Feb. 18, 1969 AKIRA ASARI 3,427,857

METHOD AND APPARATUS FOR OPERATING THE RAM OF AN IMPACT MACHINE

Filed July 12, 1966 Sheet 1 of 2

Fig. 1

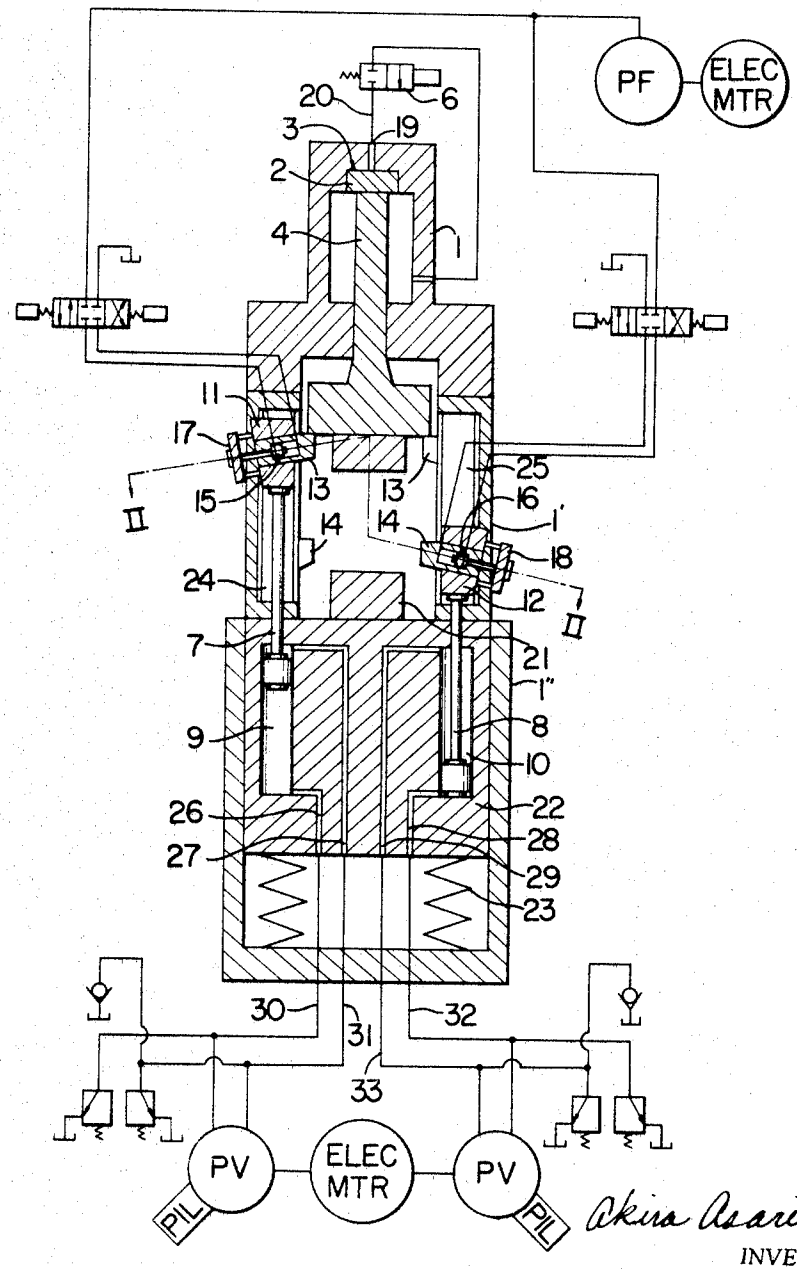

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Fig. 2

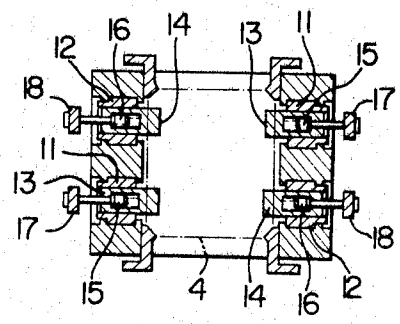
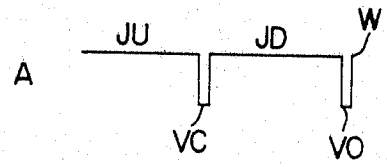
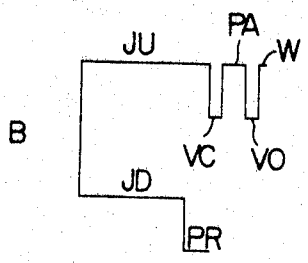


Fig. 3





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METHOD AND APPARATUS FOR OPERATING THE RAM OF AN IMPACT MACHINE

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ABSTRACT OF THE DISCLOSURE

A method for raising a ram in an impact processing machine. Two pairs of jack assemblies which are movable between an uppermost ram supporting position and a lowermost ram supporting position are provided. Each of them has vertically movable jack members and associated ram support members. The first pair of jack assemblies supports the ram in the raised position at the start of the operation, and the ram support members are retracted to allow the ram to descend. The second pair of jack members raises the ram while the first pair of jack members descends. The ram is again released, and subsequently raised by the first pair of jack members while the second pair descends.

The present invention relates to an improved impact processing method and apparatus which utilizes a fluid at a high pressure as its driving force supply source, and more particularly to a novel method for operating the ram in the above-type of impact processing machine and a novel device for carrying out the method.

Generally, in an impact processing machine the ram for the processing machine is operatively disposed within the body of the machine so that prior to actuation for one cycle of the impact processing operation, the ram is held in its uppermost inoperative position in the machine body and then the ram is caused to rapidly descend downwardly toward a work piece positioned on an anvil in the lower portion of the machine body so as to perform a desired impact processing operation on the work piece, and thereafter, the ram is caused to move upwardly to its initial uppermost inoperative position and held there ready for the next cycle of operation. In such a type of impact processing machine, in order to raise the descended ram to its initial inoperative position after the ram has performed the desired processing operation on the work piece, a jack device is usually employed. The jack device may be operated by either hydraulic pressure or mechanical means such as a crank. In one conventional type of jack device employed for the purpose, the vertically movable operating member of the jack device maintains its fully extended position so long as the operating member upholds the ram in its inoperative position and the operating member must be caused to descend just before the ram is actuated or caused to descend rapidly to perform a desired impact processing operation on a work piece positioned below the ram so that the operating member will not impede the descent of the ram. However, the operating member of the jack device usually takes a rather long time to descend, as much as one half of the time required for one cycle of the processing operation by the ram which impedes improvement of the impact processing operation in the prior art impact processing machine.

One object of the present invention is to provide an improved impact processing method which can effectively eliminate the above defects inherent in the prior art impact processing methods and machines and also to provide an improved machine for carrying out such an improved method.

Another object of the present invention is to provide an improved impact processing method which can positively eliminate the time required for the operating members of a jack device to descend from the total time required for one cycle of impact processing operation so that the descending time of the operating members does not constitute a part of the total time required for one cycle of the impact processing operation thereby to substantially shorten the total time required for one cycle of the impact processing operation.

According to the present invention, in order to operate the ram in an impact processing machine, at least two pairs of jack assemblies are provided each of which generally comprises a pair of vertically movable members and their associated vertically and laterally movable ram support members adapted to support and release the ram. The pairs of jack assemblies are adapted to alternately support and release the ram in such a manner that prior to actuation of the ram one pair of jack assemblies will maintain the ram in its uppermost inoperative position while the other pair of jack assemblies remain in their lowermost position apart from the ram when the ram is to be actuated for its intended impact processing operation, the vertically and laterally movable members associated with the first pair of vertically movable members which now support the ram are pulled away from the ram with their associated vertically movable members maintaining their uppermost position so as to release the ram to allow the latter to descend rapidly, and after the completion of one cycle of impact processing operation, the second pair of vertically movable members, which are now in their lowermost positions, are caused to move upwardly and at the same time the associated vertically and laterally movable members are caused to advance so as to engage and support the ram. In this case the first pair of vertically movable members and their associated vertically and laterally movable members are caused to descend with the latter members pulled back as the second pair of vertically movable members and their laterally movable members are moving upwardly whereby the ram can be operated by the alternating action of the two pairs of jack assemblies.

According to the present invention, there is also provided an improved ram operating device for an impact processing machine which comprises at least two pairs of jack assemblies each pair of which is adapted to move independently of the other pair. The device includes a pair of jack members and a pair of retractive members respectively associated with said jack members for movement together with the associated jack members and also for movement toward and away from the ram independently of the movement of the associated jack members, the retractive members being so arranged that when these members are advanced they can support the ram and when they are retracted they can release the ram so as to allow the ram to descend rapidly in order to perform a desired impact processing operation.

The above and other objects and advantages of the present invention will be more readily apparent from the following description when read in connection with the accompanying drawings in which:

FIG. 1 is a vertical sectional view of an impact processing machine incorporating a preferred form of device for operating the ram in said processing machine in which

the novel method of the present invention can be successfully carried out;

FIG. 2 is a cross-sectional view taken along the line II—II of FIG. 1; and FIGS. 3A and 3B are explanatory views for diagrammatically showing various stages in an impact processing operation cycle to be performed by a prior art method and the novel method.

The present invention will now be explained referring to the accompanying drawings, and especially to FIG. 1 thereof in which an impact processing machine which incorporates a preferred form of novel device for operating the ram in the processing machine is illustrated. The impact processing machine generally comprises a main body which consists of three vertically connected hollow portions, that is, the uppermost portion **1**, intermediate portion **1'** and lowermost portion **1''**. The uppermost portion **1** defines a gas cylinder into which a gas under a high pressure is to be introduced and entrapped and a trigger chamber **3** is formed in the top wall of the gas cylinder **1**. The top wall of the uppermost body portion or gas cylinder **1** is further provided with a gas passage **19** which connects the interior of the trigger chamber **3** and a gas flow conduit **20** which leads to a suitable conventional pressurized gas supply source (not shown). A ram **4** having a plunger **2** on the top is operatively disposed within the main body of the processing machine and extends from the gas cylinder **1** through the bottom wall of the cylinder into the intermediate body portion **1'**. When the ram **4** is not operated, the plunger **2** of the ram **4** is positioned within the trigger chamber **3** of the gas cylinder **1** while the lower enlarged end of the ram **4** is positioned apart from the bottom wall of the gas cylinder **1** as seen in FIG. 1. The position of the ram **4** shown in FIG. 1 is the initial position or dead point of the ram **4** prior to the start of an impact processing operation.

For the operation of the ram **4**, a change-over valve **6** disposed in the conduit **20** is initially shifted to its partially open position so as to permit a restricted flow of high pressure gas to flow from the supply source through the conduit **20** and gas passage **19** into the trigger chamber **3**. The thus introduced restricted flow of pressurized gas acts against the upper surface of the plunger **2** thereby causing ram **4** to descend within the main body a distance just enough to allow the plunger **2** of the ram to clear the trigger chamber **3**. As soon as the plunger **2** has cleared the trigger chamber **3**, the change-over valve **6** is shifted to its fully open position so as to permit a non-restricted flow of high pressure gas to pass into the trigger chamber **3** which acts against the upper surface of the plunger **2** with a stronger force so that the ram **4** will descend rapidly to strike against a work piece (not shown) disposed on an anvil **21** which is in turn provided on a block member **22** which is elastically supported by shock absorbing elements or springs **23** which are disposed between the under surface of the block and the inner surface of the bottom of the lowermost body portion **1''**.

After the completion of one cycle of the impact processing operation, it is necessary to move the ram **4** upwardly to return it to its initial position in which the plunger **2** of the ram **4** is disposed within the trigger chamber **3** formed in the top wall of the gas cylinder **1**. According to the present invention, a novel jack device is provided for operating the ram **4**. The novel jack device comprises two pairs of jack assemblies. One jack assembly generally comprises a pair of oil pressure operated pistons **7** and **7** (only one of them is shown in FIG. 1) and their associated pair of cylinders **9** and **9** (only one of them is shown in FIG. 1) while the other jack assembly generally comprises a pair of oil pressure-operated pistons **8** and **8** and their associated pair of cylinders **10** and **10**. The cylinders **9**, **9** and **10**, **10** are respectively formed in the block member **22** adjacent to the four corners of the block member and communicate

through bores formed in the top wall of the block member **22** and in the bottom wall of the intermediate body portion **1'** which also has vertical openings **24**, **24** and **25**, **25** adjacent to the four corners of the intermediate body portion **1'** in positions corresponding to the four cylinders **9**, **9** and **10**, **10** respectively. Thus, the four pistons **7**, **7** and **8**, **8** can move upwardly and downwardly within their respectively associative cylinders **9**, **9** and **10**, **10** and **24**, **24** and **25**, **25**. The block member **22** is also provided with oil passages **26**, **27**, **28** and **29** which communicate through oil conduits **30**, **31**, **32** and **33** to suitable oil pressure supply sources (not shown). The passages **26** and **27** communicate with one pair of cylinders **9** and **9** so as to operate the pistons **7** and **7** disposed in the cylinders while the passages **28** and **29** communicate with the cylinders **10** and **10** so as to operate the pistons **8** and **8**. In the illustrated embodiment of the jack device, in each pair of assembly the jack pistons are diametrically opposed to each other with respect to the center ram **4** and the jack cylinders are also diametrically opposed to each other with respect to the center ram **4**. The openings **24**, **24** and **25**, **25** formed adjacent to the four corners of the intermediate body portion **1'** extend vertically along a substantial length of the body portion and open to both the interior and exterior of the intermediate body portion **1'**. The oil pressure-operated pistons **7**, **7** and **8**, **8** are respectively provided at their upper ends with pawl boxes **11**, **11** and **12**, **12**, respectively, and inclined cylindrical pawls **13**, **13** and **14**, **14** extend across the respectively associated pawl boxes **11**, **11** and **12**, **12** for freely slidable movement within the inclined bores formed in the associated pawl boxes in advancing and retreating directions. Pistons **15**, **15** and **16**, **16** are respectively provided in the bores of the pawls **13**, **13** and **14**, **14** for operating the pawls and the pistons are adapted to move into and out of the bores of the respectively associated cylindrical pawls so as to effect reciprocal movement of the pawls in advancing and retreating directions. The pistons **15**, **15** and **16**, **16** are operatively connected to the respective pawl boxes by means of support plates **17**, **17** and **18**, **18**. The pawls **13**, **13** and **14**, **14** are so arranged that when the pawls are fully advanced into the interior of the intermediate body portion **1'** they can engage the lower edge of the ram **4** at diagonal opposed points thereof, while when they are fully retreated into the pawl boxes they move out of engagement with the ram edge portions. It should be understood that the two pawls in the same pair are caused to advance and retreat simultaneously; that is, the two pawls and associated pistons should move always in the same direction. For effecting the forward and backward movement of the pistons **15**, **15** and **16**, **16**, and accordingly, the pawls **13**, **13** and **14**, **14**, separate oil pressure conduits are provided for each piston and pawl assembly (only those associated with two of such assemblies are schematically shown in FIG. 1). In order to advance each pawl, oil pressure is supplied from a suitable oil supply source (not shown) via an associated conduit and bore formed in the associated pawl box and pawl against the rear surface of the piston head within the particular pawl while in order to retract the thus advanced pawl oil pressure from the same supply source is supplied via another associated conduit and another bore formed in the same associated pawl box and pawl at points apart from the previously mentioned bores in the same pawl box and pawl against the front surface of the same piston head. The shifting of the oil pressure flow from one conduit to the other conduit is effected by means of a change-over valve common to the two oil pressure conduits. In order to move upwardly and downwardly, each jack piston, as mentioned above, two separate passages are provided for each jack piston in the block member **22** and the two passages communicate with the respective oil pressure conduits which in turn communicate with a common oil pressure supply source.

The pairs of oil pressure-operated jack pistons 7, 7 and 8, 8 are so arranged and operated that when the ram 4 is to be positioned in its uppermost or inoperative position, one pair of jack pistons of the two pairs of pistons, for example, the jack pistons 7 in the same pair are urged upwardly by supplying oil pressure from the oil supply source through the conduits 30 and passages 26 into the cylinders 9 and at the same time their associated pawls 13 are urged forwardly into the interior of the intermediate body portion 1' by supplying oil pressure against the rear surface of the associated pistons 15 in the manner as mentioned above so as to abut against the lower edge of the ram head at two diagonally opposite corners of the latter. Thus the ram 4 will be pushed upwardly to its inoperative uppermost position being supported by the abutting pawls 13 which are urged upwardly as the associated jack pistons 7 ascend within the cylinders 9 and openings 24 and the ram 4 will be held in the uppermost position by the fully advanced pawls 13 when the jack pistons 7 have reached the uppermost position. In this case, the jack pistons 8 remain in their lowermost position and their associated pawls 14 also maintaining their fully retracted position. In order to effect the actuation of the ram 4 from the above-mentioned inoperative position, firstly, the pawls 13 associated with the jack pistons 7 are retracted from their advanced position by supplying oil pressure against the front surface of the pistons 15 and in this case the pawls will release the ram 4. However, the ram 4 does not immediately descend, but remains suspended within the machine body because of the high pressure gas entrapped within the cylinder 1 which acts against the lower surface of the plunger 2 of the ram 4 so as to hold the ram in position. After the pawls 13 are completely retracted from the interior of the body portion 1', the change-over valve 6 is shifted as described above to cause the ram to descend to carry out the desired impact process by the impact of the descending ram 4. After one cycle of the impact processing operation by the ram 4 has been completed, the jack pistons 8 in the other pair which are now in their lowermost positions are caused to ascend and at the same time their associated pawls 14 are caused to advance to engage the ram 4 in the manner as described above. The jack pistons 8 continue to ascend with their associated pawls 14 abutting against the underside of the ram at two diagonally opposite corners of the latter until the ram reaches its uppermost inoperative position where the ram is maintained ready for another cycle of impact processing operation. The pistons 7 which have previously been raised to the uppermost position and held there, are now caused to descend by supplying oil pressure from the supply source through the conduit 31 and passage 27 into the upper portion of the cylinders 9 and their associated pawls 13 are simultaneously retracted while the other pair of jack pistons 8 are ascending and their associated pawls 14 are advancing. After the jack pistons 7 have reached their lowermost position and the jack pistons 8 have reached their uppermost position, and in consequence the ram 4 has been returned to its uppermost position, ram 4 is ready for the next cycle of impact processing operation by repeating the operation described above.

The impact processing cycle carried out by the use of the illustrated impact processing machine incorporating the novel dual-type jack device according to the present invention is diagrammatically shown in FIG. 3B and that by the use of one conventional impact processing machine incorporating a prior art single-type jack device is diagrammatically shown in FIG. 3A. When the cycle of FIG. 3B is compared with that of FIG. 3A, it will be noted that the total time required for performing one cycle of impact processing operation by the machine incorporating the novel dual-type jack device is shorter than that required for the same operation by the conventional machine incorporating the prior art single-type jack device by an amount substantially corresponding to the time required for the jack pistons to descend. In these figures, various symbols designate the following motions:

JU—Upward movement of jack pistons
JD—Downward movement of jack pistons
W—Impact stroke (downward movement of ram)
VO—Opening of change-over valve 6
VC—Closing of change-over valve 6
PA—Advancement of pawls
PR—Retreat of pawls

As mentioned hereinabove, in the novel dual-type jack device according to the present invention, since the two pairs of jack assemblies are adapted to alternately return the ram to its uppermost position and when the ram is to be actuated the supporting members or pawls associated with the respective jack pistons are caused to retreat so as to release the ram, the time required for the jack pistons to descend will not be added to the total time required for one cycle of the impact processing operation and accordingly, as compared with any conventional operation the total time required for performing one complete cycle of impact processing operation will be shortened by an extent corresponding to the time required for the jack pistons to descend, and furthermore, immediately after a work piece has been positioned on the anvil, the ram can be actuated, and accordingly, if the work piece is hot, the same can be properly impact-processed before the same becomes cold.

It should be understood that the present invention is not precisely limited to the illustrated construction and arrangement, but the invention can be equally applied to other constructions and arrangements in which the jack pistons and the associated pawls are actuated by mechanical means rather than hydraulic pressure as illustrated. Furthermore, the construction of and arrangement of the jack pistons and their associated pawls may vary within a wide range within the scope of the present invention; for example, the jack piston rods themselves may serve as the support means for the ram and rock laterally thereby to eliminate their associated pawls which are otherwise necessary.

While one preferred embodiment of the invention has been shown and described in detail it will be understood that the same is for the purpose of illustration only and is not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. A method for raising a ram in an impact processing machine by the use of a jack device having at least two pairs of jack assemblies movable between an uppermost ram supporting position and a lowermost non-ram supporting position and each of which includes vertically movable jack members and associated ram support members movable together with said respective jack members movable laterally in advancing and retreating directions for supporting and releasing said ram independently of the jack members, said method comprising the steps of retracting the ram support members of the first pair of jack assemblies which are in their uppermost ram supporting position while associated jack members remain in their uppermost position so as to release the ram to allow the same to descend rapidly to complete its downward stroke to accomplish a desired impact processing operation on a work piece, then advancing the ram support members of the second pair of jack assemblies which are in the lowermost position so as to support said ram, and at the same time causing the jack members of the second pair to ascend to return the ram to its initial uppermost position while being supported by the support members of the second pair of jack members while at the same time causing said jack members and the associated support members of the first pair of jack assemblies to descend, repeating the cycle of operations by raising the jack members of the first pair while lowering the jack members of the second pair.

2. A device for operating the ram in an impact processing machine comprising at least two pairs of jack assemblies adapted to be operated independently of each other, and means for alternately actuating the jack assemblies of said pair of the jack assemblies for causing one jack assembly to lift the ram and simultaneously causing the other jack assembly to descend, each pair of said jack assemblies including a pair of vertically movable jack members and a pair of associated ram support members for vertical movement together with said jack members and also for lateral movement in advancing and retreating directions so as to support and release said ram independently of the jack members, said ram support members being adapted to advance to support the ram when the ram is to be caused to ascend and to retract from the advanced position to release the ram when the ram is to be actuated in order to perform a desired impact processing operation.

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