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SWAGING MACHINE WITH ADJUSTABLE STROKE

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3 Sheets-Sheet 1

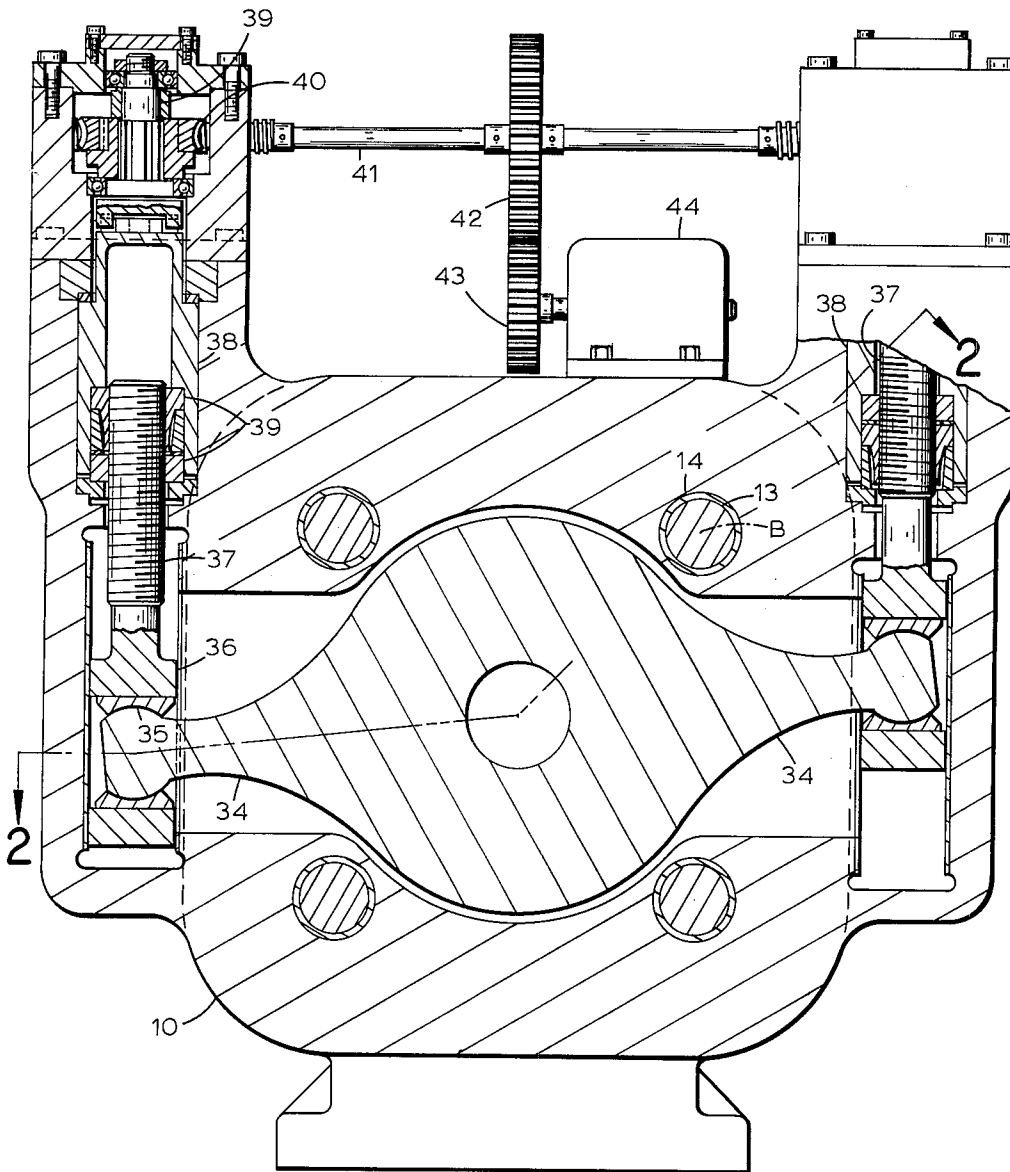


Fig. 1

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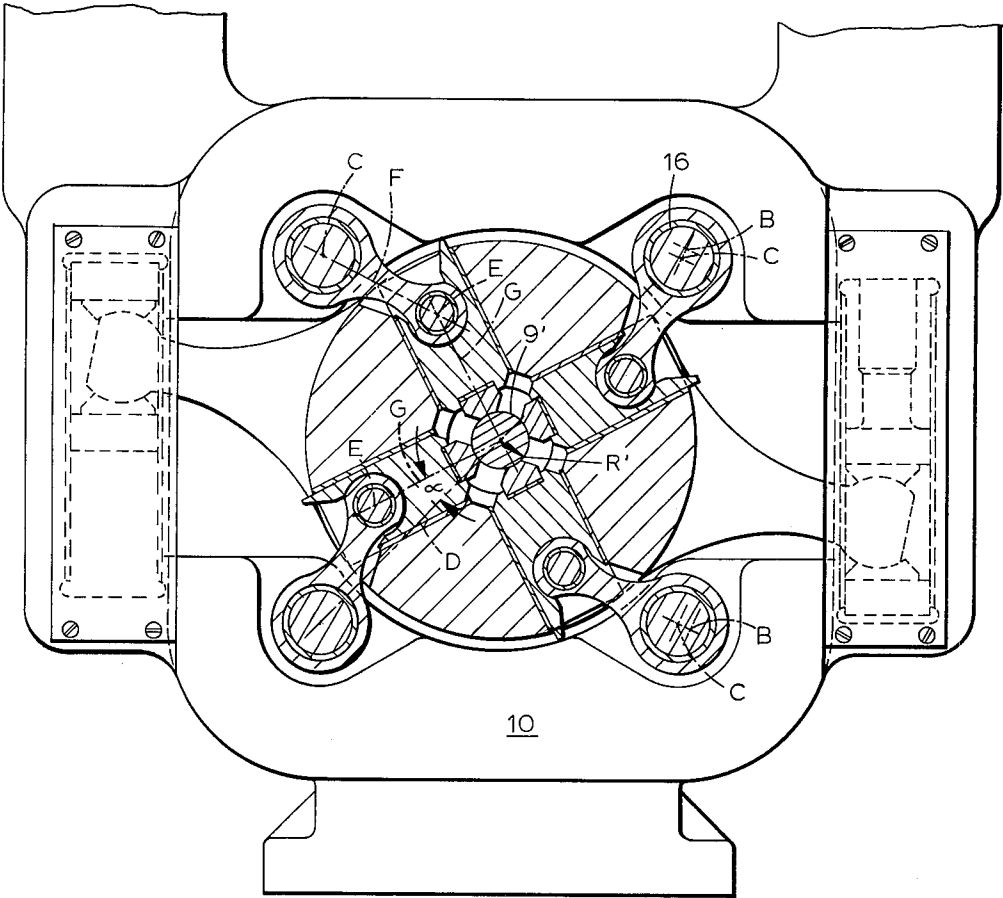


Fig. 4

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SWAGING MACHINE WITH ADJUSTABLE STROKE

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3 Claims. (Cl. 72-402)

The present invention relates to a swaging machine and, more particularly, to the adjustment of the stroke of the hammers in a swaging machine.

In a typical swaging machine, a rotating workpiece is fed along an axis into an operating zone. A plurality of pulsating hammers, angularly spaced around the workpiece and reciprocating in a radial direction with respect to that axis, impinge in unison upon the workpiece in the operating zone to form the workpiece. Each hammer (which usually comprises a block having a die connected to its inner end) may, for example, be driven by a crankshaft mounted outboard of the hammer and extending parallel to the axis of the workpiece. The cross-sectional size of the finished workpiece is determined by the distance of the extreme inner limit of movement of the die face from the workpiece axis. It is usually desirable that the inner limit of movement of the die face be adjustable with respect to the workpiece axis so that workpieces of different size can be formed.

In one method used heretofore to effect adjustment of the die stroke, a wedge is interposed between the driving member (such as a crankshaft) and the die for adjusting the distance between the crankshaft (which is mounted in the machine a fixed distance from the workpiece axis) and the die. The wedge, however, precludes a continuous positive mechanical connection between the driving member and the die and introduces undesirable vibration, particularly at high speeds.

In another method used heretofore to effect adjustment of the die stroke, each driving member (such as a crankshaft) is adjustable radially with respect to the axis of the workpiece. This construction, however, complicates the problem of applying power to the crankshafts.

In the usual swaging machine having means to adjust the stroke of the dies, as in the two types of machine described above, a member (such as the wedge or the crankshaft) must be adjusted to effect adjustment of each die. These members must be adjusted a like amount, since each die must be adjusted the same amount as every other die with respect to the workpiece axis. To facilitate this difficult task, mechanism is provided to coordinate the adjustment of all these members. It will be appreciated that the uniformity of adjustment of the dies will depend to a large extent on the precision of this coordinating mechanism.

In the present invention, each hammer is pivotally connected to a drive rod and the stroke of the hammer is adjusted by altering the alignment of drive rod and hammer. In the preferred form of the invention, a plurality of crankshafts are fixed in the machine, angularly spaced around the workpiece axis and at equal distances from said axis. The outer ends of the drive rods are mounted, respectively, on the crankshafts to orbit in fixed circles and the inner ends of the drive rods are pivotally connected to hammers. A guide block surrounds the workpiece axis and has a plurality of ways, radial with respect

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to the workpiece axis, which respectively receive the hammers. The hammers, each of which carries a die at its inner end, therefore reciprocate radially in the respective ways for impingement on a workpiece. The guide block, however, is angularly adjustable about the workpiece axis and it is the angular adjustment of the guide block which alters the alignment between the pulsating drive rods and the hammer to adjust the stroke of the hammers. This adjustment of the hammer strokes changes the inner limit of movement of the hammers, and changes the size to which the workpiece is formed. Thus, mechanism is provided to alter the stroke of the hammers without shifting the crankshafts (which would make it difficult to drive the crankshafts, particularly at a constant speed) or without interrupting the driving connection between the crankshaft and the hammers (which would tend to increase vibration of the machine). Moreover, with angular adjustment of a single member (the guide block) the stroke of all hammers is adjusted a like amount.

It is therefore one object of the present invention to provide, in a swaging machine, improved mechanism for adjusting the stroke of the hammers. It is another object of the present invention to provide mechanism for altering the stroke of a die hammer in a swaging machine without adjustment of, or interruption of, the driving mechanism. It is yet another object of the present invention to provide mechanism for adjustment of the strokes of a plurality of hammers in a swaging machine a like amount by adjustment of a single guide member.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification, considered in conjunction with the accompanying drawings forming a part thereof, and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

FIG. 1 is a view in cross-section of the head of a swaging machine, the plane of cross-section being indicated by line 1—1 of FIG. 2;

FIG. 2 is a view taken on the line 2—2 of FIG. 1;

FIG. 3 is a view taken on the line 3—3 of FIG. 2; and

FIG. 4 is a view similar to the view of FIG. 3 except showing the guide block in a different angular position.

There is shown in FIG. 1 the head of a swaging machine having a frame 10 with a front opening 11 and a rear opening 12 (see FIG. 2), the openings being located on a longitudinal axis A on which a rotating workpiece 9 is received in the head for an operation thereon in an operating zone 7. Any conventional means may be used to feed a workpiece, as indicated by arrow 8, along axis A into the head and rotate the workpiece during the operation thereon. Four crankshafts 13 are journaled in bushings 14 and 15 in the frame, parallel to axis A and equally angularly spaced (90 degrees apart) around axis A. Each crankshaft rotates about a fixed axis B (which axes are all equally spaced a fixed distance from axis A) and each has a crank portion 16 with a central axis C.

A drive sleeve 17, journaled in bushings 18 and 19 in the frame, extends through opening 12. Drive sleeve 17 has a pulley 20 secured thereon outside the frame and a gear 21 secured thereon inside the frame. Each crankshaft has a gear 22 secured thereon, and gear 21 is continuously engaged with all four gears 22. When pulley

20 is driven by a motor (not shown) through belts 23, all four crankshafts are driven in unison. As the crankshafts rotate, the central axes C of crank portions 16 orbit about axis A. All the crankshafts are connected to the drive sleeve (through gears 21 and 22) so that the crankshafts 5 reach the inner limit of their orbit at the same time, as shown in FIG. 3). Each crankshaft has a flywheel 13a secured thereon.

Each crank portion 16 has a bushing 24 on which the outer end of a drive rod 25 is received. The inner end of each drive rod 25 seats in a socket 26 at the outer end of a block 27 and is pivotally connected to the block, on a pivot axis E, by pin 28. The inner end of each block has a die 29 connected thereto, the block 27 15 and die 29 defining a hammer 50 for impingement on a workpiece in the operating zone 7.

A guide block 30, having an opening 31 on axis A extending therethrough, is journaled in bushings 32 and 33 in the frame. The guide block 30 has two diametrically opposite arms 34 extending therefrom, the outer ends of which are pivotally received in sockets 35 of slide blocks 36. Each slide block 36 is received in the frame 10, one on each side of guide block 30, for vertical movement therein, and each has a threaded stud 37 extending upwardly therefrom. A sleeve 38 is journaled in the frame 10 above each slide block, and each sleeve has nuts 39 secured therein which are engaged with stud 37. Each sleeve 38 is coupled to a stub shaft 39 journaled in the frame. The shafts 39 each has a worm wheel 40 secured thereon driven by a worm shaft 41 which, in turn, is driven through gears 42 and 43 by a motor 44. Thus the sleeves 38 are rotated in unison by the motor 44 to rotate the nuts therein. The threads on the two studs 37 are of opposite hand so that as one slide block is raised by rotation of the nuts 39 in one of the sleeves 38, the other slide block is lowered. By operation of the motor 44, the slide block 30 can be angularly adjusted from one extreme angular position as shown in FIGS. 1 and 3, to the opposite extreme angular position, shown in FIG. 4.

The guide block 30 has four straight guide ways 45, each extending radially with respect to the axis A on which the workpiece is received. The ways 45 are equally angularly spaced (90 degrees apart) and each slidably receives one of the hammers 50. When the guide block 30 is in its extreme counter-clockwise angular position as shown in FIG. 3, each guide way is parallel to, and centered with respect to, a straight line D extending between workpiece axis A and crankshaft axis B. As the crankshafts rotate, and axes C of the crank portions 16 orbit about axes B, the upper end of the drive rods also orbit. The lower ends of the drive rods, pivotally connected at axis E to the hammers (which are constrained to move only in ways 45), reciprocate on line D and cause the die faces to reciprocate between an extreme outer limit of movement, indicated at 46, and an extreme inner limit of movement, indicated at 47. Since all crankshafts are synchronized, all dies impinge on the workpiece 9 in unison and all reach their inner limit of movement simultaneously. As can be seen from FIG. 3, the inner limit of movement of the dies determines the radius R of the workpiece formed. With the die block in the angular position shown in FIG. 3, each drive rod 25 and the hammer pivotally connected thereto are aligned on line D when the hammer is at its inner limit of movement as shown. Since the outer end of each drive rod 25 orbits (with axis C) and the inner end thereof reciprocates (with the hammer) along the line D, the alignment between the hammer and drive rod continuously changes through a small range. When the die block 30 is in the position shown in FIG. 3, the central axis F of the drive rod (the straight line between axis C and axis E) swings an equal amount around axis E on 75

both sides of the line D. Thus, the mean position of axis F is colinear with line D and colinear with a line G (between axis E and axis A) representing the path of the hammer. The continuous change of the instantaneous alignment between drive rod and hammer stemming from the use of a rotating crank to pulsate the hammers does not determine the size of a workpiece formed since it is only at one instant in each rotation of the crank (shown in FIG. 3) when the die is at its inner limit of movement.

To form a workpiece of a radius larger than R, the die block 30 is angularly shifted clockwise from the position shown in FIG. 3. At its extreme limit of clockwise angular adjustment, the die block will be in the angular position shown in FIG. 4. With this adjustment the guide ways are inclined at an angle α from the line D extending between the axes A and B, and the pivot axis E at the connection between the drive rod and the hammer is always spaced from the line D. Consequently, the stroke of the hammers is shorter and the inner limit of the movement of the dies is farther from the axis A. Thus, with this adjustment, the radius R' of the workpiece 9' formed is larger than the radius R of workpiece 9. This selective change of alignment, unlike the instantaneous change of alignment resulting solely from the use of a crank to pulsate the hammers, changes the mean position of the line F (shown in FIG. 4) with respect to the line G and, in this manner, changes the inner limit of the movement of the hammer to affect the size of the workpiece to be formed.

Thus, in the mechanism disclosed, there is no interruption or adjustment of the drive train defined by pulley 20, sleeve 17, gears 21, 22, crankshaft 13, 16, drive rod 25, hammer block 27, and die 29. Instead, adjustment of the stroke of the hammers is achieved solely by adjustment of a guide member 30, and adjustment of this single member serves to adjust the stroke of all hammers exactly the same amount.

What is claimed is:

1. In a swaging machine having an operating zone in which a workpiece is received on an axis,
 - (a) a frame,
 - (b) a plurality of crankshafts mounted in the frame parallel to said axis and angularly spaced around said axis,
 - (c) a drive rod connected to each of said crankshafts,
 - (d) a hammer pivotally connected to each drive rod for reciprocation thereby,
 - (e) a guide block mounted in said frame and surrounding said axis, said guide block adjustable about said axis and having angularly spaced straight radial ways to receive, respectively, said hammers,
 - (f) and means to effect angular adjustment of said guide block from an angular position in which said radial ways are in line with the crankshafts and said axis to shorten the stroke of said hammers.
2. In a swaging machine having an operating zone in which a workpiece is received on an axis,
 - (a) a frame,
 - (b) a plurality of crankshafts mounted in the frame parallel to said axis and angularly spaced around said axis,
 - (c) a drive rod connected to each of said crankshafts,
 - (d) a hammer pivotally connected to each drive rod for reciprocation thereby,
 - (e) a guide block mounted in said frame and surrounding said axis, said guide block angularly adjustable about said axis and having angularly spaced straight radial ways to receive, respectively, said hammers, said guide block having an arm extending therefrom,
 - (f) and a slide block slidably received in said frame and pivotally connected to said arm for angular adjustment of said guide block.

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3. In a swaging machine having an operating zone in which a workpiece is received on an axis,

- (a) a frame,
- (b) a guide block having radial ways extending radially with respect to said axis, 5
- (c) a plurality of hammers slidably received, respectively, in said ways,
- (d) a drive rod extending from the frame and pivotally connected to each hammer, 10
- (e) means to effect relative angular rotation between the frame and the guide block to alter the alignment of the ways with respect to the drive rods for like adjustment of the strokes of the hammers, and

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(f) means to reciprocate the drive rods in any angular relationship between the frame and guide block.

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