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Hasselgren et al.

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[54] **METHOD OF AND APPARATUS FOR SEPARATING LIGHTWEIGHT (AERATED) CONCRETE ELEMENTS**

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[52] **U.S. Cl.** ..... **29/200 D,** 29/427

[51] **Int. Cl.**... **B28b 13/04,** B23p 19/00, B23p 19/02

[58] **Field of Search** ..... 29/200 D, 427, 200 R, 29/426; 214/8.5 R, 152

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Primary Examiner—Thomas H. Eager

Attorney—Roberts B. Larson et al.

[57] **ABSTRACT**

Apparatus for separating a stack of adhering lightweight concrete elements comprises upper and lower pairs of mutually opposite elongate clamping units, the units of each pair being mounted for generally horizontal relative clamping movement toward each other so that the two pairs can grip adjacent elements in the stack. At least one clamping unit, preferably in the upper pair, is mounted for movement normal to the clamping direction so as to pivot the upper element relative to the adjacent lower element and separate these elements. This unit, and preferably all the units, comprises a multitude of single clamping jaws arranged for individual and independent movement in the clamping direction so as to compensate for possible irregularities in the elements of the stack. The clamping jaws are carried by pivotally mounted arms, the arm being pivotally mounted on a vertically movable carrier so that the clamping jaws can be moved downwardly to effect separation of all elements in the stack. This avoids the necessity of removing an upper separated element before the next lower element can be separated. A method of separating the elements comprises the described operation of this preferred apparatus embodiment.

16 Claims, 8 Drawing Figures

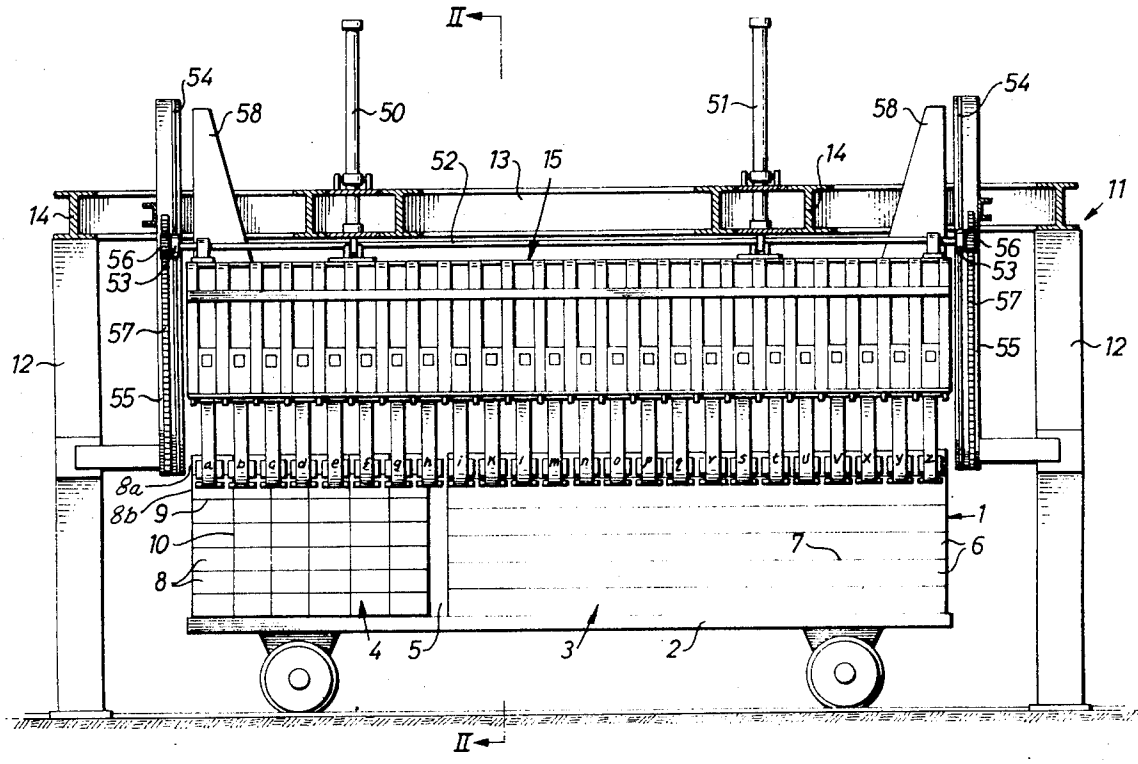

Fig. 1

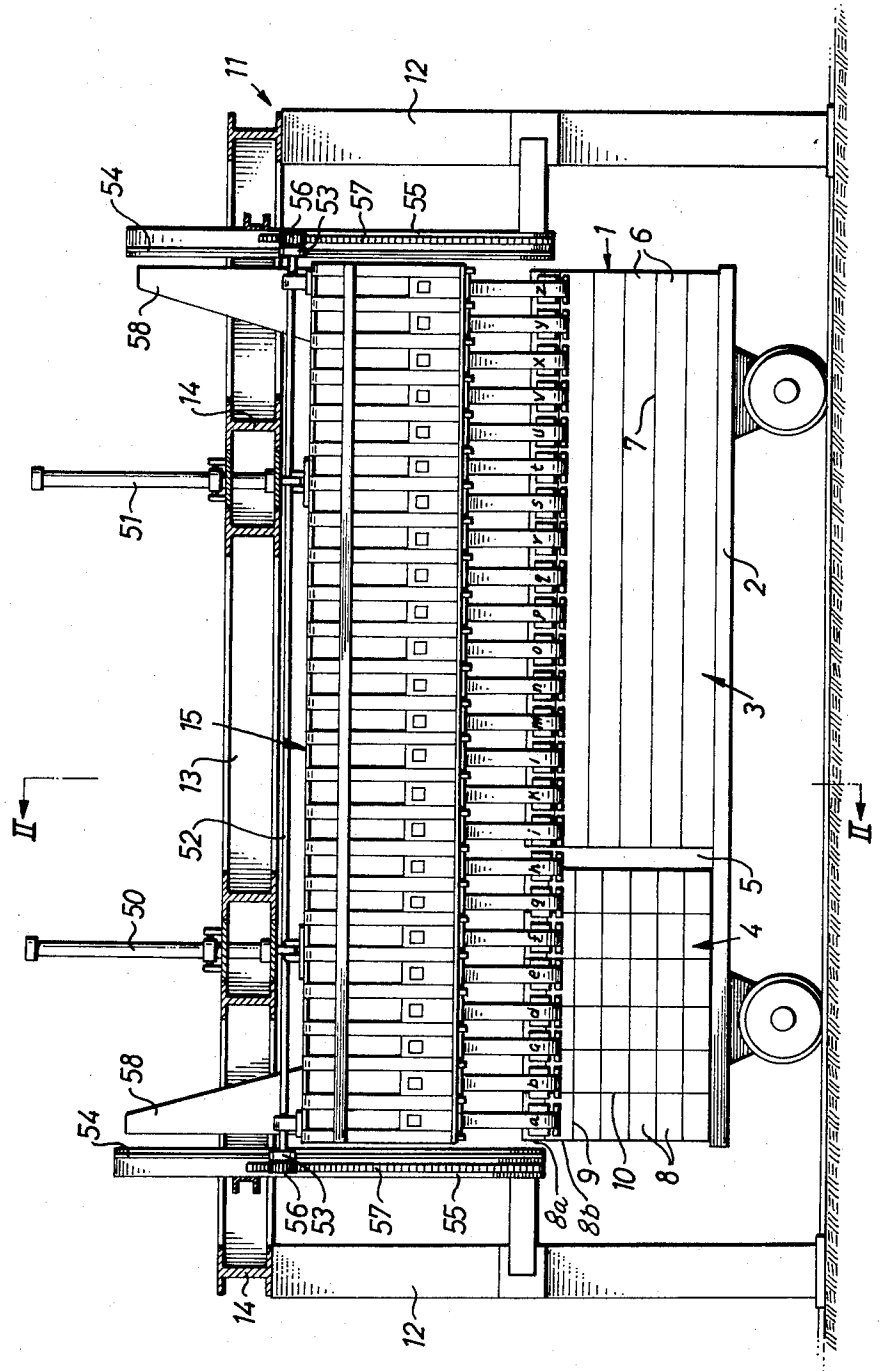
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Fig. 2

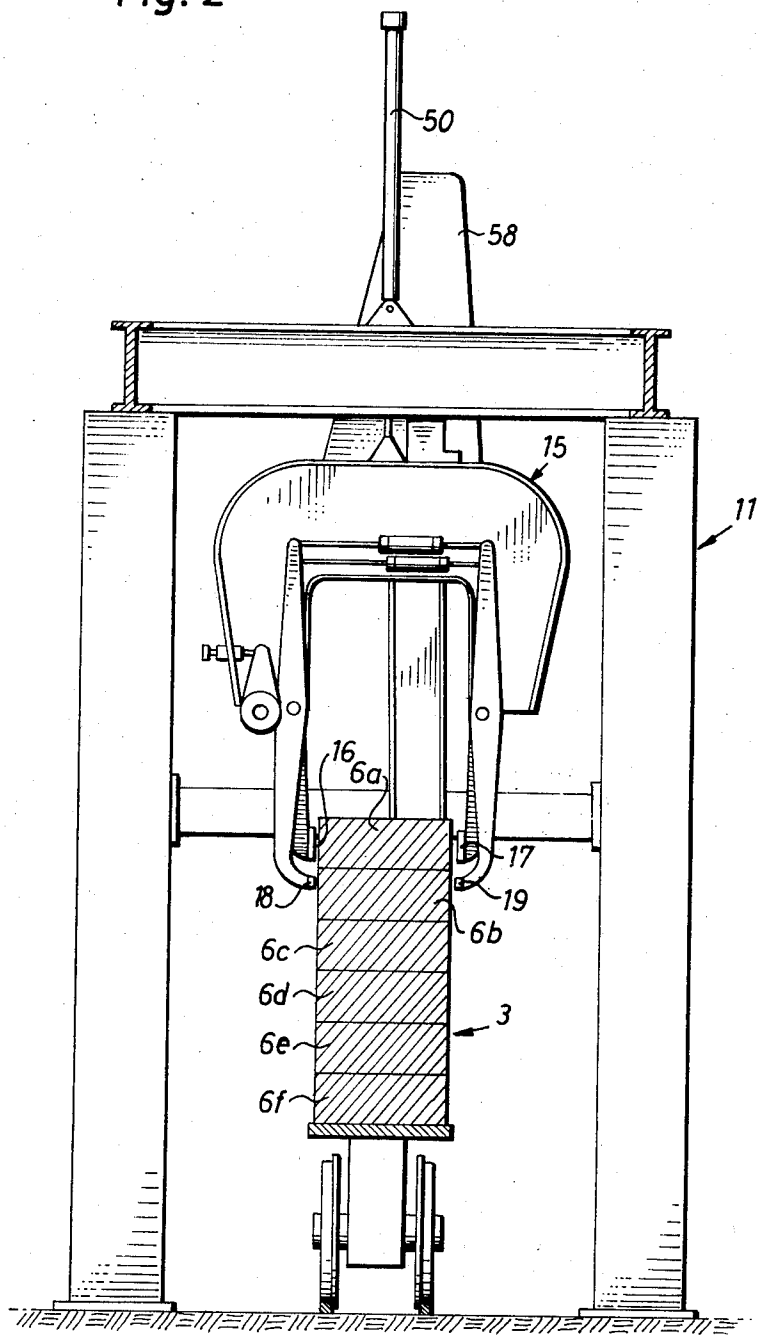

Fig. 3

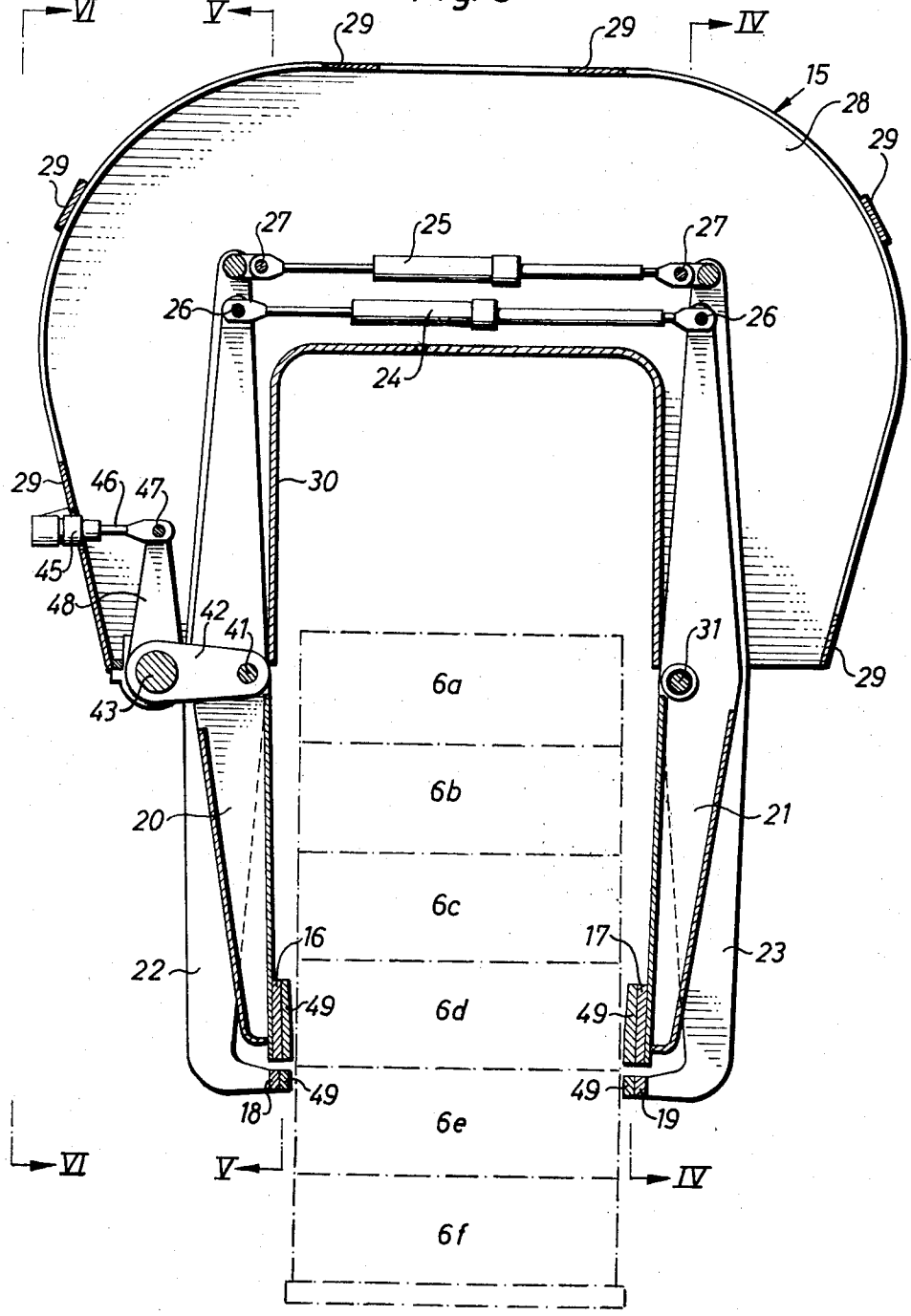
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Fig. 4

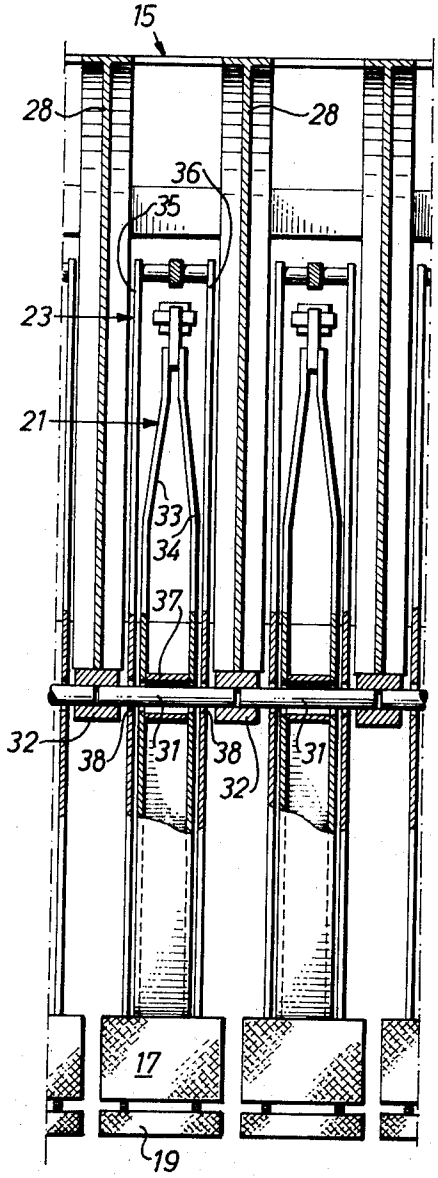
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Fig. 5

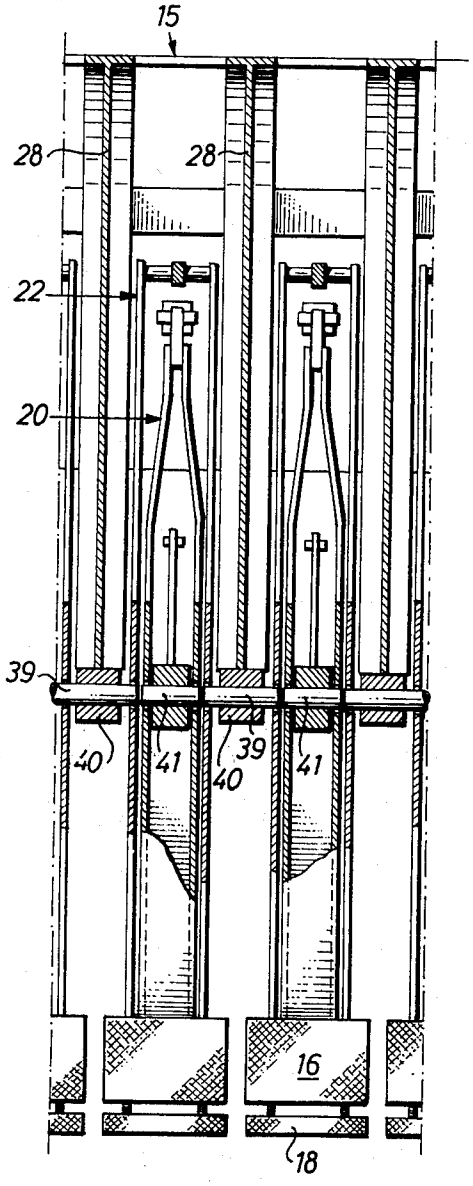
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Fig. 6

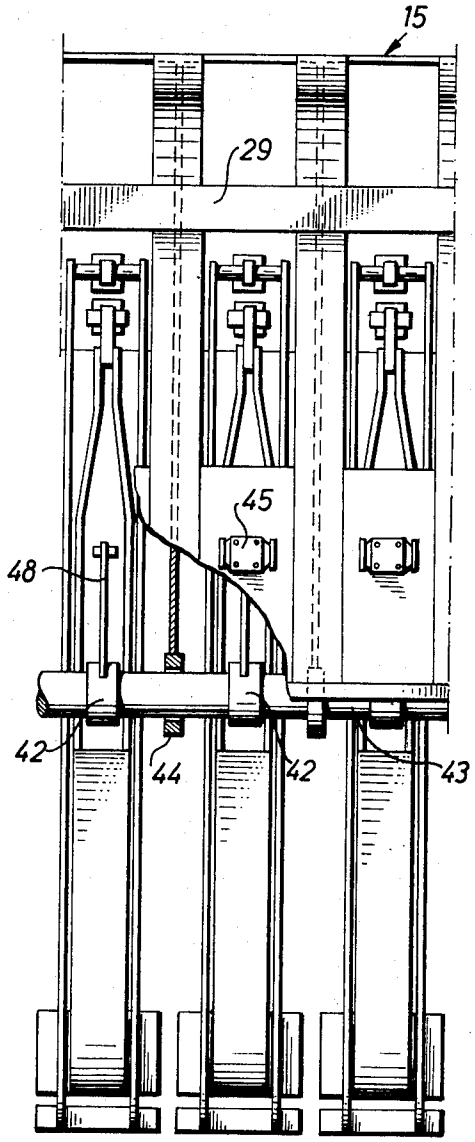


Fig. 7

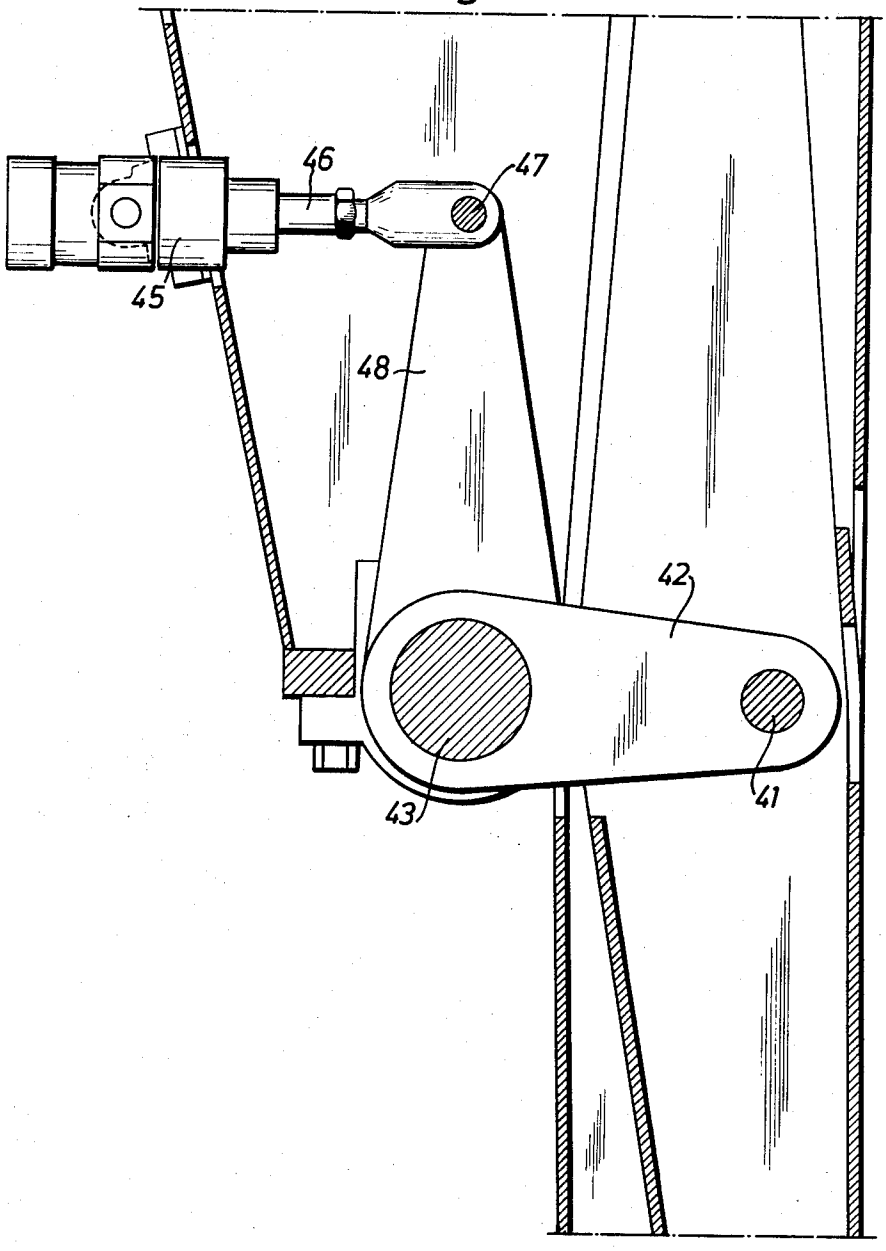
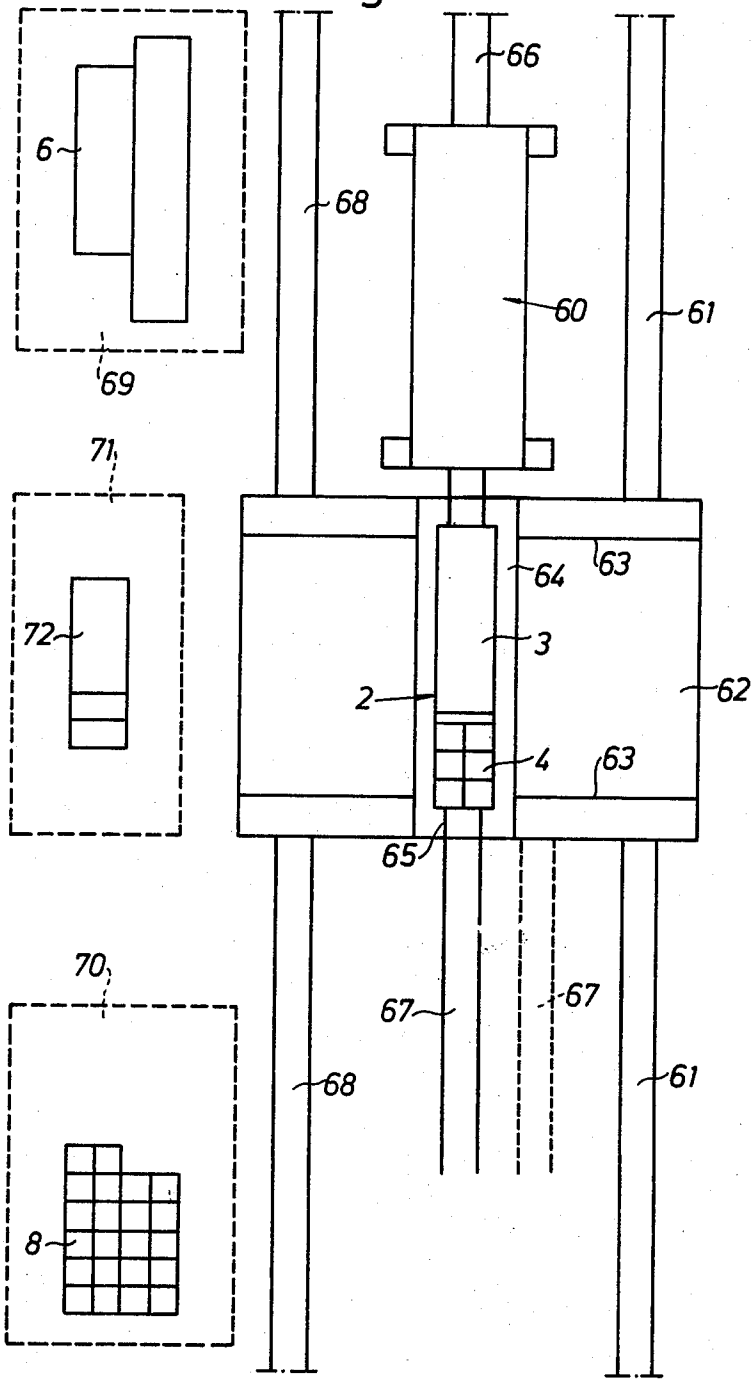


Fig. 8



METHOD OF AND APPARATUS FOR SEPARATING LIGHTWEIGHT (AERATED) CONCRETE ELEMENTS

FIELD OF THE INVENTION

This invention relates to a method of and apparatus for separating lightweight concrete elements.

BACKGROUND AND SUMMARY OF THE INVENTION

Lightweight concrete products may be produced in the following way: Down into a casting mould a lightweight concrete-forming mass is poured which, having been made porous by means of gas generating or foaming agents for instance, is brought to bind or harden into a semiplastic more or less cheese-like consistency. The casting mould mentioned frequently consists of a parallelepipedon-shaped box open upwards which advantageously may have the length 600 cm, the width 120 cm and the height 60 cm. This means that the mass cast will have its plane or its large surface oriented horizontally. When the mass, as has been said, has bound into a block of semiplastic self-bearing consistency, this block is raised on its edge, i.e. is turned by 90° so as to get its large surface oriented vertically, and, after that, it is subjected to a dividing procedure, preferably by bringing wires, operating horizontally as well as vertically, to pass through the block, thus cutting it up. This dividing of the block may proceed in almost an unlimited number of ways. The raised block may e.g. be divided by horizontal cuts only into four elements measuring 600 × 60 × 30 cm or six elements measuring 600 × 60 × 20 cm and so on. But it is possible, too, by the so-called dimension change, to divide the block into elements of quite different dimensions and ranges of application. The dimension change may be carried out by making one or more slots in the block, into which slots cutting frames of varying wire distribution are then brought in. Elements of many dimensions are of course possible to produce e.g. by arranging two or more slots for the dimension change. Finally the divided block is brought into an autoclave to be cured by means of steam and to obtain its final strength.

After the curing is finished, the cuts dividing the block into single elements, may most closely be characterized as crack indications. This is due to a phenomenon which is here called adhesion and implies that the elements stick to each other strongly enough to prevent them from being separated without anything further. The adhesion is particularly manifest in the downmost cuts of the block where, as is natural, the weight of the block itself provides an extra pressing-together of the elements. Within the lightweight concrete technique there have appeared many methods and devices for the separating of lightweight concrete elements sticking together in the said way.

Thus, through the Swedish Patent No. 164 138 a device is known which comprises one upper and one lower pair of mutually opposite longish clamping units arranged to hold or to grip like tongs each its own of two lightweight concrete elements situated on either side of a dividing slot, one clamping unit of the upper pair being movable vertically or across the clamping direction to provide a swinging of one element relatively to the other so as to separate the elements from each other. More strictly spoken both units of the upper pair together form an upper frame box and those of the lower pair, likewise, a lower frame box, whereby one clamping unit of each pair has the shape of a rigid pressure plate covering all the length of the block and movable to and from the opposite unit, by means of hydraulic cylinders for instance. The frame boxes are hinged mutually, affording the possibility of swinging the upper one relatively the lower one by means of special vertically acting pressure boxes. This device worked satisfactorily inasmuch as the separating, as a consequence of the swinging movement, proceeded easily and smoothly. Those investigations, however, which have lead to the present invention, sometimes revealed crack formation and other non-desirable damages in elements separated by means of the device in question. The reason for that has proved to be the fact that unevennesses, be they ever so small, in the sides of the elements cause the relatively great forces emanating from the straight and longish pressure plates to act unevenly along the sides of the elements, pressure strain thus occurring locally. Another disadvantage of the device is that it involves the necessity of removing each element from the block immediately after the separation, by means of a lifting stirrup for instance, and bringing it onto a piling pallet or other place of storing. This means complicated and extremely slow separating operations. The present invention refers to a method which lacks the disadvantages described above and, besides, has several advantages as compared to earlier known methods within the field. Characteristic of the method invented is that the elements are held by pairs of clamping units of which at least one in each pair consists of a multitude of single clamping jaws which when clamping, are brought to move individually or independently of each other towards the opposite clamping unit of the pair, the jaws of at least one unit during the separating operation being brought to move together or simultaneously across the clamping direction.

Additionally, the invention also refers to a separating device for practicing the method. Characteristic of this device is that at least one of the units in the upper as well as in the lower pair of clamping units consists of a multitude of single clamping jaws arranged for moving individually or independently of each other towards the opposite clamping unit during the clamping procedure, and in that the clamping jaws of at least one clamping unit are movable together or simultaneously across the clamping direction for bringing-about said separating of the elements. Other distinctive features and advantages are seen from the attached claims. The expression lightweight concrete elements in this connection firstly refers to elements of aerated concrete or foam concrete, i.e. kinds of concrete obtained by using gas producing or foaming agents respectively, but it is of course also possible to adapt the invention to every other kind of lightweight concrete afflicted with problems of sticking.

With reference to the attached drawings a detailed description is given below of a preferred embodiment of the invention as an example. In the drawings FIG. 1 is a longitudinal partly sectional assembly view of the device on a first scale, FIG. 2 a somewhat enlarged cross section II — II of FIG. 1, FIG. 3 a still more enlarged cross section of the most vital part of the device, FIG. 4, 5 and 6 show partly sectional vertical views IV — IV, V — V, and VI — VI respectively of FIG. 3 and FIG. 7 an extremely enlarged detail of the device. FIG.

8 provides a strongly schematic plan view of a plant including the separating device.

In the Figures, 1 is the general designation of a lightweight concrete block resting on a support 2 which may be carried by wheels for instance. In this case the block is shown divided up into two different parts or piles 3 and 4 by a dimension change slot 5, the first pile 3 in its turn having been divided into six longish elements 6 by means of horizontal cuts 7 having the nature of indications, whereas the other pile 4 has been divided into several elements 8 by horizontal as well as vertical cuts marked 9 and 10 respectively.

The invented device comprises a stationary stand with the general designation 11, composed of a number of vertical columns 12, longitudinal beams 13 and cross beams 14. The beams together form a frame structure resting on the columns. In the frame structure 13 – 14 there is a carrier 15 suspended which in its turn carries one pair of upper clamping units 16 and 17 and one pair of lower ones 18 and 19. See FIGS. 2 and 3. In accordance with the invention these clamping units consist of a great number of single clamping jaws, in FIG. 1 marked with *a* – *z*.

To explain more clearly how the clamping jaws cooperate with the carrier 15 special reference is made here to FIGS. 3 – 6. From these Figures it is seen that all the clamping jaws of units 16 – 19 are situated each on the lower end of one of the equally numerous arms 20, 21, 22 or 23 respectively, which are essentially vertical. Thus the upper clamping jaws 16 and 17 belong together to those arms which are here called upper arms 20 and 21, while the lower clamping jaws 18 and 19 belong together to the arms 22 and 23 here called lower arms. These arms all are possible to swing or move around shafts or shaft pivots oriented horizontally or parallelly to the longitudinal direction of the carrier. Turning of the arms is carried out in this case by means of telescopic bars 24 and 25 the former of which via hinges 26 mutually connects the upper arms 20 and 21 while the latter one via hinges 27 connects the upper ends of the lower arms 22 and 23 to each other. The telescopic bars may suitably consist of hydraulic cylinders encompassing reciprocating pistons. The bars thus can be lengthened when the clamping jaws by turning of the arms are to be caused to move towards each other in order to grip a lightweight concrete element. Loosening of the clamping jaws is brought about by reducing the length of the bars.

The carrier 15 is composed of a great number of sheets 28 placed crosswise and being of a U-shaped profile. These are mutually connected by longish beams or plates 29 (FIG. 3), the structure thus becoming rigid lengthwise as well as crosswise. Inside the carrier there is arranged a U-plate 30.

From FIG. 4 is seen that the arms 21 and 23 shown in FIG. 3 to the right of the lightweight concrete block 1, encompass a pivot 31 common to them both. Such a pivot 31 is kept in position by holders 32 situated at the lower parts of the sheets 28. From FIG. 4 it is seen, too, that the lower arm 23 consists of two parts or struts 35 and 36, and that upper arm 21 consists of struts 33 and 34. The arms are mounted on the pivot by bearings 37 and 38. It is evident from the above that the pivots 31 are rigidly connected to the carrier 15 and that the sole possibility of moving the arms 21 and 23 is to swing them.

It is otherwise with the arms 20 and 22 shown in FIG. 5. Truly enough the lower arms 22 are mounted with bearings on unmovable pivots 39 fixed to holders 40 situated at the lower parts of the sheets 28, but of the upper arms each one is mounted with a bearing around pivot 41 movable relatively to the carrier 15. The pivot 41 is by a bracket 42 connected to a synchronizing shaft 43 stretching uninterruptedly along all the length of the carrier. The synchronizing shaft is possible to turn but the brackets 42 for all pivots 41 have been fixed to the shaft 43 in question, by welding for instance. The shaft — as is perhaps best seen from FIG. 6 — is mounted in hubs 44 fixed to the lower parts of the sheets 28. The possibility of turning the shaft in this case is provided by hydraulic cylinders 45 fixed to the carrier 15. The number of these cylinders may suitably coincide with that of the brackets to get an evenly distributed loading though it would in itself be thinkable to use only one or few hydraulic aggregates for turning the shaft. The piston 45 of the hydraulic aggregate or the rod 46 of the piston is via a hinge 47 connected to an upright 48 which, like the bracket, is fixed to the shaft 43 though in this case the connection is perpendicular to the bracket. It will be evident that, when the pistons of the hydraulic aggregates are moving inwards in the cylinders, the shaft 43 will turn anti-clockwise at least by some little distance, while the brackets 42 are swinging, causing the pivots 41 with their pertaining arms 20 and clamping jaws 16 to move upwards. At that procedure all the upper clamping jaws 16 move upwards simultaneously according to the invention. FIG. 3 shows now there are rubber wedges 49 on the clamping jaws 16 – 19 to make contact with the lightweight concrete elements.

Now again reference is made to FIG. 1. Here is illustrated that the carrier 15 is movable vertically by means of two synchronized hydraulic cylinders 50 and 51. The vertical movement of the carrier is controlled by a shaft 52 situated at the top of the carrier and provided both with wheels 53 running in vertical guides 54 on the hanging beams 55 and with cog wheels 56 meshing with straight cog bars 57 on the hanging beams. On the carrier there are housings 58 for driving aggregates supplying power to the different parts of the device.

As will most clearly be evident from FIGS. 2 and 3 the distance between the lower clamping jaws 18 and 19 and the horizontal part of the carrier which unites both its downward shanklike parts is at least almost as long as the height of the block or pile 3. In this case the distance between said horizontal part of the carrier and the lower clamping jaws is a little longer than the height of the block.

The device described operates in the following way: A lightweight concrete block 1, already cured, is brought in, resting on the support 2, to a position under the carrier 15 and the vertical position of the latter is adjusted so as to place the upper pair of clamping jaws 16 and 17 above the cut at hand between the topmost element 6*a* or 8*a* and the next one, 6*b* or 8*b*, and to place the lower pair 18 – 19 under the cut of the pile in question, i.e. 3 or 4, respectively. See FIG. 2. In this position the telescopic bars 24 and 25 are elongated causing the clamping jaws of each pair to bear against the sides of the elements and to grip these. It should be noticed here that in a first stage, for example, only the clamping jaws *a* – *h* work those adjacent pile 3 (*i*–*z*) being kept apart. When the synchronizing shaft 43 is

turned by the hydraulic aggregates **45** far enough to bring the clamping jaws **16** to move about 10 mm vertically. This causes the element or course of elements **8a** to revolve relatively to elements **8b**, the elements thus being separated. In the next stage (FIG. **2**) the clamping jaws *i* – *z* adjacent pile **3** are brought to work, those adjacent pile **4**(a-h) being kept apart. The carrier **15** is lowered far enough to bring the pairs of clamping jaws on both sides at the level of the upmost cut of the pile **3**. The clamping jaws *i* – *z* are caused to grip the upmost element **6***a* which revolves and is separated by turning the synchronizing shaft. In a third stage the carrier is brought to sink further down in order to bring the clamping jaws *a* – *h* into their working positions on each side of the next-to-topmost cut in the pile **4**, after which the operations described are repeated alternately until all elements or courses of elements in both piles **3** and **4** have been separated. FIG. **3** illustrates an exemplary subsequent stage. Finally both piles are lifted somewhat from the support **2** to make it possible to insert pallets or similar bearing devices under them, and the piles are brought down to rest on these pallets, ready to be transported to some suitable place of storing or unloading.

It is evident from the above that all single elements after being spearated from the block in question remain resting each on the other until all the elements at hand in the pile have been separated. There is, thus, no question of removing the elements one after another from the pile as they are being spearated, such as has been the case for earlier known methods and devices within the field. The possibility of keeping all elements in the pile brings about essential advantages as the total time consumption for the separating and the arranging of the elements into piles possible to store, is reduced to a minimum, handling damages, particularly in the edges of the elements are also manifestly reduced and to this there is a saving of tools.

In FIG. **8** an example is given of how the described separating device may be arranged in a plant for the separating and storing of lightweight concrete elements. In the Figure the totality of the separating device is marked with **60**. **61** signifies one or more, in this case two, tracks or transport lines leading from an autoclaving or curing station to a traverser pit **62**. In this pit there is arranged a traverser truck **64** movable to and fro laterally along rails **63** or similar. On the traverser truck **64** there are rails or transport lines **65** for the support **2** which is movable longitudinally and carries the piles **3** and **4** of the lightweight concrete elements **6** and **8** respectively. From the separating device **60** there leads a transport line **66** for transporting the support **2** in and out. For support most often plane sheets, so-called curing plates, are used. At the side of the traverser pit **62** one or more tracks **67** are arranged for the accumulating of piles. FRom the traverser pit there are one or more tracks **68** leading to one or more stores, e.g. a store **69** for reinforced elements **6** and a store **70** for unreinforced elements **8**. **71** signifies a store of pallets **72** of suitable sizes. The plant described may of course be modified in many ways. Thus the separating device **60** may be movable instead of stationary, an economy of transport lines being gained. Further the cured elements may be taken into the separating device via the tracks **66** instead of the tracks **61**, the latter thus made away with.

The plant normally functions in the following way: The elements are taken into the separating device **60** either directly via the tracks **66** or via the tracks **61** and the traverser truck **64**. They are separated in the manner described above being brought to rest on pallets **72**. From the separating device the elements are brought to the stores **69** and **70** via the traverser truck **64** and the tracks or transport lines **68**.

HOwever, it is many times advantageous to accumulate many piles **3** or **4** containing elements of the same dimensions to get a support carrying exclusively the same sort of elements before starting the separting operation. For that purpose the ranging tracks **67** are used on which supports can be kept standing until they have been filled for instance with unreinforced elements **8** of uniform dimensions. If the plant is run in that way, the alternate operations mentioned previously of the clamping jaws of the carrier, are no more necessary. It is of course also possible to separate all elements of one pile before separating those of the second one. But then the carrier **15** will have to be brought up and down two times instead of one.

The hydraulic aggregates belonging to the device here described may suitably be connected to a special operating panel from which the operations are controlled in an optional way not shown here, preferably electronically.

The advantages of the invented method and device are evident as the clamping forces are evenly distributed along all the length of the element because of the multitude of the clamping jaws. The number of these jaws may suitably be **3 – 6**, preferably 4, per meter. Another advantage is that the device allows for the separating of blocks of different dimensions. This is particularly important for elements of different thickness and different profiles, e.g. tongue-and-groove elements contra plain elements.

It is self-evident that the invention is not limited to that embodiment only which has been described and shown in the drawings. Thus it is possible to use carriers movable also horizontally by being suspended to an overhead travelling crane or by wheels at hand on the stand **11**. Instead of hydraulic operating, naturally, other ways of running the plant may come into question, such as pneumatic, mechanic or similar running. Many other modifications, too, are possible within the scope of the following patent claims:

We claim:

1. A method of separating lightweight concrete elements mutually delimited by essentially horizontal cuts but adhering to each other to form at least one block of stacked multiple elements, comprising the steps of causing one upper pair and one lower pair of mutually opposite elongate clamping units each to grip in a tong-like manner its respective element of two elements situated on either side of a cut, and imparting to at least one clamping unit of one pair a movement relative to the other pair, thus separating one element from the other, wherein at least one clamping unit in each pair consists of a multitude of single clamping jaws which are moved individually and independently of each other toward the opposite clamping unit to grip the respective elements, thejaws of at least one of the jaw-type units being moved simultaneously across the clamping direction during the separating operation to effect said separation of one element from the other.

2. A method according to claim 1 wherein each stacked element after being separated is left remaining in the block until essentially all elements lying on top of each other have been separated.

3. A method according to claim 2 wherein the block, after separation of all its stacked elements, is lifted by lifting the lowermost element so as to lay bare its bottom, and at least one pallet is inserted under the block, which is then lowered and brought to rest on said pallet.

4. A method according to claim 2 wherein the block comprises at least one first stack and one second stack horizontally adjacent each other and containing elements of different dimensions, and wherein in a first step the topmost element of the first stack is separated and in a second step the topmost element of the second stack is separated, after which the clamping units are controlled alternately to hold and separate elements of the different piles, the clamping units continuously moving downwardly until all elements have been separated from each other.

5. A method according to claim 1 wherein the jaw-type unit which is moved across the clamping direction is one unit of the upper pair, and moves relatively to the other unit of the upper pair and both units of the lower pair so as to effect a pivotal movement of the element being separated.

6. Apparatus for separating lightweight concrete elements delimited by essentially horizontal cuts but adhering to each other to form at least one block of plural stacked elements, said apparatus comprising one upper pair and one lower pair of mutually opposite elongate clamping units, means mounting the units of each pair for relative clamping movement toward each other to have each pair grip in a tong-like manner a respective element of two elements situated on either side of a cut, at least one clamping unit of at least one pair being mounted for movement also across the clamping direction to bring about a pivotal movement of one element relative to the other for separating said elements from each other, at least one of the units in the upper as well as in the lower pair of clamping units comprising a multitude of single clamping jaws arranged for moving individually and independently of each other toward the opposite clamping unit during the clamping movement, the clamping jaws of at least one of said jaw-type clamping units being movable together and simultaneously across the clamping direction for effecting said separating of the elements.

7. Apparatus according to claim 6 wherein both units of each pair consist of a multitude of single clamping jaws, and said across-movable unit comprises one of the units of the upper pair which moves across the clamping direction relative to the other unit of the upper pair and relative to both units of the lower pair.

8. Apparatus according to claim 7 wherein each of said clamping jaws is mounted on a pivotally mounted arm, the arms for the across-movable upper clamping jaws being mounted on pivots free of adjacent pivots on which are mounted the arms for the adjacent lower clamping jaws.

9. Apparatus according to claim 8 wherein the arms of all the clamping jaws which are movable across the clamping direction are connected mutually by a common synchronizing shaft for effecting the simultaneous movement of the clamping jaws across the clamping direction.

10. Apparatus according to claim 9 wherein the arms of the across-movable clamping jaws are connected to the synchronizing shaft via a linkage for effecting the simultaneous movement of the arms across the clamping direction.

11. A device according to claim 10 wherein the synchronizing shaft is rotatable and said linkage comprises a bracket fixed to the synchronizing shaft and connected to said pivots around which said across-movable arms are mounted so as to move said pivots in said across direction.

12. Apparatus according to claim 11 wherein the synchronizing shaft is turned by means of at least one hydraulic motor.

13. Apparatus according to claim 8 wherein the mutually opposite upper clamping jaw arms and the mutually opposite lower clamping jaw arms are connected at their upper ends above said pivots by piston-and-cylinder devices for effecting said clamping movements.

14. Apparatus according to claim 13 wherein each of the arms consists of at least two mutually connected adjacent struts, the arm of each upper clamping jaw being mounted between the struts which together form the arm of a lower clamping jaw.

15. Apparatus according to claim 13 wherein the clamping jaws and their pivotal arms are carried by an elongate carrier of essentially U-shaped cross section, and means mounting the carrier for vertical movement.

16. Apparatus according to claim 15 wherein the distance between the lower clamping jaws and the horizontal part of the U-shaped carrier which unites the depending shanks of the U-shape is at least almost as long as the maximum height of a block of stacked elements to be separated, such that the lower clamping jaws can grip the lowermost element of a stack when said carrier is moved downwardly.

* * * * *