1. 3,138,978 AUTOMATIC DIE PRESS
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Filed May 29, 1962, Ser. No. 198,499
Claims priority, application Germany June 13, 1961
3 Claims. (Cl. 79—59)

Our invention relates to automatic die presses which comprise ram means cooperating with a plurality of forging dies in which metal slugs are successively forged to a desired final shape, in known presses of that type ejector means at least partially lift the slugs from the dies after each pressing stroke of the ram and transfer means move the slugs from the die to die between said succeeding forging operations.

Known automatic die presses of said type have common driving means for the press ram and for the said transfer means. This is very disadvantageous because the slug transfer operation is dynamically and mechanically quite complicated and requires a relatively long time whereas the proper pressing operation is much simpler and can in fact be effected quickly to allow the pressing tools to remain in contact with the hot slugs for only the shortest possible time and thus prevent overheating of and damage to the tools and the resulting necessity for repeated replacements thereof.

To evade said disadvantage our new automatic die press comprises separate and independent driving means for the press ram and for the said slug transfer means and it includes first control means actuated by the ram or its driving means arresting the ram after each pressing stroke and second control means actuated by the slug transfer means or their driving means for automatically reactivating the press ram after the completion of each slug transfer operation. This improvement permits to operate the press ram with a speed which is independent of the time required for the necessarily slower transfer operation. Additionally the said independent driving means permit to incorporate into the driving means for the transfer means a safety clutch to serve as protection against any overload caused for example by slugs occasionally sticking in their die.

The said and other objects of our invention will be more fully understood from the following specification when read with the accompanying drawing in which one embodiment of our new automatic die press is illustrated.

In the drawing:
FIG. 1 shows a somewhat diagrammatic longitudinal sectional view of the automatic die press,
FIG. 2 a similarly more or less diagrammatic cross sectional view thereof, and
FIG. 3 a kinematic diagram illustrating the operation of the die press.

The automatic die press shown in FIGS. 1 and 2 comprises a machine frame 11 guiding a vertically reciprocable ram 13 which is provided with a plurality of equally spaced punches 12, for example three punches 12a, 12b, 12c, and is actuated by a pitman 14 and crank shaft 15. This crank shaft is rotated by a not shown motor over the electrically controlled clutch 16. A control disk 17 keyed to the opposite end of said shaft 15 is provided with a trip cam 18 which actuates an electrical switch 19 causing a periodic disengagement of the clutch 16 after each complete turn of shaft 15. A periodic reengagement of said clutch 16 is effected by the electrical switch 47 which is actuated by the trip cam 46 described in detail hereinafter. The electric means are schematically indicated by the switch box 19 and the wirings 19' and 47'.

Each of the said punches 12a, 12b, 12c cooperates with one of the dies 20a, 20b, 20c, which are mounted in the machine frame and in which slugs are successively forged. After each forging operation the slugs are at least partially lifted from their respective die by push rods 21 or similar lifting means and thereafter each lifted slug is seized by one pair of a plurality of laterally engaging gripping jaws 22 and horizontally transferred by one spacing of the die. The preheated raw slugs are individually fed in known manner for example by a not shown feed chain to a receiving platform 50; there each slug is seized by a first pair gripping jaws 22 and horizontally transferred into the first die 20a; after being partially forged therein and lifted therefrom the slug is seized by a second pair of gripping jaws 22a and horizontally transferred into the second die 20b; again, after being further forged therein and lifted therefrom the slug is seized by a third pair of gripping jaws 22b and horizontally transferred into the third die 20c; and after being finally forged therein and lifted therefrom the slug is seized by a last pair of gripping jaws 22 and horizontally transferred upon a receiving platform 51 from which it is carried off by conventional means such as a not shown transportation chain. It will be well understood that the said pairs of gripping jaws operate concomitantly and that the preheated slugs may be fed into the first die and the finally forged slugs removed from the last die in any of different known manners.

The vertically guided push rods 21 are at their lower ends connected to an up and down moving horizontal beam or other support 23. This up and down movement is effected by crank arms 26 keyed upon shaft 27 and by the slotted levers 24 and link members 25. The two shafts 27 are operatively connected and synchronized by the cross shaft 28 and the bevel gears 28'. One of the shafts 27, namely the one shown in FIG. 2, serves as the principal driving shaft and is continuously propelled by a not shown motor; an interposed friction clutch 29 serves as protection against overloading.

The gripping jaws 22 are elastically mounted on a pair of transfer members such as beams 30 each of which is elastically guided for up and down displacement by guide rods 34 fixedly attached to saddles 32. These saddles are slidably resting upon benches or similar supports 33 and are concurrently displaceable against and from each other as indicated by the associated arrows 30 shown in FIG. 2 to effect the gripping and releasing action of the jaws 22. This displacement is effected by multi-armed levers 34 pivoted at 35 in said supports 33; said levers 34 are loaded by spring 36 and prop with rollers 37 against stationary face cams 38.

The supports 33 are displaceable in vertical and horizontal direction by rocker arms 39. These rocker arms are pivoted in sliding blocks 41 which reciprocate between guide means 42 swivelingly mounted upon the machine frame and are actuated by crank arms 40 keyed upon shaft 27.

It will be understood that as supports 33 move in a vertical direction the cams 38 force rollers 37 in a direc-
tion away from each other, and the side arms engaging spring 36 will be rotated to point in a downward direction. In this position spring 36 will bias the levers 34 to rotate the same and close the jaws 22 on the workpiece for transfer. After such transfer has been completed the levers 34 are again pivoted by an adjacent set of cams 43 and jaws 22 will be held open by the bias of spring 35.

The said rocker arms 39 impart to the bench members 33 in addition to their above mentioned displacement in vertical direction a reciprocating horizontal movement which is limited by the shoulders 43. To allow the said rocker arms 39 the kinematically required freedom of movement relative to the bench members 33 they engage the latter over interposed pressure springs 44.

The shaft 27 drives over bevel gearing 27 the above mentioned control disk 45 provided with a trip cam 46 which actuates an electrical switch 47 causing a periodic reengagement of the clutch 16 with the crank shaft 15.

The operation of our new die press may be best described with reference to the kinematic diagram of FIG. 3, showing the closed approximately beanshaped trajectory k followed by the driving end of rocker arms 39 which impart to the bench members 33 the above indicated composite motion. The following legend lists the meaning of the reference characters appearing in FIG. 3:

- **a**—amplitude of rocker 39
- **b**—operative movement of the reciprocating transfer means
- **c**—inoperative return movement of the reciprocating transfer means
- **d**—compression of springs 44 after the lateral movement of bench members 33 has been arrested by shoulders 43
- **e**—pressing and return stroke of ram 13
- **f**—clutch 16 is engaged by switch 47 to start the operation of ram 13
- **g**—clutch 16 is disengaged by switch 19 to stop the operation of ram 13
- **h**—closing movement of jaws 22 and seizure of slugs proceddingly lifted from the dies by push rods 11
- **i**—lifting of the transfer means and the jaws with the seized slugs
- **j**—forward movement of the transfer means and the seized slugs by one spacing of the dies
- **k**—lowering of transfer means and the jaws with the still seized slugs
- **l**—opening of jaws and releasing of slugs

Let this description start at point A of trajectory k. Shortly before this point has been reached namely at point H, the punches 12 have completed a pressing operation within the respective dies 20 and have been withdrawn therefrom by the push rods 21. The said push rods 21 have lifted the operated on slugs from the dies. The clutch 16 has been disengaged by the cam means 17, 18 actuating the switch 19 and the ram 13 is arrested in its uppermost position while the uninterruptedly driven shaft 27 continues to rotate. In this position, as illustrated in FIG. 1, the left bench member 33 contacts with its right flank the shoulder 43 and the two, namely the said left and the right members 33 which are coupled by the transfer beam 30, terminate their horizontal return movement r to start a straight upward movement from A to B and to C. During the upward movement from A to B the saddles 32 and the transfer beams 30, which are slidably mounted on guide rods 31 and therefore will not follow said upward movement, approach each other as explained above and the jaws 22 are caused to grip the slugs which meanwhile have been lifted from their respective dies by the push rods 21. When the gripping action is completed at B the rising bench members 33 contact the transfer beams 30 and start to lift the same and the operating jaws mounted thereupon together with the gripped slugs, so that the slugs will be completely removed from the dies in which they were previously operated on. This lifting movement is completed at C and the transfer beams 30 with the operating jaws and the slugs held therein move thereafter to the left along the trajectory section C-D by the spacing of the dies so that each slug gripped and lifted from one die is transferred to above the next following die at D. At this moment the right bench member 33 was stopped in its horizontal movement by the right shoulder 43 and the two bench members 33 continue to move vertically downward as indicated by the line D–E–F. The downward movement of the transfer beams 30 is terminated at E at which point the bench members 33 disengage from said beams and continue to move downward from E to F causing the said beam 30 and thus also the transfer beam 30 to move away from each other whereby the jaws 22 are opened and the temporarily held slugs released into the next following dies. At this moment F the bench members 33 and the transfer beams 30 start their return movement r to the starting position at A.

At point G the trip cam 46 actuates the switch 47 which reengages the clutch 16 to the shaft 15. The shaft 15 is allowed to make an at least approximately full turn to effect a press stroke of ram 13 causing the punches 12, b, c, to forge the slugs within the respective dies 20, b, c. Before the shaft 15 completed said turn, the trip cam 18 operates the switch 19 which disengages the clutch 16 and thereby arrests the press ram 13 in its uppermost position shown in FIG. 1 of the punches 12.

While specific embodiments of our invention have been shown and described in detail to illustrate the application of the principles of our invention, it will be well understood that the same may be otherwise embodied without departing from such principles and without avoiding the scope of our appended claims.

What we claim as our invention is:

1. In an automatic die press including a reciprocating press ram provided with a plurality of aligned and equally spaced punches, and the same plurality of dies in operative relation thereto, the improvement comprising in combination:
   - (a) first driving means reciprocating said ram;
   - (b) lifting means for at least partially raising slugs from said dies after each pressing stroke of said ram;
   - (c) transfer means reciprocable above said dies in the direction of their alignment, said transfer means adapted to seize slugs lifted from the dies and to transfer the same in a forward movement to the next following die;
   - (d) second driving means for said reciprocating transfer means and said lifting means, said second and said first driving means being independent of each other;
   - (e) first control means actuated by said first driving means to arrest the press ram in its inoperative position after each return stroke following a pressing stroke, and
   - (f) second control means actuated by said second driving means to reactivate said first driving means not sooner than at the start of the return movement of the transfer means.

2. An automatic die press according to claim 1 comprising:
   - (a) an electrically controlled clutch within the first driving means;
   - (b) first cam means operated by said first driving means;
   - (c) a first electric switch actuated by said first cam means for disengaging the said clutch after each re-
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5 turn stroke of the ram following its pressing stroke; (d) second cam means operated by said second driving means; and (e) a second electric switch actuated by said second cam means for reengaging said clutch not sooner than at the start of the return movement of the transfer means.

3. An automatic die press according to claim 1 comprising a safety clutch incorporated into said second driving means.

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