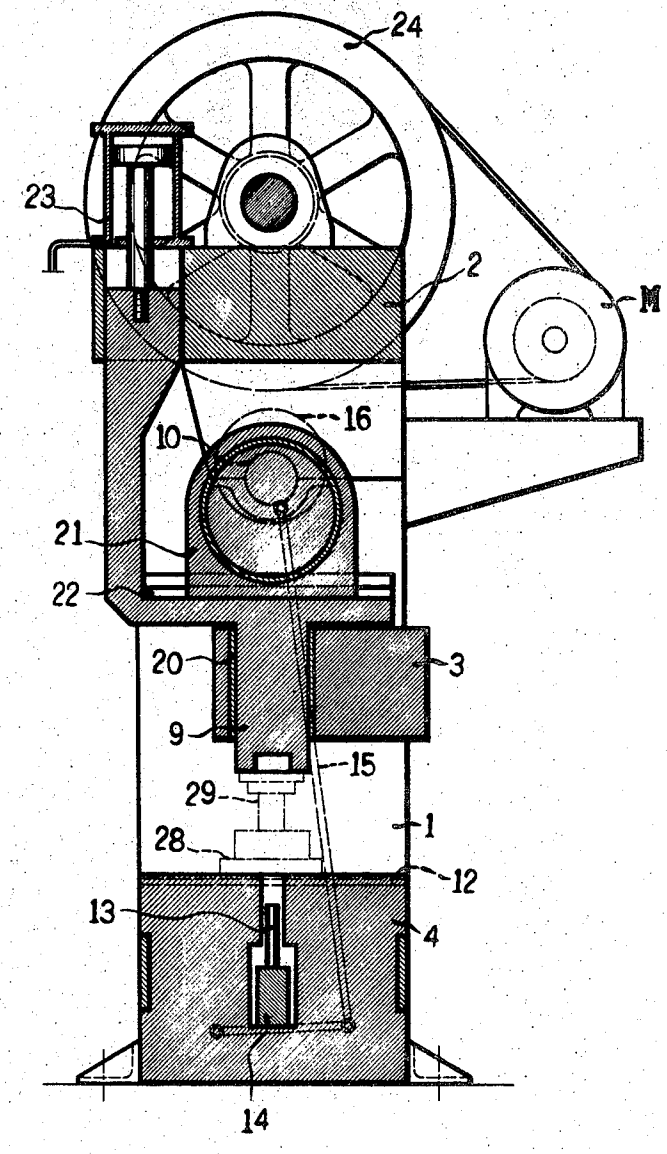
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Filed July 24, 1968 4 Sheets-Sheet 2

FIG. 2

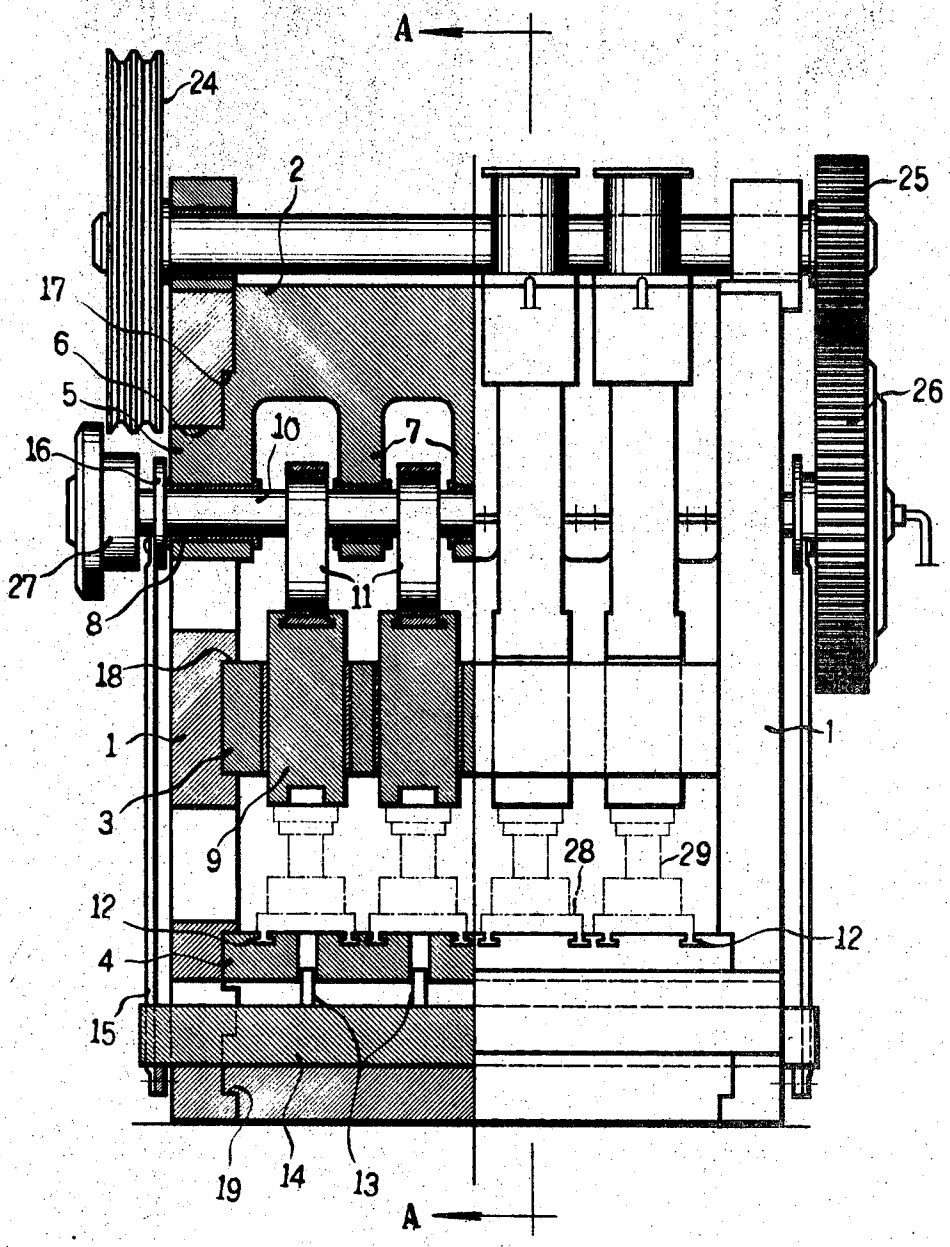


Jan. 26, 1971 TADASHI SAITO ET AL 3,557,600

TRANSFER PRESS

Filed July 24, 1968 4 Sheets-Sheet 1





Jan. 26, 1971 TADASHI SAITO ET AL 3,557,600

TRANSFER PRESS

Filed July 24, 1968 4 Sheets-Sheet 3

Fig. 3

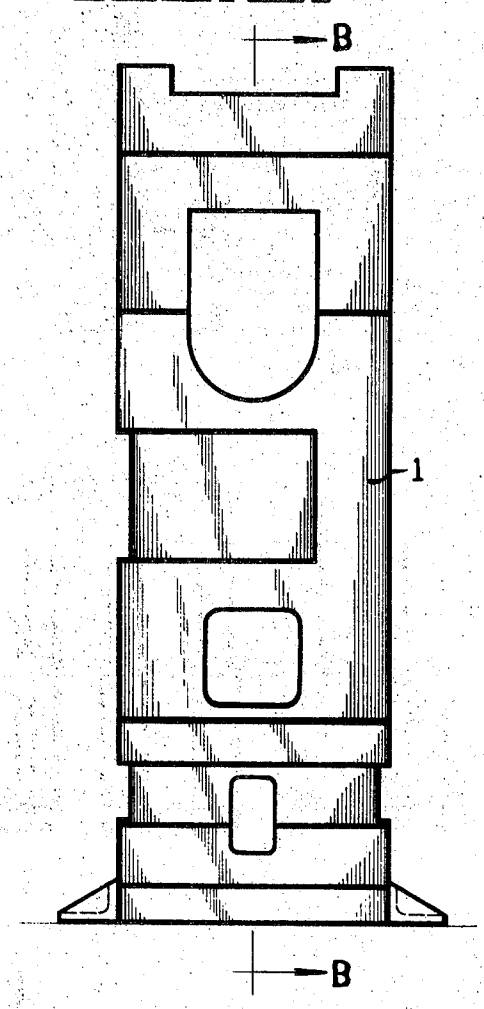


Fig. 4

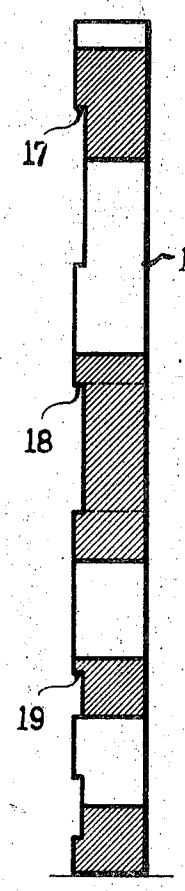


Fig. 5

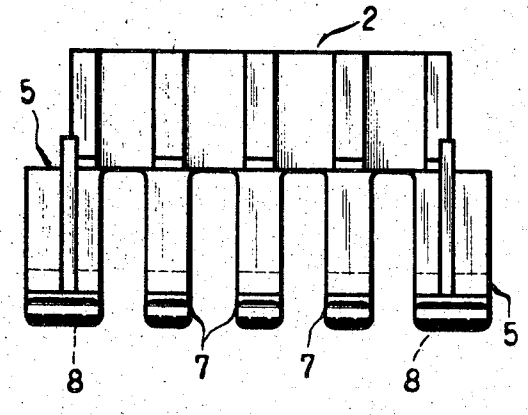
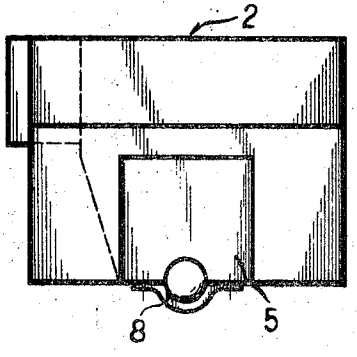


Fig. 6



Jan. 26, 1971 TADASHI SAITO ET AL 3,557,600

TRANSFER PRESS

Filed July 24, 1968 4 Sheets-Sheet 4

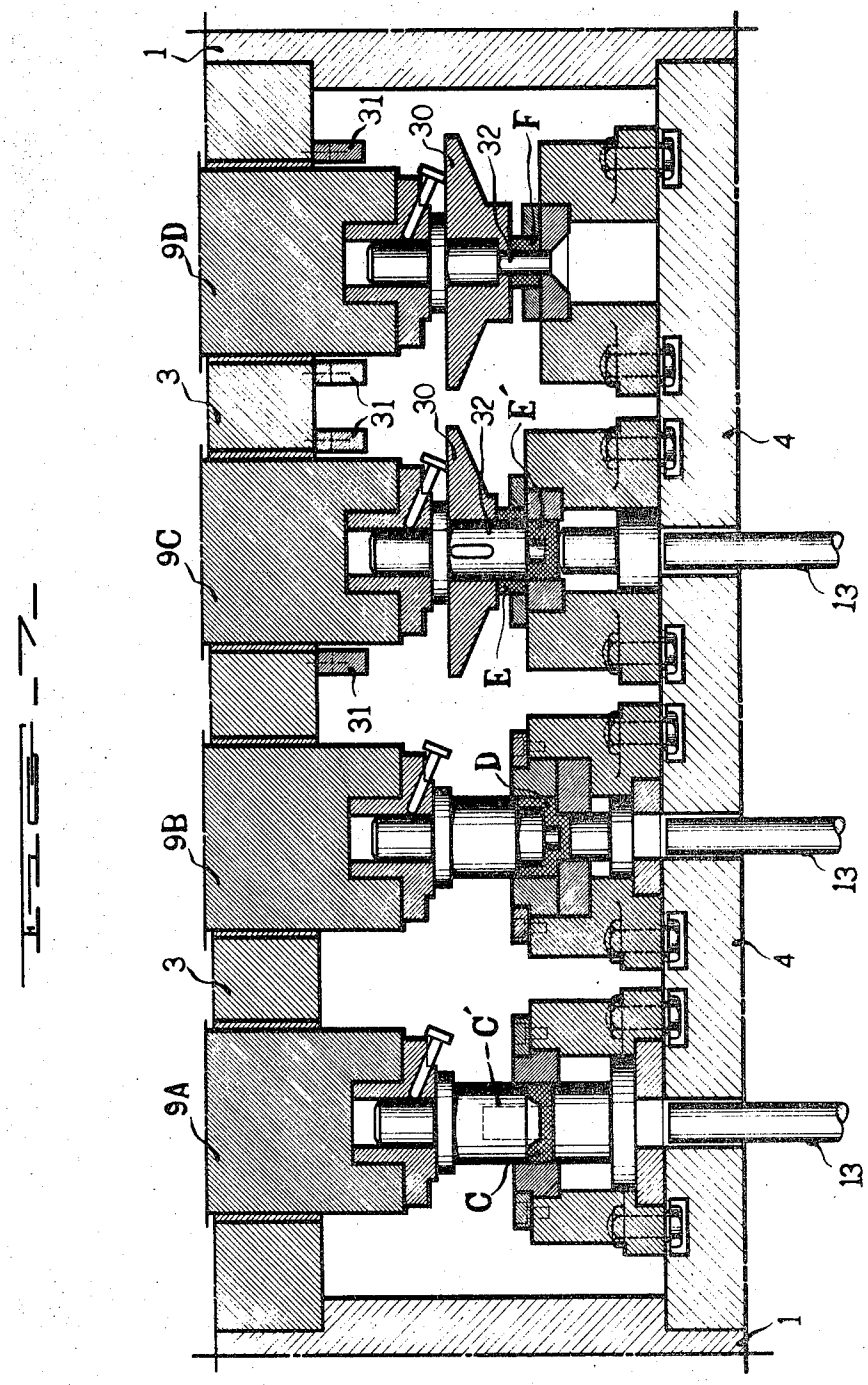


FIG. 7

United States Patent Office 3,557,600 Patented Jan. 26, 1971

3,557,600

TRANSFER PRESS

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Int. Cl. B21j 9/18
U.S. Cl. 72—404 2 Claims

ABSTRACT OF THE DISCLOSURE

A transfer press comprises a pair of spaced pillars which support a beam, ram-slide and bed. The beam supports a main shaft providing cams for moving rams and has in its lower portion a plurality of shaft supporters. The ram-slide slidably supports each of the rams in perfect independent relationship with the adjacent rams so as to prevent each ram from being subjected to objectionable influences due to the movement of the other rams.

The present invention relates to a transfer press by which several steps of pressing operation are carried out with one press.

At present, there is a tendency that the plastic working by presses is ever progressively developed because of various advantages with respect to speed of operation and economical use of material and labour. In case where a desired working operation is not completed by one heating, namely in one step, several steps of operation are generally carried out to obtain desired products. In this case, there are two methods, one employing several presses each of which performs one step, and the other in which one press is provided with dies for several steps each of which is successively driven into pressing action to accomplish the pressing operation. Either of these methods has merits and demerits of its own, and in some cases the conventional method of pressing can no longer meet the need of the modern society that every product should be provided with improved precision and quality.

In general, great pressing force is essential in presses. In order to obtain products of desired high precision, it is necessary to improve the plasticity of the material in the dies. For this purpose, substantial increase of the compressive force and uniformity in the dimensions of the products must be effected, so that there arises a necessity to step up the pressing force to such an extent that it is by far superior to the resistance created in working the material. The great pressing force is also indispensable in manufacturing products which are smooth and pleasant to the touch. The strength of the press and the pressure to be exerted thereby should, therefore, be several times as great as those of conventional apparatuses so far designed and put to use. It should also be provided with rigidity which keeps the machine free of the stress to be produced the moment the working operation is performed.

The above mentioned two methods will be studied with respect to the pressing operation comprising several steps. It will be understood that a system for carrying out several successive steps of pressing operation comprising several presses providing die for the respective steps requires a large installation cost and wide area with substantial loss involved in the transference of the materials and products, so that the manufacturing cost per product becomes inevitably great. In case of the other system in which working operation is successively performed by dies mounted on a press for several steps, a relatively large type of press must be employed which has spaced wide enough to provide a number of dies.

A press generally comprises an upper die and lower die, and the material is placed into the lower die and pressed by the upper die thereby a large pressure being exerted within the enclosed dies. It is required that the pressure applied on the material be in the range of 50 to 60 kg./mm.^{2} for hot working at a temperature of 1200° C. and in the range of 250 to 300 kg./mm.^{2} for cold working at a temperature of 5 to 20° C. In case of products having a size of 50 mm. square, the required pressing pressure ranges 125 to 150 t. in hot working at a temperature of 1200° C. and 600 to 750 t. in cold working. In case of products of a size of 100 mm. square, the pressure required is between 500 and 600 t. for hot working, between 2500 and 3000 t. for cold working.

In a press comprising a lower bed and eccentric shaft, pressing force exerted by a crank or cam mounted on a main shaft is utilized, while in a press employing a mechanism of fluid pressure such as oil pressure, a cylinder and an upper laterally supported beamlike structure apply the pressing force therebetween for the operation. Accordingly, it is required that the main shaft, beamlike structure, bed and the like above described should have rigidity and strength great enough to prevent the flexure resulting from the pressing force. However, the longer the span of the lateral shaft and beamlike structure, the smaller their strength becomes proportionally therewith. In other words, in order to provide a longer span, the press should be built in a large size structure. The manufacturing cost of a press rises substantially in proportion to the third or fourth power of the rate of increase in the length of the span. Furthermore, the pressure produced by the crank, cam or oil pressure is of a nature that it concentrates on the central point, so that when the resistance of the applied pressure is deflected off the center, the elements of the machine will be damaged and the precision will be markedly deteriorated. To solve this problem, it was conventionally contemplated that a double crank or two cylinders were installed in series, or the ram-slide was elongated, or the slide was provided across the shaft. However, these could not perfectly preclude the above mentioned defects. That is, in accordance with the conventional technique, the principle of carrying out each step by one die and one press was considered to be the best method conceivable.

An object of the present invention is to provide a transfer press which is capable of performing several steps of pressing operation by one press and which is free of the disadvantages attendant to conventional presses. In more detailed description, an object of the present invention is to provide a transfer press which has rams for respectively and independently performing several steps of pressing operations, each of the rams being adapted to perform the pressing operation in its central portion as if in a single press, without being subjected to objectionable effects such as inclination, deflection or displacement due to the movement of the other rams notwithstanding concurrently performed pressing operations, whereby several steps of pressing operation are continuously carried out in seriatim without damage being caused to the dies or the precision of the products being deteriorated.

Another important object of the present invention is to provide a novel transfer press quite compact in overall structure in which wide spaces are provided between respective dies by dispensing with pillars or the like for supporting the main shaft between each of the rams disposed in series, thereby facilitating the installation of the devices such as for feeding materials to respective dies, discharging the workpieces therefrom and delivering them therebetween, the main shaft being provided with a structure capable of satisfactorily maintaining its rigidity and strength.

Other objects and advantages of the present invention will be understood from the detailed description with reference to the accompanying drawings, in which:

FIG. 1 is a front view partly in cross section showing a transfer press in accordance with the present invention;

FIG. 2 is a view in vertical section taken along the line A—A in FIG. 1 showing the transfer press of the present invention;

FIG. 3 is a side elevation of a side pillar in the transfer press in accordance with the present invention;

FIG. 4 is a view in vertical section taken along the line B—B in FIG. 3 showing the side pillar in the transfer press of the present invention;

FIG. 5 is a front view of a beam portion in the transfer press in accordance with the present invention;

FIG. 6 is a side elevation of the beam portion; and

FIG. 7 is an enlarged view in section of principal parts showing a mode of carrying out the pressing operation in accordance with the present invention.

Referring to FIGS. 1 and 2, pillars **1** and **1** are disposed in opposite side portions of the machine and constitute the framework of the apparatus together with a beam **2**, ram-slide **3** and bed **4**. The beam **2** has in the opposite end portions thereof protrusions **5** and **5** to be fitted into the pillars **1** and **1**, whereby it is tightly inserted into lateral holes **6** and **6** in the pillars **1** and **1**, the beam thereby being adapted to withstand the resistance attributable to the pressing force of the press and complicated load such as flexure, torsion and the like. The beam **2** is also provided with a number of intermediate shaft supporters **7** . . . in the lower portion thereof, the supporters together with supporters **8** and **8** formed in the protrusions **5** and **5** supporting a main shaft **10** for moving a number of rams **9** . . . upward and downward. The main shaft **10**, in particular, is supported by the supporters, short spans thereby being defined with each of cams **11** of the main shaft **10** disposed respectively between the adjacent supporters. The main shaft is therefore prevented from flexure and bending against the pressing resistance of a plurality of rams **9** . . . to satisfactorily ensure the dimensions and precision of the products.

The rams **9** . . . are vertically slidably fitted into holes **20** formed in a ram-slide **3**. The upper surfaces of the rams are engaged through dovetail grooves **22** with cam receivers **21** movably only in rearward and forward, the cam receivers **21** being adapted to be moved by the cams of the main shaft **10**. A portion of each ram **9** extends upward and is connected with each of secondary cylinders **23** which is provided in the front portion of the beam **2**. The secondary cylinders serve to assist the vertical movement of the rams **9**.

The bed **4** has grooves **12** for mounting lower dies **28** in the upper surface thereof and internally pushers **14** providing pushing-up bars **13** for pushing up the worked products off the lower dies for discharge. By means of connecting rods **15**, the pushers **14** are operatively connected to a crank disc **16** and adapted to be actuated into upward and downward movement upon rotation of the crank disc. The bed, beam **2**, ram-slide **3** are firmly fitted into cut-out recessed portions **17**, **18** and **19** formed in the pillars **1** and **1**, the juncture being connected by such means as bolts or welding.

Now, a motor M drives, through a flywheel **24** and a small gear **25**, a large gear **26**, which further drives the main shaft **10** in operative relationship with a clutch mounted in the large gear and a brake **27** provided on the opposite side of the main shaft **10**. Through the rotation of the main shaft **10**, the cams **11** are brought into rotation thereby downwardly pushing down the cam receivers **21** while they are being moved forward or rearward (the state shown in FIG. 2). Due to this, the rams **9** are moved down, whereby upper dies **29** attached to the lower ends of the rams and upper rams **28** fixed to the upper surfaces of the bed **4** shape products. Then the main shaft **10**, half rotated, brings the cams **11** back to the starting position, and the clutch is released and the brake **27** is applied to return the unit to the state ready for the operation.

FIG. 7 shows a mode of pressing operation performed by a transfer press in accordance with the present invention, the figure showing four steps of the operation carried out simultaneously by urging down four rams **9A**, **9B**, **9C** and **9D** simultaneously for the pressing work. In this example, a material, round bar C′, is beaten into a disclike article C in the first step; the workpiece is further forced to be pressed into an article D of a desired shape in the second step; the article is then, in the third step, cut into upper and lower two elements E and E′ to obtain a finished product E which is in the shape of a ring as desired; and in the fourth step the element E′ is subjected to the pressing operation to get the bottom thereof punched off, thereby another annular finished product F being produced. The operation to transfer the material from the first step to the next steps in succession is automatically carried out by mechanical feed means such as magic hands or the like during the intervals of the pressing operations, namely while the rams are elevated. At this time, since there are no obstacles like pillars in the space between ram-slide **3** and bed **4** in accordance with the present invention, feed means for performing delivery operation in the above described order can be readily installed.

In the third and fourth steps of the abovementioned, for the release of the pressed products from the punches, there are disposed work release members **30** which, when the rams **9C** and **9D** are raised up, strike against release pillars **31** downwardly extending from the ram-slide **3**, thereby releasing the products out of the engagement with punches **32**.

From the foregoing description it will readily be understood that the transfer press of the present invention has the following advantages.

In accordance with the invention the main shaft for vertically moving a plurality of rams is supported by the shaft supporters formed in the lower surface of the beam **2** provided between the pillars **1** and **1** and by the supporters formed in the protruding portions of the opposite ends of the beam, the main shaft **10** in particular being supported by the supporters thereby short spans being defined, the cam portions of the main shaft **10** being so disposed as to be each positioned respectively between the supporters, so that the main shaft **10** is prevented from flexure, bending and the like against the pressing resistance of a number of rams, the dimensions and precision of the products thereby being satisfactorily secured. By dispensing with the pillars and the like for supporting the main shaft between each ram, the machine, compact as it is, can provide wide spaces between respective dies thereby facilitating the installation of the feed means for delivering the workpiece from one set of dies to another in the order of the operations.

Furthermore, the ram-slide **3** supports a number of rams, each perfectly independently of the adjacent rams and without being subjected to their influence, each being capable of performing pressing operation, perfectly free of the influence such as inclination deflection, slippage or displacement due to the simultaneous pressing operation of other rams as if in an independent press. This is also an important characteristic of the transfer press of the present invention.

Since the beam **2** in the transfer press of the present invention supporting the main shaft **10** for bringing a plurality of rams into vertical reciprocating movement is joined to the pillars **1** and **1** by fitting the protrusions formed in the opposite end portions thereof into the lateral holes in the pillars **1** and **1**, namely since the beam and the pillars are not integrally casted of the same material as conventionally done, crack or some other damage which might be caused to the abovemen-

tioned juncture due to complex load on the beam such as flexure, torsion or the like created upon pressing can be precluded, and the strength of the material can fully be exhibited.

Thus in the transfer press of the present invention, strengthened frame provides a plurality of rams each of which is equipped with dies in the center of the lower end as if each of the rams were an independent press, the dies placed on the theoretical center line of the pressing force essential to the pressing operation thereby being aligned with the center of the stress created in the working. Each of the rams is accordingly perfectly ensured against the objectionable influences such as inclination, displacement, or movement to be attributable to the movement of other rams in simultaneous operation and the effects similar to those accomplished by a number of presses provided in series can be brought about. In addition, by dispensing with the obstacles such as pillars and the like between respective rams, the transfer of the material between the steps can be facilitated.

It is a significant advantage of the present invention that, as apparent from the foregoing structure, the transfer press which is capable of performing several steps of pressing operation and in which the material transference is facilitated can be constructed of smaller amount of material in compact structure.

What we claim is:

1. A transfer press comprising a pair of vertical pillars, a plurality of rams provided between pillars, a ramslide provided between said pillars, a main shaft provided with cams, a bed provided between said pillars and a beam disposed between and supported by upper portions of said pillars and supporting said main shaft, said beam being provided in the opposite end portions thereof with protrusions for fitting into said pillars and said pillars

have lateral holes of a shape mating with said protrusions, whereby said beam is tightly fitted in the lateral holes in said pillars in secured connection therewith so that the connecting portions may be prevented from a crack or the like damage due to complex force like flexure and torsion to be exerted on said beam during operation of said press.

2. A transfer press as claimed in claim **1**, wherein in the working operation to be performed by the cooperation of each upper die attached to the lower end of each of said rams and each lower die attached to the upper surface of said bed in corresponding relationship with said upper die, said rams are so adapted that a material round bar may be beaten into a disc like article (C) by a first ram, said article being further pressed into a workpiece in a desired shape (D) by a second ram, said workpiece being cut into two elements so as to obtain a finished product (E) of a desired annular shape by a third ram, the other element of said cut off works being subjected to bottom punching-off operation by a fourth ram so as to obtain another annular finished product (F).

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U.S. Cl. X.R.

72—450, 455