston 23 rises. As soon as the control rod 43 closes the limit switch 44, the control valve 20 is pushed into its right-hand limit position. With a slight delay, the valve 41 displaces into its left-hand limit position. Since the pipes 21 and 39 are now connected to each other by the control valve 20, the cylinders 4 and 32 and the pressure fluid space 22 are connected to each other and the upper hammer tup 2 is accelerated downwards. Since the pipes 37 and 42 are connected to each other by the control valve 20, the connection between the cylinder volumes 34 and the reservoir 29 is produced. The pressure fluid in the cylinder volumes 34 can escape and the lower hammer tup 3 is driven upwards at the same time as the movement of the upper hammer tup 2 by the fluid pressure in the cylinder spaces 6. The speeds of the two hammer tup and their strokes must be in an inverse ratio to their masses.

For reasons which are connected with the hammer tup recoil, the upper hammer tup 2 is, however, allowed to move somewhat faster than a speed which corresponds with this ratio. At the moment of the blow, with small flows previously, the control valve 20 is returned for example by an adjustable, electronic timing circuit which is not shown. Since the valve 41 remains in its left-hand limit position, the pipe 39 and thus also the cylinder 4 is now connected to the reservoir 29; Therefore the upper hammer tup is moved upwards due to the pressure in the cylinder 32. The pistons 9 have such large dimensions that the pressure in the cylinders 34 is always considerably less than the pressure in the pressure fluid space 22 until the pistons 9 no longer contact the stops 45. Therefore the pump 11 now pumps through the non-return valve 25 and the pipes 26, 37 and 35, into the cylinders 34 and the lower hammer tup 3 is moved downwards. Since it only has to carry out a very small stroke, this can happen very slowly, so that no precautions are necessary for absorbing forces due to inertia. As soon as the pistons 9 have reached the stops 45, the further supply of pressure fluid into the cylinders 34 is stopped. Thus the pump 11 then again supplies the pressure fluid space 22.

By returning the valve 41 to its initial position, the discharge from the cylinder space 4 into the reservoir 29 is blocked and the upper hammer tup 2 is retarded by the counter pressure in the pressure fluid volume 22 and its specific weight, since the pressure fluid from the cylinder 4 can only escape through the pipes 40 and 30 and the non-return valve 31. The two pumps 11, 12 continue to pump until the control rod 43 contacts the limit switch 44. If the foot switch (not shown) is actuated again, then the next blow occurs, otherwise the two valves 13, 14 are opened and the hammer tup remains stationary.

If due to some incorrect adjustment of the air or gas pressure in the cylinders 6 and 24 the lower hammer tup exceeds its normal stroke in an upwards direction, then the pistons 8 are carried upwards by means of the stops 46. The pressure in the cylinders 6 therefore becomes ineffective and simultaneously the lower hammer tup 3 is effectively retarded by its specific weight. If the lower hammer tup 3, due to incorrect adjustment of the fluid pressure in combination with a very hard recoil after a blow, should fall short of its normal stroke in a downwards direction, then the additional stroke 48 is available. In this case the lower hammer tup 3 becomes disengaged from the contact points 47 of the piston rods 10. If the control valve 20 is prematurely returned to the initial position, for example before the blow has been effected, then the pressure fluid escapes from the cylinders 34 through the non-return valve 36 into the space 22.

In place of the two pistons 8 there may be used a central piston. The arrangement of two pistons has the sole purpose of keeping free the center for the possible addition of an ejector. It is also possible to arrange the cylinders 6 in the base plate 7 in place of in the lower hammer tup 3 and to allow the pistons 8 to push against the lower hammer tup instead of against the base plate. In this case the pistons and lower hammer tup are unconnected with each other. In addition it is possible to connect the piston rod 10 to the lower hammer tup 3 and to disconnect it from the piston 9.

In a less advantageous embodiment, the lower hammer tup 3 has flanges which are mounted laterally instead of sides which project upwards and the hydraulic piston-cylinder arrangements bringing about the return stroke are set deeper, nearer to the ground 54. It is also possible to connect the piston rods 10 to the lower hammer tup 3 rigidly and to provide separate buffers below the lower hammer tup.

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

1. A counter-blow hammer comprising (1) a hammer frame, (2) an upper hammer tup and a lower hammer
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tup mounted separately on the hammer frame to be movable towards and away from each other, (3) a 
piston and cylinder device for moving the upper hammer tup, said device being fixedly connected 
between the hammer frame and the upper hammer tup, and (4) a hammer drive for moving the lower hammer 
tup, the hammer drive including (a) at least one gas pressure operated piston and cylinder device disposed 
between the frame and the lower hammer tup for urging the lower hammer tup towards the upper hammer 
tup, (b) at least one hydraulically operated piston and cylinder device for urging the lower hammer tup away 
from the upper hammer tup, each said hydraulically operated piston and cylinder device being disposed 
between the frame and the lower hammer tup and above the gas pressure operated piston and cylinder 
device, (c) means fixedly connecting the gas pressure-operated and hydraulically operated piston and 
cylinder devices to only one of the hammer frame and the lower hammer tup, (d) stop means for limiting the 
strokes of the gas pressure-operated and hydraulically operated piston and cylinder devices, and (e) control 
valve means for said hydraulically operated piston and 
cylinder device, said valve means being opened to ef 
flect movement of the lower hammer tup towards the 
upper hammer tup.

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2. A counter-blow hammer as claimed in claim 1, 
wherein the lower hammer tup is substantially U-
shaped with the arms of the U receiving between them 
the upper hammer tup and wherein each hydraulically 
operated piston and cylinder device engages one of the 
arms of the U.

10

3. A counter-blow hammer as claimed in claim 2, 
wherein projections on the hammer frame guide the 
upper hammer tup above the side pieces of the U-
shaped lower hammer tup and a piston rod of each 
hydraulically operating piston and cylinder device 
passes through an aperture in one of the projections.

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4. A counter-blow hammer as claimed in claim 1, 
wherein the cylinder of each gas pressure operated 
piston and cylinder device is formed in the lower 
hammer tup and the piston is movable relative to the 
hammer frame.

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