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(54) Method to forge with a swaging machine, and a swaging machine suitable to carry out the method.

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Description

The invention concerns a method to forge with a swaging machine and also a swaging machine suitable to perform the method.

To be more exact, the invention concerns a method which provides for a differentiated frequency of hammering during the forging step with a swaging machine for metals which is hydraulic or mechanical.

Hydraulic swaging machines of the type to which the invention is applied are disclosed and illustrated, for instance, in EP-A-0297312, US-A-4745793 or US-A-3707866.

Mechanical swaging machines with hammers actuated by an eccentric are also known.

In this invention the word "forging" includes also "swaging".

Hydraulic swaging machines performing swaging work are fed at the present time by fixed displacement pumps and their hammering frequency is unchanged. The hammering frequency is altered by small values by varying the number of revolutions of the pump, but this system in itself is neither enough nor advantageous in view of the masses in movement and therefore of the waste of energy with each variation in the quantity of movements.

The same problem is encountered with mechanical swaging machines, which have substantially one single working speed that can be altered a little by acting on the speed of rotation.

The swaging machines, whether hydraulic or mechanical, are of two types, one with a long stroke and the other with a short stroke. The machines with a long stroke apply a small number of hammer blows per minute, whereas those with a short stroke carry out a greater number of hammer blows per minute.

Swaging machines with a long stroke are used for roughing work, whereas those with a short stroke serve for finishing work. Therefore, both machines are required to perform a finished forging work, so that one machine can be used for the rough-shaping and the other be used thereafter for the finishing.

This entails high investment, waste of energy, considerable employment of space, increased maintenance costs, more personnel, longer times, machines for handling work, etc., which are factors no longer acceptable in the present competitive conditions and in the environmental situation which has become more and more evident as time goes by.

In fact, the long stroke of the hammers of one type of swaging machine is ill-suited to the work of finishing a forged product. In other words, great investments in space, machines, plant, manpower and a high energy consumption are necessary nowadays to obtain a high output.

The present applicant has therefore tackled a problem which has been felt for some time now, and has studied, tested and achieved this invention.

The method for the rough shaping and finishing of metallic workpieces and the swaging machine suitable to carry out the method according to the invention are defined in claims 1, 3 and 4 respectively, while the dependent claims describe variants of the ideas of the respective main solutions.

According to the invention the hammers of the swaging machine can perform at least two different strokes, a long stroke and a short stroke; the short stroke is associated with a greater frequency of hammer blows; this frequency may be four times or more greater than the slow frequency.

The drive motor may be an electric D.C. motor or an electric motor with a sliding connection or any other system which enables the speed of the drive shaft to be varied.

If the swaging machine is a mechanical machine, a second eccentric is placed in cooperation with the eccentric that actuates the relative single hammer. The reciprocal positions of the two eccentrics determine the longest stroke, shortest stroke and any intermediate stroke.

Instead, where the swaging machine is hydraulic, each pump assembly cooperating with a specific hammer is equipped with means able to change its displacement. Such change in its simplest form provides for the obtaining of two different displacements for each piston of the pump.

Modification of the displacement alters the quantity of oil aspirated by and pumped into the actuation chamber of the piston that bears the hammer in question.

Alteration of the quantity of oil changes the stroke of the piston and therefore of the hammer in question.

The achievement of a differentiated displacement is obtained with an auxiliary piston that has an inactive position (greatest displacement) and a working position (smallest displacement).

According to a variant the auxiliary piston may be formed with concentric elements, each of which can take up both the two inactive and working positions. These concentric elements, being one or more in number, can be set to work as required so as to obtain as many different displacements.

According to a further variant an independent chamber in which an auxiliary piston works or can work at the same time as the main piston is included coaxial with the chamber where the main piston works.

The ability to vary the displacement is achieved by inserting or not in the circuit one or the other of the compression/aspiration chambers or both of them.

As we said above, alteration of the displacement alters also the quantity of hydraulic oil displaced and thus modifies the stroke of the specific piston that bears the hammer in question.

If the displacement is reduced, the quantities of movements in question are reduced and the mass of oil the displaced is reduced much more.

It is then possible to change more easily and quickly the number of revolutions by increasing them.

With the invention it is therefore possible to bring about at least two conditions of actuation of the swaging machine and to enable the machine to work either as a rough-shaping forging machine (long stroke, low frequency) or as a finishing swaging machine ((short stroke, high frequency).

The attached figures, which are given as a non-restrictive example, show the invention applied to hydraulic swaging machines.

Fig.1 shows an embodiment according to the invention;

Fig.2 shows a variant of the embodiment of Fig.1;

Fig.3 shows another embodiment of the invention.

Fig.1 shows a diagram of a vertical section of a pump 10 corresponding to a main piston 11. A chamber 13 in which the main piston 11 plunges is connected to the specific piston of the hydraulic swaging machine (not shown in the figures) through a pipe 12.

The hydraulic swaging machine may be of the type disclosed in EP-A-0297312 or in US-A-4,745,793 or be of another known type.

The main piston 11 is displaced axially by a connecting rod 14 actuated by a crankshaft 15 set in rotation by a motor 16.

So long as the main piston 11 is free to slide in the chamber 13, the displacement stays constant, as also does the stroke of the hammer.

The number of strokes per unit of time can be varied by speeding up or slowing down the rotation of the crankshaft 15, namely by acting on the motor 16 and crankshaft 15.

If an auxiliary piston 18 is rested on the main piston 11 and is solidly fixed thereto, the displacement is reduced by the volume correspondingly taken up by the auxiliary piston 18.

In its working position the auxiliary piston 18 has to move together with the main piston 11.

When the auxiliary piston 18 is in its inactive position, the displacement will be the maximum available.

In the example of Fig .1 the auxiliary piston 18 is positioned by an actuation piston 19 actuated by fluid under pressure coming from the pipe of a reservoir 17.

When the auxiliary piston 18 is in its working position, that is to say, rendered solidly fixed continuously to the main piston 11, the actuation piston 19 thrusts the auxiliary piston 18 always against the main piston 11 so that both pistons 11-18 travel concordantly with each other.

In this way two different displacements are obtained with two different strokes of the specific pistons that bear the hammers of the swaging machine.

In fact, if the displacement of the specific pistons that bear the hammers remains constant, a variation of displacement of the pump changes the stroke of those specific pistons.

A variant of the invention, shown diagrammatically in Fig.2 for instance, provides for two or more auxiliary pistons cooperating with the upper surface of the main piston 11. These auxiliary pistons may be independent and be positioned, for instance, along a circumference, or may be coaxial. Fig.2 shows an example of coaxial auxiliary pistons (18-118-218 etc.)

In the embodiment shown in Fig.2 each auxiliary piston 18 has a positioner assembly 20 comprising, for instance, a grearwheel-rack coupling 22, which in this case includes springs 21 to enable the auxiliary piston 18 to follow the stroke of the main piston 11.

Fig.3 shows another variant, which provides for at least two coaxial chambers 13-113 independent of each other. The main piston 11 operates in one chamber 13, while the auxiliary piston 18 solidly fixed to the main piston 11 operates in the other chamber 113.

In this way both pistons 11-18 operate in their own chambers 13-113, and the connection or disconnection of one or both chambers 13-113 to or from the pipe 12 leading to the specific piston of the swaging machine determines the desired displacement.

By means of the invention it is possible to link to one or the other displacement of the pump the required speed at the axis of the crankshaft 15.

Claims

1. Method for the rough shaping and finishing of metallic workpieces with one single swaging machine, characterised in that the hammers have a first working rate with a long stroke and with a low number of hammer blows per minute and a second working rate with a short stroke and with a great number of hammer blows per minute, the first rate being associated with the rough-shaping step whereas the second rate is associated with the finishing step, the speed of an actuation motor being associated with the first and second working rates.

2. Method as in Claim 1, whereby the number of hammer blows per minute connected to the second working rate is even more than four times greater than the number of hammer blows per minute connected to the first working rate.

3. Mechanical swaging machine suitable to carry out the method of the claims hereinbefore and characterised in that it comprises for each eccentric actuating a single hammer a counter-eccentric to regulate the stroke of the hammers, an actuation motor being able to run at least at two

speeds.

4. Hydraulic swaging machine suitable to carry out the method of the claims hereinbefore and characterised in that the stroke of the individual hammers is altered by acting on the displacement of relative pumps, and an actuation motor being able to run at least at two speeds.

5. Hydraulic swaging machine as in Claim 4, which comprises a pump wherein a chamber (13) in which a main piston (11) operates is directly connected to the chamber of the specific piston that bears the specific hammer, the pump being characterised in that the displacement of each chamber (13)/main piston (11) assembly has at least two values.

6. Hydraulic swaging machine as in Claim 5, in which a variation of displacement of the pump is obtained with at least one auxiliary piston (18) having an inactive position and a working piston, the auxiliary piston (18) operating in the chamber (13) and being substantially solidly fixed to the main piston (11) when in its working position (Figs.1 and 2).

7. Hydraulic swaging machine as claimed in Claim 5, in which the variation of displacement of the pump is obtained with at least one auxiliary chamber (113) coaxial with and independent of the main chamber (13), an auxiliary piston (18) coaxial with and solidly fixed to the main piston (11) operating in the auxiliary chamber (113).

Patentansprüche

1. Verfahren zum Rohformen und Feinbearbeiten von metallischen Werkstücken mit einer einzigen Schmiedemaschine, **dadurch gekennzeichnet,** daß die Hämmer einen ersten Arbeitstakt mit einem langen Hub und einer geringen Anzahl von Hammerschlägen pro Minute und einen zweiten Arbeitstakt mit einem kurzen Hub und einer großen Anzahl von Hammerschlägen pro Minute aufweisen, wobei dem ersten Arbeitstakt die Rohformung und dem zweiten Arbeitstakt die Feinbearbeitung zugeordnet ist und die Geschwindigkeit eines Antriebsmotors den ersten und zweiten Arbeitstakten entsprechend zugeordnet wird.

2. Verfahren nach Anspruch 1, bei dem die mit dem zweiten Arbeitstakt verbundene Anzahl von Hammerschlägen pro Minute mehr als viermal größer ist als die mit dem ersten Arbeitstakt verbundene Anzahl von Hammerschlägen pro Minute.

3. Mechanische Schmiedemaschine zur Ausführung des Verfahrens nach den vorstehenden Ansprüchen, **dadurch gekennzeichnet,** daß zur Regelung der Hammerhübe für jeden einen einzelnen Hammer betätigten Exzenter ein Gegenexzenter vorgesehen ist, wobei der Antriebsmotor mit mindestens zwei Geschwindigkeiten drehen kann.

4. Hydraulische Schmiedemaschine zur Ausführung des Verfahrens nach den vorstehenden Ansprüchen, **dadurch gekennzeichnet,** daß der Hub der einzelnen Hämmer durch Einwirkung auf die Verdrängung der entsprechenden Pumpen änderbar ist, und daß der Antriebsmotor mit mindestens zwei Geschwindigkeiten drehen kann.

5. Hydraulische Schmiedemaschine nach Anspruch 4, die eine Pumpe aufweist, wobei eine Kammer (13), in der ein Hauptkolben (11) arbeitet, direkt mit der Kammer des den ensprechenden Hammer betätigenden Kolbens verbunden ist, **dadurch gekennzeichnet,** daß die Verdrängung jeder Kammer (13)/Hauptkolben (11) - Einheit mindestens zwei Werte aufweist.

6. Hydraulische Schmiedemaschine nach Anspruch 5, bei der die Veränderung der Verdrängung der Pumpe mit mindestens einem Hilfskolben (18) erreicht wird, der eine Ruhestellung und eine Arbeitsstellung aufweist, wobei der Hilfskolben (18) in der Kammer (13) arbeitet und in seiner Arbeitsstellung im wesentlichen haltbar am Hauptkolben (11) festgelegt ist.

7. Hydraulische Schmiedemaschine nach Anspruch 5, bei der die Veränderung der Verdrängung der Pumpe mit mindestens einer Hilfskammer (113) erreicht wird, die koaxial mit und unabhängig von der Hauptkammer (13) angeordnet ist, wobei ein Hilfskolben (18) vorgesehen ist, der koaxial am Hauptkolben (11) befestigt ist und in der Hilfskammer (113) arbeitet.

Revendications

1. Procédé de dégrossissage et de finition de pièces métalliques avec une seule machine d'estampage, caractérisé en ce que les marteaux présentent une première vitesse de travail à course longue et faible nombre de coups de marteau par minute, et une seconde vitesse de travail à course courte et grand nombre de coups de marteau par minute, la première vitesse étant associée à l'étape de dégrossissage, la seconde vitesse étant associée à l'étape de finition, la vites-

se d'un moteur d'actionnement étant associée avec la première et la seconde vitesse de travail.

2. Procédé selon la revendication 1, dans lequel le nombre de coups de marteau par minute associé à la seconde vitesse de travail est même plus que quatre fois plus grand que le nombre de coups de marteau par minute associés à la première vitesse de travail.

3. Machine mécanique d'estampage convenant pour exécuter le procédé selon les revendications précédentes, caractérisée en ce qu'il comporte pour chaque excentrique actionnant un marteau unique un contre-excentrique pour réguler la course des marteaux, un moteur d'actionnement étant capable de tourner à au moins deux vitesses.

4. Machine hydraulique d'estampage convenant pour exécuter le procédé selon les revendications précédentes, et caractérisée en ce que la course des marteaux individuels est modifiée en agissant sur le débit de pompes correspondantes, et en ce qu'un moteur d'actionnement est capable de tourner à au moins deux vitesses.

5. Machine hydraulique d'estampage selon la revendication 4, qui comporte une pompe dans laquelle une chambre (13) dans laquelle agit un piston principal (11) est reliée directement à la chambre du piston spécifique qui porte le marteau spécifique, la pompe étant caractérisée en ce que le débit dans chaque système de chambre (13) et de piston (11) présente au moins deux valeurs.

6. Machine hydraulique d'estampage selon la revendication 5, dans laquelle une variation du débit de la pompe est obtenue avec au moins un piston auxiliaire (18) présentant une position inactive et une position de travail, le piston auxiliaire (18) agissant dans la chambre (13) et étant essentiellement solidaire du piston principal (11) lorsqu'il est dans sa position de travail (figures 1 et 2).

7. Machine hydraulique d'estampage selon la revendication 5, dans laquelle la variation du débit de la pompe est obtenue avec au moins une chambre auxiliaire (113) coaxiale par rapport à la chambre principale (13) et indépendante de celleci, un piston auxiliaire (18) étant coaxial par rapport au piston principal (11) et solidaire de celuici agissant dans la chambre auxiliaire (113).

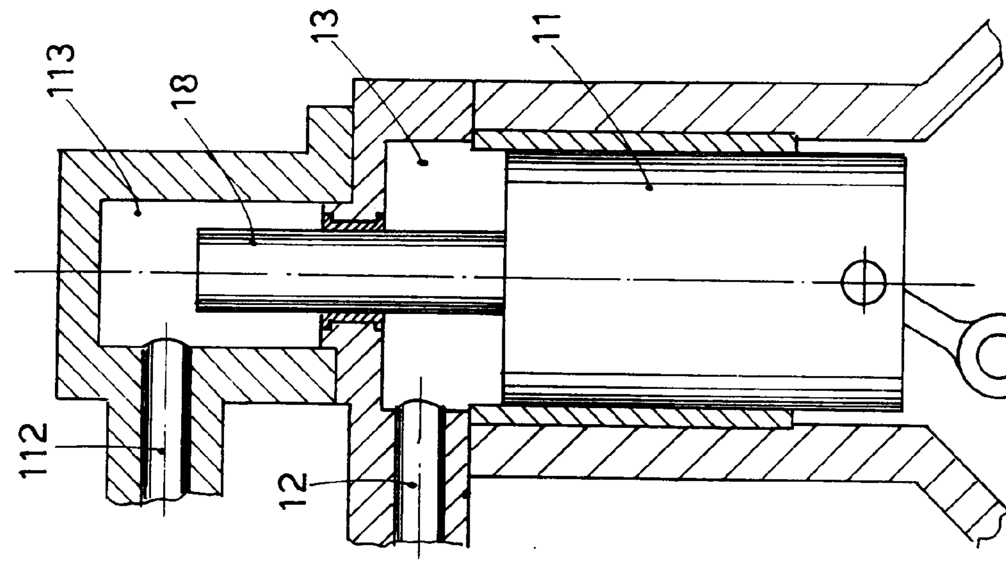

fig.3

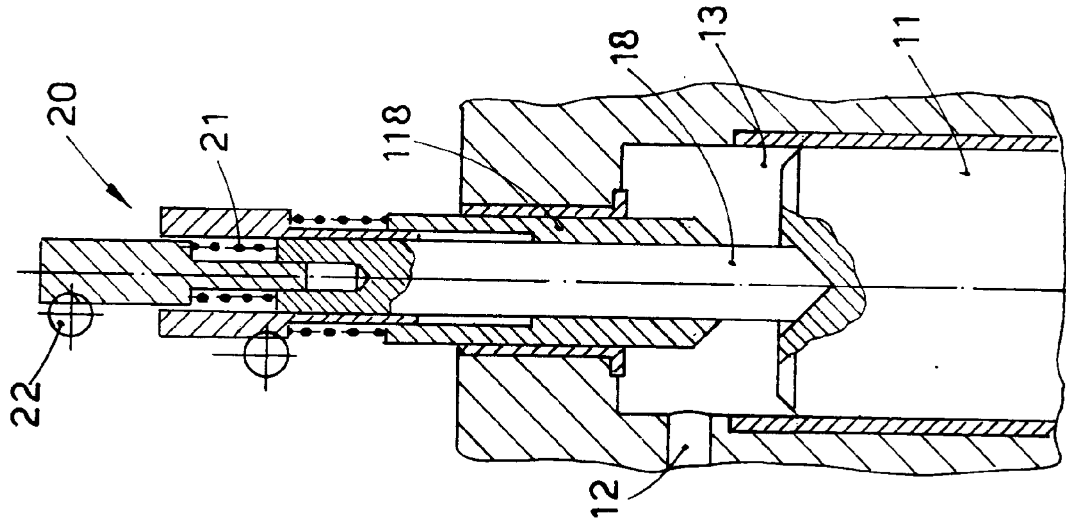

fig.2

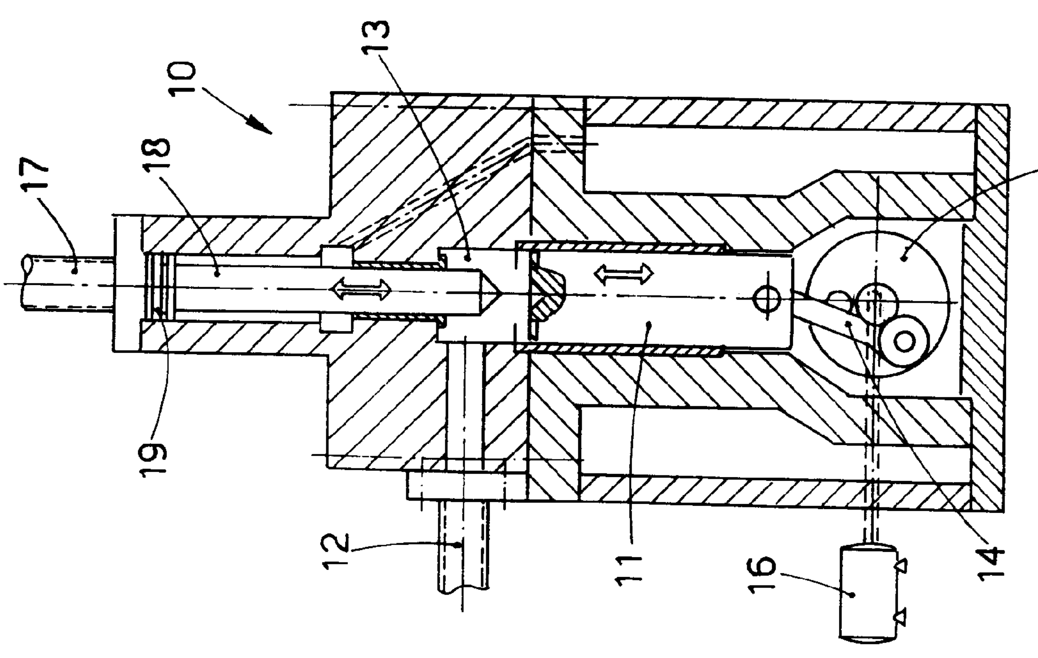

fig.1