In the known forging machines the clamping slide is driven either by the upsetting slide or by the crankshaft. The connecting elements are so constructed that during the stroke of the upsetting slide the clamping slide remains as long as possible and as accurately as possible in its closed position. Any movement, however small, of the clamping slide in its end position is a drawback not only in view of the wear thus caused but also owing to the consequent reduction of the resistance to slip of the workpiece clamped. While a larger degree of immobility of the clamping slide in its end position is desirable, it necessitates an increasing number of levers and pins in the articulated drive means for connecting the clamping slide with the upsetting slide or with the crankshaft. This relationship confines the designer's endeavours within comparatively narrow limits. The levers and pins arranged in series are subject to high wear owing to the high accelerating forces required and the resulting guide play adds up in such a manner that jeryky operation and additional stressing result. Whereas an accurate standstill of the clamping slide during the upsetting period has been achieved by means of cams, the circular section of which engages with rollers while the jaws are closed, this arrangement involves another drawback consisting in the linear contact between the cams and the rollers. Consequently such an arrangement for driving the clamping slide is unsuitable for transmitting large forces. Modern forging machines, however, are increasingly required to have strong drive means for the clamping slide to enable large deformations to be carried out also transversely to the longitudinal direction of the workpiece.

The horizontal forging machine suggested according to the invention for solution of the problems involved comprises at least one clamping jaw driven transversely to the upsetting direction and provides for the upsetting slide being actuated by a crankshaft or an eccentric shaft, and it is characterized in that the mechanically operating actuating means for moving the clamping jaw into its clamping position are effective independently of mechanically operating means for actuating the upsetting slide. Several different methods are available for performing the invention. In the first place a clutch may be arranged before the actuating means for moving the clamping jaw into its clamping position, said clutch being independent of the clutch which is arranged before the actuating means for moving the upsetting slide. Each of the two clutches can be actuated at any desired time so that the independency between the two motions, of the clamping slide and the upsetting slide, to be achieved according to the invention, is obtained. Further steps may be taken by arranging before the actuating means for moving the clamping jaw into its clamping position, a prime mover which is independent of the prime mover arranged before the actuating means for moving the upsetting slide. Since these prime movers can be operated at any desired time, the greatest possible independency is ensured, though with a corresponding constructional expense. This constructional expense may be reduced to any desired extent, with a corresponding reduction of the degree of independency, this reduction having its limit only in that the motions of the upsetting slide and of the clamping slide must still be controllable independently of one another, as regards their times of operating.

Further details of the invention may be seen from an embodiment of the invention shown in the drawings by way of example as a horizontal forging machine, in which the upsetting slide is driven by a crankshaft or eccentrics and which comprises a clamping jaw constituting a clamping slide and a separate prime mover for driving each slide. Without difficulty this embodiment could be replaced by a construction in which a single prime mover is provided and in which in each of the kinematic trains between this prime mover and the upsetting and clamping slides, respectively, a clutch is arranged, which effects the transmission of motion through the kinematic train between said clutch and the respective slide driven thereby, said motion being independent of the motion transmitted by the other clutch to the other slide. In said drawing, Fig. 1 is a side view showing a horizontal forging machine constructed in accordance with the invention. Fig. 2 is a top plan view, with partially sectional views of the crankshaft for driving the upsetting slide, of the clutch for driving the clamping slide, and of the brakes associated with both slides. Fig. 3 is a vertical longitudinal sectional view of the machine. Fig. 4 is a vertical cross sectional view of the means for driving the upsetting slide. Fig. 5 shows diagrammatically an electro-pneumatic control system for the horizontal forging machine shown in Figs. 1 to 4. The upsetting slide 3 is moved in the known manner by means of the main crankshaft 1 and the main pressure rod 2. The main crankshaft 1 is driven by the prime mover 9, through the V belts 10, gears 4, 5 and the friction clutch 8 arranged in the main flywheel 7 on the pinion shaft 6. The means for driving the clamping slide 11 are entirely separate of the aforementioned means for driving the upsetting slide, and comprise the pressure rod 12, the crankshaft 13, the friction clutch 15 mounted on the crankshaft 13 and arranged in the flywheel 14, the prime mover 16, and the V belt 17. In addition to the clutches, brakes 18 and 19 are provided on the pinion shaft 6 and on the crankshaft 13. In the embodiment shown by way of example in the drawings, the clutches as well as the brakes are of the multiple-disc type. The discs of the clutches 8 and 15 are compressed directly by air-pressurized pistons 20, 22, and are released by springs 22, 23, respectively, which springs also effect the compression of the brake discs. The inlet and outlet valves for the compressed air are controlled electromagnetically by push buttons.

In accordance with the invention the speed of rotation of the crankshaft 13 for driving the clamping slide is much higher than that of the crankshaft 1 for the main slide.

The operation of the novel machine is described as follows: The prime movers 9 and 16, their flywheels 7 and 14, and the outer discs of the clutches 8 and 15 arranged in said flywheels run continuously throughout the period of operation. To perform the working stroke, the operator presses the switch button 29, after having inserted the workpiece 26 which is to be upset, with the heated
end 34, into the die 27 of the matrix 28 of the fixed jaw 41 of the machine body 42. Thereby the compressed air is admitted to the clutch pistons 20 and 21 of the clutches 8 and 15 (as will be explained in more detail in the description of Fig. 5), so that these clutches are brought into the die 27 of the matrix 28 of the fixed jaw 41 of the machine body 42. Thereby the compressed air in the clench is 13 for the clamping slide 11, the latter reaches its inner dead centre, that is, its closing position, at a time when the upsetting slide 3 has already begun its stroke. In the closing position the movement of the clamping slide 11 is automatically arrested by the cam 30, which actuates, by way of the electric switch 40, an electrical switch 31, which causes the valve 32 to release the compressed air in the clench 15 so that the discs of the clench 15 disengage whereas the discs of the brake 19 and 23 are compressed by the springs 23 and 33 and render the brake effective. Now the workpiece 26 is firmly clamped between the clamping jaws 28 and 33. The upsetting slide 3 completes its stroke and upsetting the heated end 34 of the workpiece 26. After the upsetting has been performed, the upsetting slide returns to its initial position and in its rear or outer dead centre is arrested by means of the cam 35, the electrical switch 36, and the compressed-air valve 37 operating to disengage the clutch 8 and to actuate the brake 18. A short time before this moment the cam 38 automatically actuates the electrical switch 39, which causes the compressed-air valve 32 to effect the engagement of the clutch 15 and thereby the return movement of the clamping slide 11, which in its rear or outer dead centre is arrested similarly to the main slide.

The speed of rotation of the crankshaft 13 for the clamping slide in relation to the speed of rotation of the main crankshaft 1 is chosen so that the clamping slide returns to its initial position simultaneously with the main slide. Fig. 5 shows in detail how these control operations are put into effect. When the switch button 29 is pressed, the electromagnetic control switch 31, which is represented schematically in Fig. 1 and in Fig. 5 is divided into its two principal parts, is supplied with current, so that the magnets are excited and the valves 32 and 37 are lifted vertically and maintained in this position by holding contacts, while the button 29 returns to its original position. By the so-acted opening of the valves 32 and 37 compressed air is admitted to the pistons 21 and 20 of the clutches 15 and 8, so that, as described above, the clamping and upsetting slides 11 and 3 are set in motion. Owing to the higher speed of rotation of the crankshaft 13, the clamping slide 11 reaches the clamping position for the workpiece 26, 34 at a moment when the upsetting slide 3 has just started its working stroke. At the moment in which the clamping slide assumes its clamping position, the switch 40 is actuated by the raised portion of the cam 30, so that the switch 40 opens. Thereby the current to the control switch 31 of the valve 32 is interrupted and the latter returns to its initial position as shown in Fig. 5, that is, the piston 21 of the clutch 15 is cut off from the supply of compressed air, and such piston is vended by being connected with the atmosphere. Thus the clutch 15 is disengaged and the clamping slide 11 remains in the clamping position throughout the stroke of the brake 19. In the meantime, the upsetting slide 3 completes its stroke and performs the forging operation. In the course of the subsequent return of the upsetting slide 3 into its initial position, which occurs by reason of the fact that the electromagnetic switch associated with the valve 37 remains excited, switch 39 is actuated by the rise of the cam 38, so that the electric circuit to which switch 29 belongs is closed. In this circuit there is also situated the winding of the control magnet of the valve 32. Actuated by the exaction of its control magnet, the valve is moved upwardly and in this manner admits compressed air to piston 21. The latter throws the clutch 15 in, so that the clamping slide 11 leaves its clamping position. Other controls to its original position. At the moment when both slides 11 and 11 have reached their original positions, the switch 36 is actuated by the raised portion of the cam 35. The circuits in which the control magnets of the valves 32 and 37 are located are thus broken, and the valves 32 and 37 therefore assume the position illustrated in Fig. 5. When the valve 32 is in such position, the pistons 21 and 30 are connected with the atmosphere: that is, the clutches 15 and 8 are disengaged. This means that slides 11 and 3 maintain their original positions until the operator again depresses the switch button 29 to initiate the automatic forging process.

It is possible without difficulty to make the clamping crankshaft just as thick as the upsetting crankshaft. For this reason the forging machine according to the invention is suitable for performing transversely of the workpiece the same deformation as in the upsetting direction. In contradistinction to the known means for driving the clamping means the means of transmission elements is reduced to a minimum. As to the drive, the means for driving the clamping means in the machine according to the invention the same advantages necessarily enjoyed previously by the main slide to make upsetting work possible at all. As compared with the drive means comprising rollers the more favourable surface contact has replaced the linear contact so that the disadvantage inherent in drive means comprising rollers is also overcome. As an additional advantage the useful upsetting stroke is substantially increased. The speeds of the two drive means can be adjusted so that approximately the full stroke of the upsetting slide is available as a useful stroke. As contrasted therewith the useful upsetting stroke of all forging machines of known construction is at most two thirds of the total stroke of the upsetting slide, at most.

The crank drive 12 to 17 for the clamping slide 11 represents only one of the embodiments possible. For instance, instead of the crank, it is possible to use eccentrics, toggle levers, or slot guides. Other constructions of clutch and brake are also conceivable. The essential feature of the invention resides in that the clamping slide is driven independently of the drive means for the upsetting slide.

To increase the useful upsetting stroke to the full length of the stroke of the upsetting slide, it is possible, in accordance with the invention, to control the initiation of the movement of the upsetting slide by the drive means for the clamping slide in such a manner that this movement begins only after the clamping slide has performed its closing stroke and is in clamping position. When the clutch 15 belonging to the means for driving the clamping slide is air-pressurized at a time which precedes the time at which the upsetting slide 3 is in its outer dead centre by the amount of time required for the thus initiated movement of the clamping slide 11, the upsetting of the workpiece can begin at the time at which the slide 3 departs from its outer dead centre, the whole stroke of the slide 3 thus being fully utilized for upsetting.

It need not be emphasized that planetary gears with corresponding brake arrangements may replace the clutches.

What I claim is:
1. A horizontal forging machine, comprising in com-
bination a machine bed, an upsetting slide slidiely

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guided for horizontal movement on the machine bed, at least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment jaw for said clamping jaw, mechanically operating actu-

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ating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer in advance of each of said two actuating means, means

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for supplying a compressed medium for operating said clutches, control means for said compressed medium, and

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devices operatively associated with said control means and adapted to conduct said medium to said clutches in

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automatic dependency on the upsetting slide movement, or to relieve the clutches of said compressed medium.

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2. A horizontal forging machine comprising, in com-

bination, a machine bed, an upsetting slide slidiely

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guided for horizontal movement on the machine bed, at

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least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer

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in advance of each of said two actuating means, means

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for supplying a compressed medium for operating said clutches, control means for said compressed medium,

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and devices operatively associated with said control

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means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide

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movement, or to relieve the clutches of said compressed medium, whereby the clamping jaw is arrested.

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3. A horizontal forging machine comprising, in com-

bination, a machine bed, an upsetting slide slidiely

guided for horizontal movement on the machine bed, at

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least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer

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in advance of each of said two actuating means, means

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for supplying a compressed medium for operating said clutches, control means for said compressed medium,

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and devices operatively associated with said control

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means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide

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movement or to relieve the clutches of said compressed

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medium, said control means being adapted, in the outer
dead centre of the upsetting slide, to relieve the clot

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ch associated with said slide, and devices operatively associated with said control means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide movement, or to relieve the clutches of said compressed medium, whereby the upsetting slide is arrested.

4. A horizontal forging machine, comprising in com-

bination a machine bed, an upsetting slide slidiely

guided for horizontal movement on the machine bed, at

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least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a clutch ar-

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ranged in the line of power transfer in advance of each of

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said two drive shafts, and a pressure-fluid operated clutch arranged in the line of power transfer, control means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting-slide movement, or to relieve the clutches of said compressed medium, and thereby to bring the clamping jaw first to its outer dead centre, and in the outer dead centre of the upsetting slide to relieve the clutch associated with the said slide of the compressed medium, and thereby to arrest the upsetting slide.

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5. A horizontal forging machine comprising, in com-

bination, a machine bed, an upsetting slide slidiely

guided for horizontal movement on the machine bed, at

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least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

245

clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer

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in advance of each of said two actuating means, means

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for supplying a compressed medium for operating said clutches, control means for said compressed medium,

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and devices operatively associated with said control

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means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide

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movement, or to relieve the clutches of said compressed medium, said control means being adapted, before the

der outer dead centre of the upsetting slide is reached, to sub-

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ject the clutch associated with the clamping jaw to the

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acti

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of said compressed medium, and thereby to bring the clamping jaw first to its outer dead centre, and in the

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outer dead centre of the upsetting slide to relieve the
clutch associated with the said slide of the compressed medium, and thereby to arrest the upsetting slide.

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6. A horizontal forging machine comprising, in com-

bination, a machine bed, an upsetting slide slidiely

guided for horizontal movement on the machine bed, at

305

least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer

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in advance of each of said two actuating means, means

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for supplying a compressed medium for operating said clutches, control means for said compressed medium,

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and devices operatively associated with said control

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means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide

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movement, or to relieve the clutches of said compressed medium, said control means being adapted, before the
outer dead centre of the upsetting slide is reached, to sub-
ject the clutch associated with the clamping jaw to the
action of said compressed medium, and thereby to bring the clamping jaw first to its outer dead centre, and in the
outer dead centre of the upsetting slide to relieve the clutch associated with the said slide of the compressed
medium, and thereby to arrest the clamping jaw.

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7. A horizontal forging machine comprising, in com-

bination, a machine bed, an upsetting slide slidiely

guided for horizontal movement on the machine bed, at

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least one clamping jaw slidiely guided for horizontal

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movement on said machine bed, at least one abutment

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jaw for said clamping jaw, mechanically operating act-

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uating means for the clamping jaw and with said slide, mechanically operating actuating means for the

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clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid

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operated clutch arranged in the line of power transfer

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in advance of each of said two actuating means, means for supplying a compressed medium for operating said clutches, control means for said compressed medium, and devices operatively associated with said control means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide movement or to relieve the clutches of said compressed medium, said control means being adapted, as the clamping jaw enters its clamping position, to subject the clutch associated with the upsetting slide to the action of said compressed medium and thereby to initiate the motion of the upsetting slide.

8. A horizontal forging machine comprising, in combination, a machine bed, an upsetting slide slidingly guided for horizontal movement on the machine bed, at least one clamping jaw slidingly guided for horizontal movement on said machine bed, at least one abutment jaw for said clamping jaw, mechanically operating actuating means for the upsetting slide in engagement with said slide, mechanically operating actuating means for the clamping jaw in engagement with said jaw, separate drive shafts for the two actuating means, a pressure-fluid operated clutch arranged in the line of power transfer in advance of each of said two actuating means, means for supplying a compressed medium for operating said clutches, control means for said compressed medium, and devices operatively associated with said control means and adapted to conduct said medium to said clutches in automatic dependency on the upsetting slide movement or to relieve the clutches of said compressed medium, said control means being adapted to subject the clutch associated with the clamping jaw to the action of said compressed medium at an instant which precedes the instant in which the upsetting slide is in its outer dead centre, by the time interval required for the thus initiated movement of the clamping jaw into its clamping position.

9. An automatic horizontal forging machine comprising, in combination, a machine bed, an upsetting slide slidingly guided for horizontal movement on the machine bed, a clamping jaw slidingly guided in the machine bed for horizontal movement in a direction transverse to that of the upsetting slide, a fixed abutment jaw cooperating with the sliding clamping jaw for gripping a workpiece therebetween, separate drive shafts disposed transversely to each other and provided with actuating means for moving the upsetting slide and clamping jaw, respectively, means for effecting rotation of the clamping jaw shaft at a higher speed than that of the upsetting slide shaft, a pressure fluid-operated brake in the line of power transfer in advance of each of said two actuating means, means for supplying a compressed medium for operating said clutches and brakes, valves for controlling the flow of compressed medium to, and the discharge thereof from said clutches and brakes, electrical circuits for controlling said valves, a manually operated switch for initiating the flow of said pressure fluid to said clutches, and automatic timing mechanism associated with said circuits for thereafter controlling the operation of the clutches and brakes.

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