United States Patent [19]

Blase

[11] **3,862,564**

[45] **Jan. 28, 1975**

[54] **MACHINE PRESS WITH POSITIVE CAM DRIVEN SLIDING BED AND CAM ACTIVATED AUXILIARY SYSTEMS**

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[22] Filed: **Nov. 20, 1973**

[21] Appl. No.: **417,579**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 301,165, Oct. 26, 1972, abandoned.

[52] **U.S. Cl.** **72/405,** 72/4, 72/421

[51] **Int. Cl.** **B21j 13/08**

[58] **Field of Search** ..... 72/405, 421, 448, 452, 72/4, 26; 10/12.5, 12 T, 76 T; 198/218

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Attorney, Agent, or Firm—Mattern, Ware & Davis

[57] **ABSTRACT**

A machine press is disclosed having a base and vertical supports upstanding therefrom, a motor-driven crankshaft rotatably mounted in the vertical supports, and a ram mounted for vertical sliding movement driven by a connecting rod interconnecting the crankshaft and the ram. A bed is mounted for horizontal sliding movement under the ram, and is driven by a cam engaging two cam followers upstanding from the bed. The cam is connected to a shaft which is driven from the crankshaft through two-to-one reduction bevel gears. The cam is symmetrical, and provides two zero velocity positions of the bed coordinated with the lowermost position of the ram. Die sets comprising a plurality of stepped-height dies arrayed parallel to the motion of the sliding bed are mounted in the machine press; the lower half of the die set being mounted on the sliding bed, and the upper half being mounted on the ram. The dies come together for a stamping operation when the bed is at a first zero velocity position, and the dies are indexed one die for transfer operations when the bed is at its second zero velocity position. Additional cams are mounted on the second shaft, and these cams operate sensors controlling auxiliary devices, such as parts ejectors and missing parts detectors.

14 Claims, 9 Drawing Figures

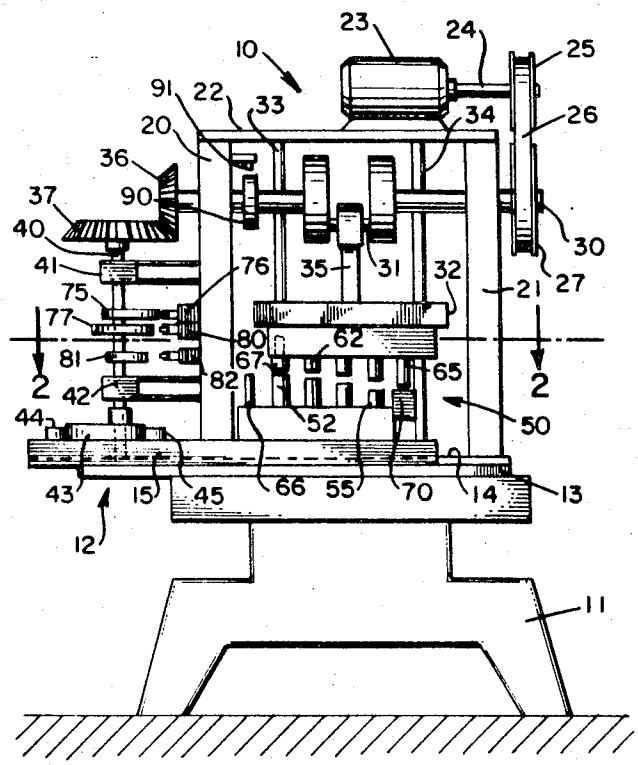


FIG. 1

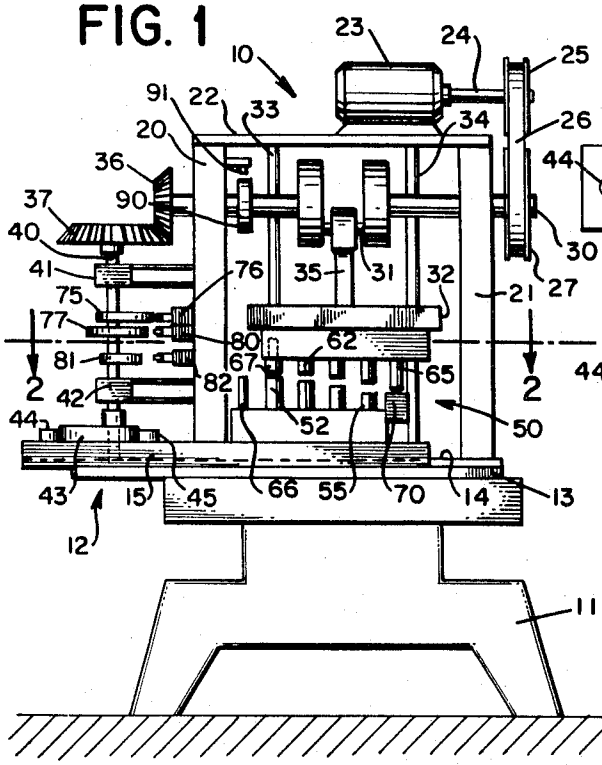


FIG. 2

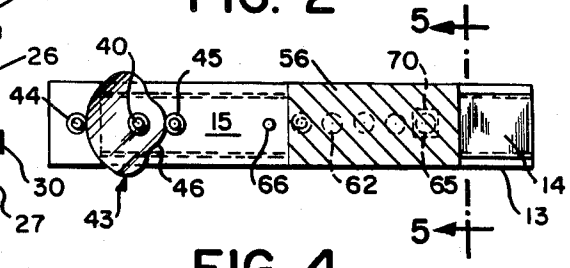


FIG. 4

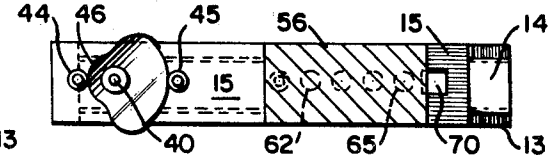


FIG. 3

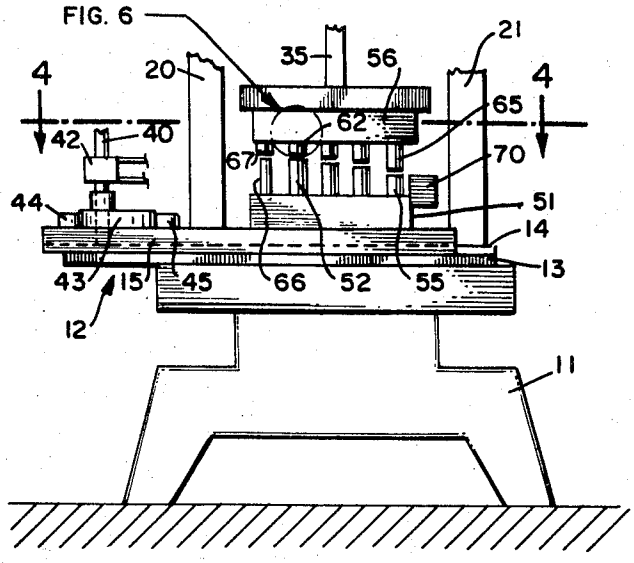


FIG. 5

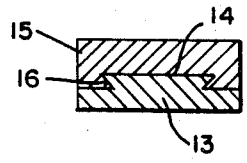


FIG. 6

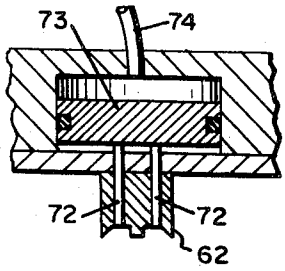


FIG. 7

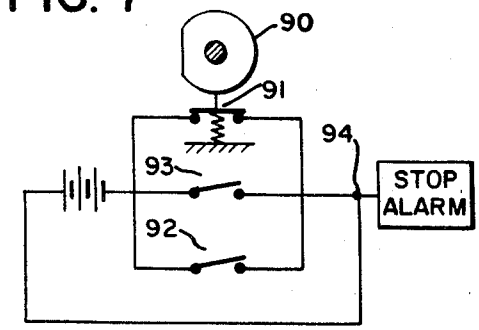


FIG. 8

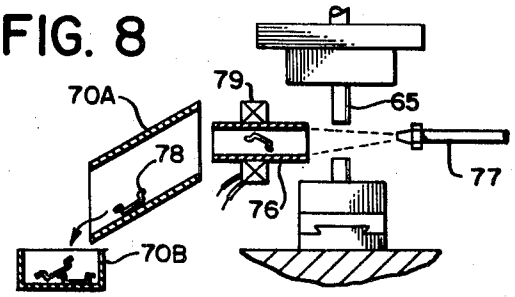
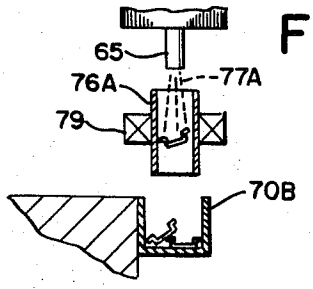


FIG. 9



MACHINE PRESS WITH POSITIVE CAM DRIVEN SLIDING BED AND CAM ACTIVATED AUXILIARY SYSTEMS

CROSS-REFERENCE

This application is a continuation-in-part application of Robert Blase's patent application relating to Machine Press with Positive Cam Driven Sliding Bed and Cam Activated Auxiliary Systems filed Oct. 26, 1972 and bearing Ser. No. 301,165, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to machine presses, and particularly to machine presses with sliding beds for performing transfer operations. The invention further relates to machine presses having sliding beds positively driven by cams wherein the sliding beds are accurately positioned and wherein ejectors, missing parts detectors, and the like are also positively actuated by cams.

2. Prior Art

Machine presses having a bed slidable under a vertically driven press member are known in the prior art. However, the prior art presses have employed various compressed air or pneumatic means for driving the bed. Typically, mechanical stops determine the position of the bed, and complicated series of relays controlling the supply of compressed air were used to drive the bed. Similarly, accessories such as ejectors were also electric-air driven, being operated by compressed air passed through a series of air relays which were in turn controlled by mechanical sensors for sensing the position of the bed and ram.

These devices were unsatisfactory in many respects. First, the positioning of the sliding bed was not precise. Also, most of the presses having beds driven by compressed air exhibited a high amount of vibration. The vibration contributed to inaccuracy and also shortened the life of the dies and the slide mechanism on which the bed was mounted.

In addition, the relays required to drive a sliding bed were extremely complicated, and required frequent repair. The repairs themselves were expensive, and also resulted in considerable down time and consequent loss of production.

SUMMARY OF THE INVENTION

OBJECTS

It is an object of this invention to provide improved machine presses having sliding beds.

It is a second object of this invention to provide machine presses having reliably and efficiently driven auxiliary devices.

It is an additional object of the invention to provide machine presses of the type having sliding beds wherein the sliding beds are accurately positioned for press operation.

It is an additional object of the invention to provide machine presses suitable for producing precision parts.

It is a further object of the invention to provide machine presses which are highly reliable and durable.

GENERAL DESCRIPTION

A machine press according to the invention herein comprises a weighted ram carrying the upper portion of a die set. The ram is mounted for sliding vertical motion and driven by a connecting rod having one end attached to an overhead motorized crankshaft. A bed is mounted for sliding horizontal motion below the ram, and the second portion of the die set is carried on the sliding bed.

The sliding bed is connected to and driven from the crankshaft by a positive mechanical link comprising a shaft driven by the crankshaft through 2:1 gearing, a cam connected to the shaft and positioned adjacent to the sliding bed, and cam followers attached to the sliding bed and engaging the cam. The cam used to drive the bed provides a modified sinusoidal variation of velocity and acceleration wherein the bed is stationary at the time of contact between the two die sets and when the die sets are in close aligned proximity for transfer operations.

Additional cams are mounted on the crankshaft and shaft, and are used to actuate auxiliary devices including parts ejectors, bed position monitors, missing parts detectors, operator safety restraints or operator position sensors, or the like.

Other and more specific objects will be apparent from the features, elements, combinations and operating procedures disclosed in the following description of the preferred embodiment and shown in the drawings.

THE DRAWINGS

FIG. **1** is a front view of a machine press according to the invention with its die set aligned for a transfer operation;

FIG. **2** is a sectional view of the cam, sliding bed, and relative positions of the dies of the machine press taken along the lines **2—2** of FIG. **1**;

FIG. **3** is a front view partially cut away of the machine press of FIG. **1** with its die sets aligned for forming;

FIG. **4** is a sectional view of the cam, sliding bed, and relative positions of the dies of the machine press taken along the lines **4—4** of FIG. **3**;

FIG. **5** is a vertical sectional view of the sliding bed and its base, taken along the lines **5—5** of FIG. **2**;

FIG. **6** is an enlarged sectional view of a parts ejector mechanism encircled in FIG. **3**;

FIG. **7** is a schematic electrical diagram of a bed position monitor of the machine press of FIG. **1**;

FIG. **8** is a framentary schematic diagram of a missing parts detector of the present invention; and

FIG. **9** is a similar fragmentary schematic diagram of a modified version of the missing parts detector of FIG. **8.**

The same reference numbers refer to the same elements throughout the drawings.

PREFERRED EMBODIMENT

Referring now to FIG. **1,** there is shown a machine press **10** according to the invention. The press comprises a base **11** having a sliding bed assembly **12** mounted thereon. The sliding bed assembly comprises a first portion **13** secured to the base **11** and having a V-shaped spline **14** comprising the male portion of a dovetail upstanding therefrom. A sliding bed **15** is mounted for linear sliding motion on plate **13,** the sliding bed **15** having a groove **16** comprising the female portion of the dovetail. As best seen in FIG. **5,** the V-shaped spline **14** and the groove **16** cooperate to hold the sliding bed **15** onto the base and to permit linear motion thereof. Bearings may be provided at the interface of the groove **16** and the spline **14.**

The machine press further comprises two supports **20** and **21** upstanding from the base **11**, and a top plate **22** connecting the two vertical supports. Mounted on the top plate **22** is an electric motor or variable speed drive means **23** having an output shaft **24** and associated pulley **25**. A drive belt **26** is engaged by the pulley **25** and by a combination brake, clutch, and fly wheel **27** which is mounted onto a shaft **30** supported in bearings in the two vertical supports **20** and **21**. The shaft **30** has an offset portion **31**, wherein the shaft **30** operates as a crankshaft.

The machine press **10** further comprises a ram **32** slidingly mounted for vertical movement on vertical guides **33** and **34**. A connecting rod **35** is connected to the ram **32** at one end and is connected to the offset portion **31** of the shaft **30** at its other end, wherein the ram **32** makes one complete up-and-down stroke for each rotation of the shaft **30**.

A first bevel gear **36** is mounted on the free end of shaft **30** adjacent to vertical support **20**. The bevel gear **36** cooperates with a second bevel gear **37** to rotate a vertical shaft **40** connected to bevel gear **37**. The vertical shaft **40** is supported by two bearings **41** and **42** which are in turn supported on the vertical support **20**. A third bearing (not shown) suports the lower end of shaft **40**. The shaft **40** is connected to and rotates a cam **43**. The cam **43** is positioned adjacent to the sliding bed **15**, and upstanding from the sliding bed **15** are two cam followers **44** and **45**, wherein the sliding bed **15** is driven and accurately positioned by the cam **43**, and wherein a positive mechanical link between the sliding bed **15** and the vertical sliding ram **32** is provided.

The bevel gears **36** and **37** have a 2:1 ratio, i.e. the shaft **40** is driven at ½ the speed of the speed of the shaft **30**. The shape of cam **43**, best seen in FIGS. **2** and **4**, causes the sliding bed **15** to be driven through one in-and-out cycle for each rotation of shaft **40**. The surface of cam **43** has a "zero speed" portion **46** wherein the surface of the cam is at a constant radius from the shaft **40**. Referring now to FIG. **2**, the zero speed protion **46** causes the sliding bed to be at rest with respect to the base at the outermost position of travel of the bed. The zero speed position of bed **15** is coordinated with the motion of ram **32** so that the lowermost portion of travel of ram **32** occurs when the bed **15** is motionless.

Referring now to FIGS. **3** and **4**, a second zero speed position of bed **15** occurs at the innermost position achieved by bed **15**. Again, the lowermost portion of vertical travel of the second downward cycle of ram **32** occurs while the bed is motionless.

A die set **50** is mounted in the machine press **10** for forming or "stamping" parts. The die set **50** comprises a lower plate **51** secured to the sliding bed **15**. Upstanding from the lower plate **51** are four individual dies **52–55** having progressively less vertical height. A second set of cooperating dies **62–65** are mounted on a plate **56** secured to the ram **32**. The dies **62–65** have progressively increasing vertical height, increment of increase being the same as the increment of decrease in height of dies **52–55**. Die sets with any number of dies can be used, and four dies are shown for convenience. The lower dies **52–55** and the upper dies **62–65** are precisely aligned for performing stamping operations when the bed **15** is in its innermost position and the ram **32** is at its lowermost position, as shown in FIGS. **3** and **4**. To better insure the precise alignment of the dies during both stamping and transfer operations, upstanding auxiliary guides such as guide **66**, are provided on the lower die set plate **51**, and mating receptacles such as receptacle **67**, are provided on the upper plate **56**.

Subsequent to stamping or forming operations, the parts are carried on the upper dies **62–65** for one up-and-down cycle of the ram **32**, during which time the bed **15** is driven to its outermost position shown in FIGS. **1** and **2**. The die **62** is then aligned with die **53**, and the like, and upper die **65** is positioned over a collection container **70**. The upper and lower dies do not touch because of the incremented vertical heights thereof. When the dies are aligned and the ram **32** is at its lowermost position, parts ejectors forming a portion of the upper die set operate to deposit the parts carried on the die set onto the lower dies, e.g. the part formed between upper die **62** and lower die **52** is deposited onto lower die **53**, whereby a further forming or stamping operation will be performed on the part between upper die **63** and lower die **53** on the next vertical cycle of the ram **32**.

Referring now to FIG. **6**, a typical parts ejector mechanism is shown at **71**. It comprises one or more vertical rods **72** passing through the upper die **62**. The vertical rods **72** butt against one end of a movable air-driven piston **73**, which is provided with air through conduit **74** connected to a source of positive pressure through valve means. Synchronization of the valve opening and the motion of the sliding bed and ram are preferably coordinated by attaching an auxiliary cam **75** to shaft **40** and attaching a mechanical finger or other mechanical sensor **76** in the path of cam **75**. The mechanical sensor **76** preferably directly operates an air valve wherein air is admitted through conduit **74** to move piston **73** and drive down the shafts **72** to eject the part. The sensor **76** can also operate an electric relay to accomplish the same purpose. Because of the reduced speed of shaft **40**, the ejector is operated only on alternate vertical strokes of ram **32**, as desired.

Other auxiliary cams can also be connected to shaft **40** for operating sensors adjacent thereto. For instance, there are shown auxiliary cams **77** and **81** (FIG. **1**) mounted on shaft **40** for operating sensors **80** and **82** each revolution of shaft **40**. Cam **77** is positioned to trigger the sensor as the ram approaches its lowermost position, and is therefore useful in cooperation with safety devices for causing a brake to operate and stop the ram if the operator's hands are not clear. The third auxiliary cam **81** attached to shaft **40** has a cooperating sensor **82** for activating a missing parts detector on each transfer stroke. The missing parts detector may be a photoelectric sensor positioned between upper die **65** and collection basket **70**, and may provide an alarm signal for stopping the press if no part is produced.

Two highly useful forms of missing parts detectors are shown in FIGS. **8** and **9**. In FIG. **8**, the completed parts container **70** is replaced by a delivery chute **70A** leading to a remote collection **70B**. A lateral delivery conduit **76** has its entrance juxtaposed to final upper die part **65** and its exit facing delivery chute **70A**. An air jet **77** propels each completed part **78** ejected from die part **65** into and through conduit **76** and thence into chute **70A**. An inductive sensor ring **79** encircles conduit **76** and is connected to a ready-or-stop control unit or stop alarm like that shown in FIG. **7**.

In the alternative version of the missing parts detector shown in FIG. **9**, the delivery chute **70A** and lateral conduit **76** are combined in a vertically-oriented conduit **76A** interposed between the overlying final die part **65** and the underlying remote collection container **70B**. Sensor ring **79** surrounds conduit **76A**, performing the identical function described above. Air jet **77** is here replaced by the force of gravity, or by a downwardly-acting air jet **77A** incorporated in upper die part **65**.

In both forms of these missing parts detectors, capacitive sensors or photocell sensors may be employed if desired, in place of inductive sensor **79**. Output signals from sensor **79**, and cycle-in-progress signals from sensor **80** or **82** for example, are both supplied to the stop alarm unit. Omission of either signal triggers the alarm which is connected to stop the press at once for inspection.

If for any reason a part is not ejected, it may cause successive stacking of a dozen or more parts between the die sets, creating danger of tooling damage or destruction. Such damage is avoided by the missing parts detectors of this invention, since the absence of a signal from sensor ring **79** during any operating cycle stops the press instantly, to permit removal of stacked or jammed parts. Human operators assigned to monitor these automatic stamping presses may become hypnotized by watching repeated operating cycles, hour after hour, and may fail to notice stacked part jams until damage has already occurred. The missing parts detector systems of this invention sense the first missing part, making these stamping presses fully automatic for long-sustained continuous operation.

Auxiliary cams can also be installed on crank shaft **30**. Such cams rotate once per revolution of shaft **30**, and twice per revolution of shaft **40**, and therefore rotate once per vertical stroke of ram **32** and once for each complete in-out cycle of sliding bed **15**.

Cam **90** is shown mounted on crank shaft **30** for operating sensor **91**. Cam **90** and sensor **91** are a portion of a bed position monitoring system which further includes right and left micro-switches (shown only in FIG. 7), the right micro-switch being closed when the bed is in its far right position and the left micro-switch being closed by the bed in its far left position. The object of the monitoring system is to provide a signal for operating the brake if the sliding bed does not operate the micro-switches at the proper time, indicating some malfunction.

Referring now to FIG. 7, the right micro-switch **92** and the left micro-switch **93** are wired in parallel with the sensor **91**. Cam **90** is preferably a holding cam, i.e. during a substantial portion of its rotation it holds sensor **91** closed and is timed to open sensor **91** just after either sensor **92** or **93** is closed by the arrival of the sliding bed and is further timed to close sensor **91** just before the movement of the sliding bed opens micro-switch **92** or **93**. Therefore, so long as the sliding bed reaches its proper position at the proper time, and so long as the shaft **30** is intact and rotating cam **90**, a signal is provided at **94**. However, if the sliding bed should fail to arrive at the proper time to close one of the micro-switches **92** or **93**, or if the shaft **30** should break or become displaced, no signal is provided at **94**, thereby activating the brake mechanism and stopping further operation of the press.

Other shapes of cam **43** may be substituted to provide various types of sliding bed motion relative to the vertical ram **32**. For instance, the bed may be caused to stop in three positions with an appropriate cam if the progression of the work pieces through the dies so requires. Also, additional auxiliary cams can be mounted on shaft **40** to run a variety of other auxiliary devices, such as counters, lubrications sprays, paint sprays, and the like.

The machine press described herein is sturdy and runs relatively free of vibration, wherein long life, low maintenance cost, and little down time can be expected. The machine press is adaptable to a variety of operations by substituting die sets, bed driving cams, auxiliary cams and sensing devices.

Since the foregoing description and drawings are merely illustrative, the scope of the invention has been broadly stated herein and it should be liberally interpreted to secure the benefit of all equivalents to which the invention is fairly entitled.

I claim:

1. A machine press comprising:

A. a base and supports upstanding therefrom;

B. a first motor-driven upper shaft rotatably mounted in the supports upstanding from the base;

C. a ram mounted for sliding movement perpendicular to the base;

D. connecting means for driving the ram from the first upper shaft;

E. a bed mounted for sliding movement on the base, said sliding movement being perpendicular to the movement of the ram;

F. a second shaft driven by the first shaft;

G. A first cam mounted on said second shaft adjacent to the bed;

H. cam followers upstanding from the bed and engaged by the first cam, wherein rotation of the second shaft and the first cam mounted thereon causes sliding movement of the bed.

2. A machine press as defined in claim **1** and further comprising:

I. at least one additional cam mounted on said second shaft; and

J. sensor means activated by said additional cam for controlling the operation of auxiliary devices.

3. A machine press as defined in claim **1** wherein the second shaft is driven by the first shaft through two-to-one reduction gears.

4. A machine press as defined in claim **3** wherein said first and second shafts are perpendicular, and wherein the reduction gears are bevel gears.

5. A machine press as defined in claim **3** wherein the first cam is symmetrical and provides a first zero velocity position of the bed when the ram is in closest proximity to the bed, and further provides a second zero velocity position of the bed when the ram is next in closest proximity to the bed.

6. A machine press as defined in claim **5** wherein the first half of a multiple-die die set is mounted on the vertical ram and the second half of the multiple-die die set is mounted on the sliding bed and wherein the dies of the first and second halves of the die set are aligned in the first zero velocity position of the bed for forming operations, and wherein some of the dies of the first and second die sets are aligned in the second zero velocity position of the bed for transfer operations.

7. A machine press as defined in claim 2 wherein one of auxiliary devices is a parts ejector.

8. A machine press as defined in claim 2 wherein one of the auxiliary devices is a missing parts detector.

9. A machine press as defined in claim 1 and further comprising:

I. at least one additional cam mounted on said first shaft; and

J. sensor means activated by said additional cam for controlling the operation of auxiliary devices.

10. A machine press as defined in claim 9 wherein one of the auxiliary devices is a bed position sensor comprising:

a. a first micro-switch operated by the bed in a first position;

b. a second micro-switch operated by the bed in a second position;

c. means connecting the first micro-switch, the second micro-switch, and the sensor means in parallel, wherein the additional cam mounted on the first shaft is designed to change the condition of the sensor means during a portion of the period when either the first or second micro-switch is operated by the sliding bed.

11. The machine press defined in claim 8 wherein the missing parts detector comprises a completed part ejection conduit positioned to receive each completed part ejected from between die parts respectively mounted on the ram and the bed, and a proximity sensor juxtaposed to the conduit and connected to produce an output signal in response to the passage of each completed part through the conduit, and a stop alarm unit connected to receive said output signals and to stop the press operation if an output signal is not generated during each press operating cycle.

12. The machine press defined in claim 11 wherein the conduit extends laterally toward a remote collection point, and further including an air jet directed to propel each ejected part into said ejection conduit.

13. The machine press defined in claim 11 wherein said ejection conduit has an entrance portal positioned directly below the ejected parts, whereby they are delivered into said portal.

14. A machine press comprising:

A. a base and supports upstanding therefrom;

B. a first motor-driven upper shaft rotatably mounted in the supports upstanding from the base;

C. a ram mounted for sliding movement perpendicular to the base;

D. connecting means for driving the ram from the first upper shaft;

E. a bed mounted for sliding movement on the base, said sliding movement being perpendicular to the movement of the ram; and

F. a missing parts detector comprising a conduit through which each completed part is ejected, and a proximity sensor associated with the conduit and providing an output signal to a stop alarm unit connected to stop press operation if a completed part sensing output signal is not transmitted during any operating cycle.

* * * * *