

[54] **APPARATUS FOR FORMING SMALL LUMPS FROM SCRAP MATERIALS**

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[51] Int. Cl. **B30b 9/32**

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[56] **References Cited**

UNITED STATES PATENTS

528,738	11/1894	Pfouts.....	83/461
3,367,019	2/1968	Williamson.....	100/98 UX
3,283,697	11/1966	Findlay.....	100/95
3,005,403	10/1961	Van Endert.....	100/98 R

3,126,816	3/1964	Thompson.....	100/98 R
3,039,343	6/1962	Richards.....	83/923 X
2,605,657	8/1952	Lindemann et al.	100/98 R
3,141,401	7/1964	Lindemann et al.	83/461 X
3,157,082	11/1964	Thompson.....	83/923 X
3,276,307	10/1966	Williamson.....	83/923 X

FOREIGN PATENTS OR APPLICATIONS

6,714,749	5/1968	Netherlands	100/232
845,438	11/1952	Germany.....	100/98

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[57] **ABSTRACT**

Apparatus for making small lumps from scrap materials, such as motor vehicles, used cars and the like, comprising means for compressing the scrap materials into a compact columnar block, and cutting means including at least two spaced and juxtaposed lower shearing dies, and at least one upper shearing die adapted to be reciprocable into the space between said lower shearing dies, whereby it is possible to form small lumps of high compactness from scrap materials, such as used cars.

5 Claims, 9 Drawing Figures

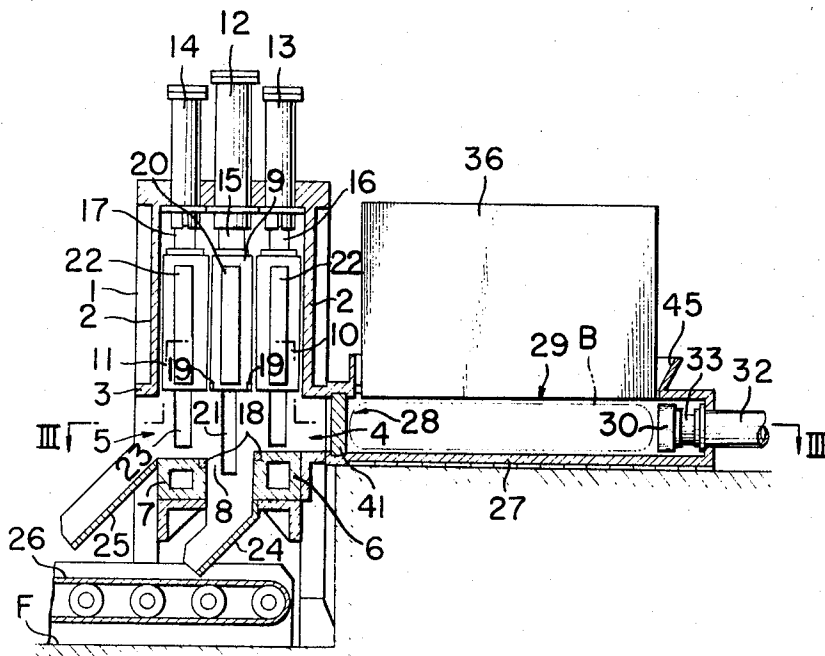


FIG. 1

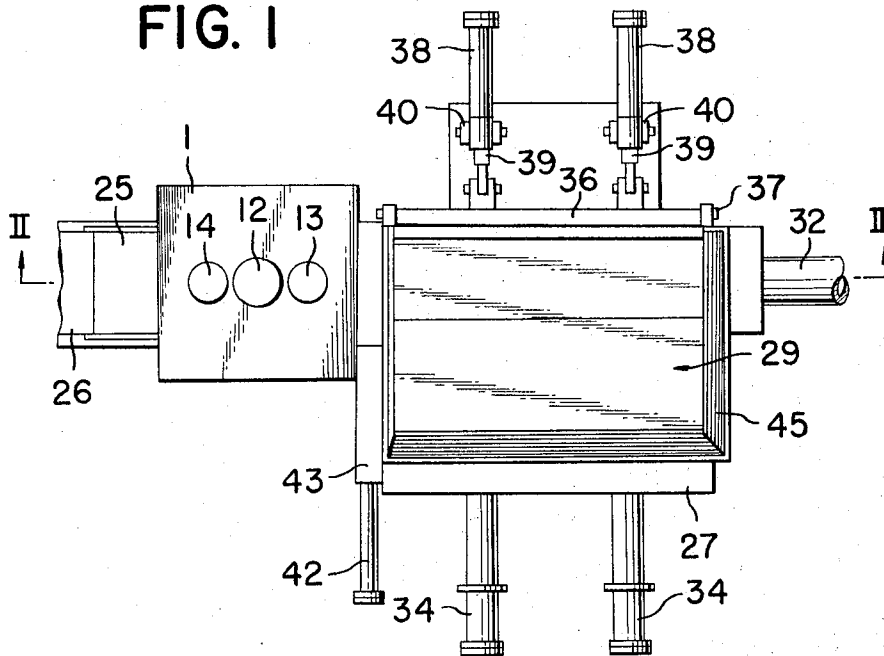
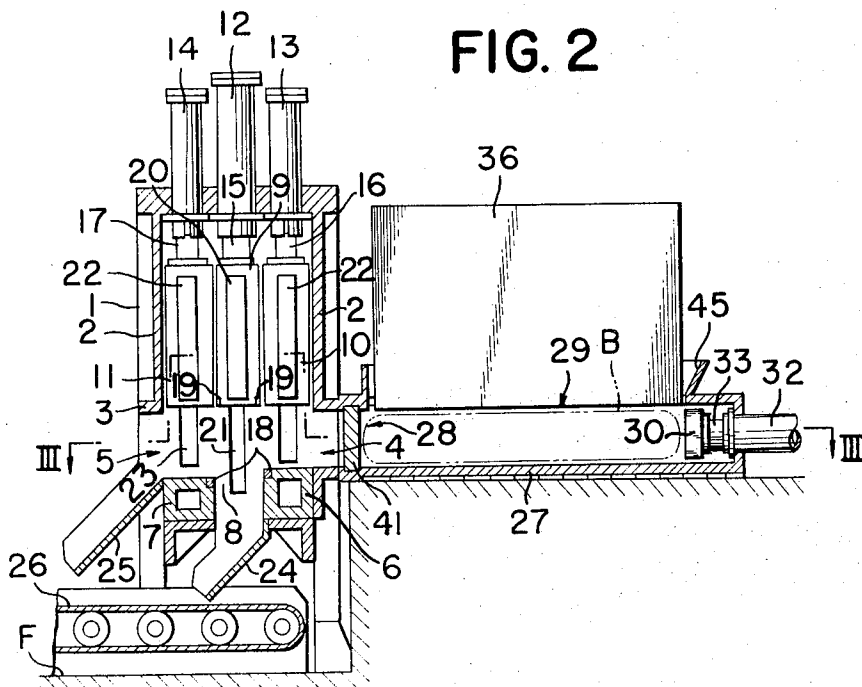


FIG. 2



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FIG. 6

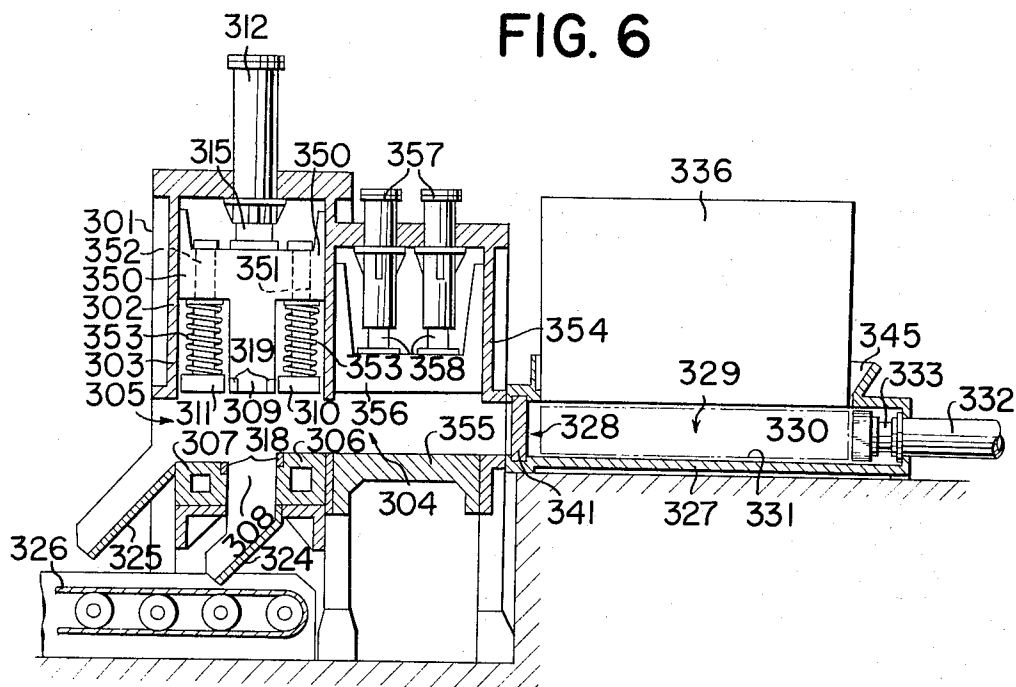
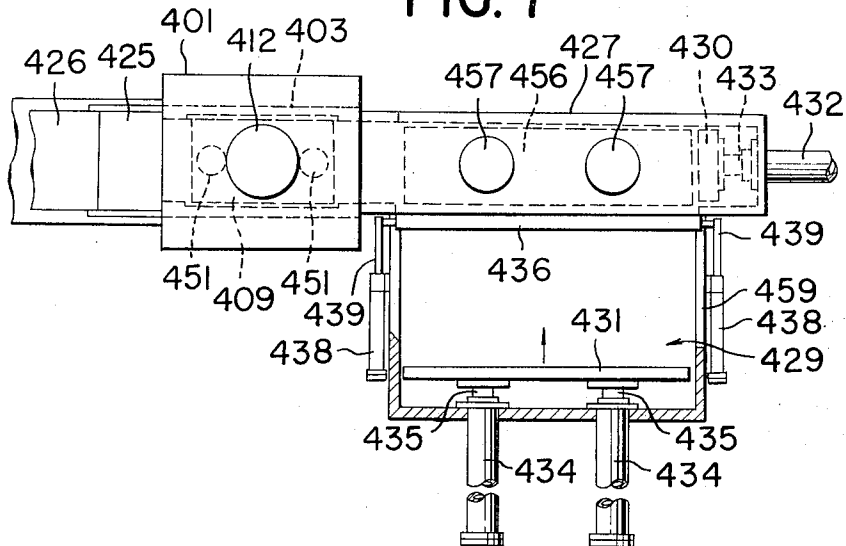


FIG. 7



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APPARATUS FOR FORMING SMALL LUMPS FROM SCRAP MATERIALS

The present invention generally relates to an apparatus for converting scrap materials, such as motor vehicles, used cars and the like, into highly compacted small lumps, mostly consisting of iron, which are in a form suitable as a raw material for steelmaking, for example by an electric furnace, open-hearth furnace or converter.

For disposal of scrap materials in the form of used cars, there are known and used devices for compressing the materials into compact blocks. In order to reduce these blocks into small lumps suited for use as a raw material for steel-making, machines are used for severing these blocks one by one, or for cutting up such blocks. However, these conventional devices and machines are poor in their productivity of small lumps, and also the cutting machines suffer rapid wear of the cutting edges or tools since they must cut or sever the scrap-material blocks at normal temperature.

This invention is designed to eliminate the above-said and other defects accompanying conventional devices and to provide a novel and improved apparatus for forming small lumps from scrap material, such as used cars.

According to the present invention, there is provided an apparatus for forming small lumps, comprising means for compressing the scrap materials into a compact columnar block and means for cutting the block into small lumps, said cutting means including at least two spaced and juxtaposed lower shearing dies, and at least one upper shearing die which is reciprocable into the space between said lower dies. The compact columnar blocks formed from the scrap materials are reduced into at least two small lumps in the shearing operation, thus attaining an efficient cutting operation for forming small lumps of high density.

Thus, according to the present invention, a used car, cleared of non-ferrous metals and other undesired materials during the heating step, is compressed and sheared while it is still at a high temperature, whereby it can be compressed into a block of high density and easily sheared into small lumps with small force. Also, the shearing edges used according to the invention suffer little wear, and the obtained small lumps prove to be of high purity. The obtained material will be predominantly iron, suitable for use as a raw material for steelmaking, such as, for example, by an electric furnace, an open-hearth furnace or a converter.

It is therefore an object of the present invention to provide an apparatus with high productivity for forming small lumps from scrap materials such as used cars.

Other objects, features and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description, when considered with the accompanying drawings, wherein

FIG. 1 is a plan view of a first embodiment of an apparatus according to the invention for forming small lumps from scrap materials;

FIG. 2 is a vertical cross-sectional view taken along line II — II of FIG. 1;

FIG. 3 is a horizontal cross-sectional view taken along line III — III of FIG. 2;

FIG. 4 is a vertical cross-sectional side view, somewhat similar to FIG. 2 but omitting the structure of the compression box, of a second embodiment of the apparatus according to the present invention;

FIG. 5 is a vertical cross-sectional side view, similar to that of FIG. 4, of a third embodiment;

FIG. 6 is a vertical cross-sectional side view, similar to the complete FIG. 2, of a fourth embodiment;

FIG. 7 is a partly cut-away plan view of a fifth embodiment, resembling the illustrations of FIGS. 1 and 3;

FIG. 8 is a longitudinal cross-sectional side view further illustrating the invention, for forming small lumps from scrap materials; and

FIG. 9 is a vertical cross-sectional view taken along line IX — IX of FIG. 8, illustrating how a motor vehicle is caught by fork means.

In the following, the first exemplary embodiment of the inventive apparatus will be described with reference to FIGS. 1 to 3. There is shown a frame 1 erected on floor F, and at its top is formed a cutting box 3 enclosed by side walls 2, with a feeding port 4 formed in the rear side wall, and a delivery port 5 formed in the front side wall. At the bottom inside of cutting box 3 are secured two lower shearing dies 6, 7 with a space or opening 8 therebetween. At the upper part, inside cutting box 3, are provided an upper shearing die 9 and holding or pressing blocks 10, 11 positioned on both sides thereof. Upper die 9 and blocks 10, 11 are coupled to the bottom ends of respective rams 15, 16, 17 of respective hydraulic cylinders 12, 13, 14 supported vertically by a top plate of frame 1.

Lower dies 6, 7 are substantially as wide as space 8 and have flat top surfaces, with edges 18 provided at the opposed top ends of the dies. It will also be noted that dies 6, 7 are arranged in a stepped or staggered relation with respect to each other so that the top face, particularly the edge portion, of one of the dies, namely 7, is positioned lower than that of the die 6.

The upper die 9 is a cube-shaped structure having a slightly smaller width than space 8 and is provided at its bottom with edges 19 corresponding to edges 18 of lower dies 6, 7. As means for guiding the vertical motion of upper die 9, there are provided on both sides of the upper die vertical protuberances 20 which are slidably fitted in guide grooves 21 formed in side walls 2 of cutting box 3.

Blocks 10, 11 are cubic structures each having a flat bottom face and being provided on both sides with protuberances 22 which are slidably fitted in guide grooves 23 formed in side walls 2 of box 3 to act as guides for the vertical movement.

A chute 24 is provided below space 8 and another chute 25 below delivery port 5, and beneath these chutes 24, 25 is arranged a conveyor 26.

Behind cutting box 3 is provided a compression box 27 connected thereto. Box 27 is of a oblong structure and has formed at one side of its front an opening 28 communicating with feeding port 4, and the top of the box is entirely open to provide an inlet 29. The configuration of the compression box 27 allows the scrap material to be compressed into substantially columnar form, as will be explained in more detail as the description proceeds. At the rear end inside compression box 27 is slidably mounted a push plate 30, and along a side of said box is slidably mounted a force plate 31 disposed perpendicularly to push plate 30.

Plate 30 is coupled to a ram 33 of a hydraulic cylinder 32 supported horizontally behind box 27 while force plate 31 is coupled to rams 35 of hydraulic cylinders 34 supported likewise at the side of box 27. A lid 36 of inlet 29 is pivotally mounted by a shaft 37 at the upper end of the box side wall, and hydraulic cylinders 38 for driving lid 36 are pivoted to brackets 40 provided outside the box, with rams 39 of cylinders 38 being coupled to lid 36.

At opening 28 is slidably mounted a slide door 41 adapted to open or close said opening as desired, and a hydraulic cylinder 42 for driving door 41 is supported by a door frame 43 secured to compression box 27, with a ram 44 of cylinder 42 being coupled to door 41. There is also mounted a hopper 45 at the inlet 29.

Now the operation and function of the above-described exemplary apparatus will be explained. A used car, constituting the scrap material to be processed, is charged from above, e.g., with a crane, into compression box 27 and then lid 36 is closed by actuation of cylinders 38. The bulky car is crushed flat by the closure of the lid. Then force plate 31 is pushed forward by actuation of cylinders 34 whereby the car is compressed laterally into a columnar block B.

If desired, it is also possible to compress the block B longitudinally by push plate 30 which is advanced by actuation of cylinder 32. Then door 41 is opened by actuating cylinder 42, and plate 30 is advanced to push block B into box 3 until the foremost end of the block rides on lower die 7. Then cylinders 12, 13 and 14 are actuated to cause upper shearing die 9 and blocks 10, 11 to descend. The blocks 10, 11, in cooperation with the upper faces of lower dies 6, 7, vertically compress the columnar block while holding it therebetween.

The upper die 9, while compressing the columnar block B, shears it into two small lumps between edges 19 and 18 of the respective upper and lower dies. One of the lumps is discharged from opening 8 and through chute 24 unto conveyor 26 while the other lump remains on the top face of lower die 7. The succeeding columnar block is likewise forced into box 3 by push plate 30 and subjected to shearing operation in the same manner. The previous lump which remained on lower die 7 is pushed from behind by the succeeding block and dropped through chute 25 unto conveyor 26.

Referring now to FIG. 4, there is shown a second embodiment of the present invention in which a push block 147 having a bevelled top face 146 is vertically slidably mounted in a space or opening 108 between lower dies 106, 107 in a cutting box 103, push block 147 being coupled at its bottom to, and thereby supported by, a ram 149 having a hydraulic cylinder 148.

Other structural arrangements are substantially the same as in the first embodiment, and it will be understood that the numerals 101, 102, 104, 105, 109 to 123, 125 to 127 and 141 identify parts substantially corresponding to the counterparts shown in FIGS. 1 to 3, such as 1, 2, 4, etc., respectively.

According to this embodiment, the small lumps entering opening 108 during the shearing operation are forced out with ascent of push block 147 and are directly passed down along bevel 146 unto chute 125 or the top face of lower die 107.

In FIG. 5 is represented a third exemplary embodiment of the present invention in which a T-shaped upper die 209 having arms 250 at both upper end wings

is vertically slidably mounted in a cutting box 203, and a pair of rods 251, 252 having presser blocks 210, 211, respectively, at the bottom end thereof, are vertically slidably supported by said arms 250, and between each arm and block 210 is interposed a spring 253 tending to elastically press said block downwards.

The structure is otherwise substantially the same as in the first embodiment, and the reference numerals 201, 202, 204 to 208, 212, 215, 218, 219, 224 to 227 and 241 designate parts corresponding to their structural counterparts in FIGS. 1 to 3, e.g., 1, 2, 4, etc.

According to this embodiment, presser blocks 210 are caused to move downward with the descent of upper die 209, thus allowing simultaneously to perform compression and shearing of the columnar block.

Referring now to FIG. 6, there will be seen a fourth embodiment of the inventive apparatus wherein arrangement is made so that the used car fed to the compression box is fully compressed in both vertical and lateral directions. A primary compression box 327 is provided with a force plate 331 adapted to effect lateral compression in the same manner as in FIG. 3, and a push plate 330 is arranged to deliver the block. Between the front of box 327 and the rear end of a cutting box 303 is mounted a secondary compression box 354 for accomplishing vertical compression. At the bottom inside of box 354 is provided a horizontal bed 355, and at the top of said box is vertically slidably supported a force plate 356 of substantially the same width as box 303.

As will also be noted, rams 358 of two hydraulic cylinders 357, secured vertically to the top plate of box 354 are coupled to force plate 356. As in the case of the embodiment of FIG. 5, an upper shearing die 309, presser blocks 310, 311, each having a spring 353, as well as lower dies 306, 307 are provided in cutting box 303.

It is apparent that numerals 301, 302, 304, 305, 308, 312, 315, 318, 319, 324 to 326, 328, 329, 332, 333, 336, 341 and 345 relate to structural elements corresponding to their counterparts as shown in FIGS. 1 to 3, e.g., 1, 2, 4, etc., and the numerals 350, 351 and 352 denote parts substantially identical with the counterparts in FIG. 5, namely 250, 251 and 252.

According to this embodiment, the scrap material in the form of a used car body is first compressed laterally by force plate 331 in box 327 and then compressed vertically by plate 356 in box 354 whereby the body is reduced into a compact block which is columnar in section. When this block is sheared into small lumps, each of the obtained lumps proves to be very compact and of extremely high density.

The fifth embodiment shown in FIG. 7 is a combination of the primary and secondary compression boxes of FIG. 6, wherein it will be noted that a top-opened feeder box 459 is provided alongside a compression box 427 connected to a cutting box 403, and a force plate 456 for effecting vertical compression is attached to the rams of two hydraulic cylinders 457 supported vertically to the top plate of box 427 while a push plate 430 is secured to a ram 433 of a hydraulic cylinder 432 supported horizontally at the rear of box 427.

It will also be noted that a laterally compressing force plate 431 is coupled to rams 435 of two hydraulic cylinders 434 supported horizontally at the rear of feeder

box 459. At the front end of said box is pivotally mounted a lid 436 for the inlet 429 of box 459, lid 436 being adapted to be opened and closed by the action of rams 439 of hydraulic cylinders 438 which are swingably supported on both sides of box 459.

The structural arrangement of the cutting means is substantially the same as that in FIG. 5, with the numerals 401, 409, 412, 425, 426 and 451 identifying parts which correspond to their counterparts in FIG. 5, e.g., 301, 309, etc. The only exception is that no door is provided at the boundary between compression box 427 and cutting box 403.

For purposes of further illustrating the present invention, and the method of forming small lumps from scrap materials, reference will now be had to FIGS. 8 and 9. The applicant does not claim herein the method and arrangement to be described hereunder, which are respectively covered by U.S. Pat. Nos. 3,323,908 and 3,339,905, issued on June 6 and Sept. 5, 1967; however the close correlation with the subject matter of the present invention appears to warrant further elucidation.

It will be seen in FIGS. 8 and 9 that stage 560 of a suitable height is provided on one side of a compression box 527 and upon this stage is built a heating chamber or furnace 561 in which the motor vehicle or used car is heated. In said chamber and on both sides thereof there are provided a pair of rotatable and retractile catch forks 562 adapted to catch and hold a car, and at the ceiling of the heating chamber are mounted several burners 563 using, for example, heavy oil, gas or the like fuel. The floor portion 564 beneath the catch forks is arranged to be vertically moved by a hydraulic cylinder 565.

A truck 566 carrying a car C thereon is guided along rails 567 into heating chamber 561. Then cylinder 565 is actuated to raise floor portion 564 up to a position where car C is aligned with said pair of catch forks 562. The forks are then made to project to securely hold the car from both sides. After lowering floor portion 564 to its normal position, burners 563 are ignited and the forks are rotated.

The car is thus heated to about 1,000° C whereby non-ferrous metals and other impurities contained therein are melted off. Upon completion of this heating treatment, the car is again carried on truck 566, delivered out of heating chamber 561 and immediately charged into compression box 527 through a chute 568. The car charged into box 527 is compressed by a force plate 531 into a columnar block, in the same manner as has been described above.

It should be noted that the just described procedure, and apparatus therefor, as covered by the aforementioned earlier patents of the same inventor, essentially serve for separating ferrous and non-ferrous metals of a motor vehicle, used car and the like, without making use of the remnants, that is the chassis or frame proper, with any useful parts which have not yet been removed by melting. This is where the present invention takes over, or becomes effective, in that the useful scrap material contained in the remnants of the car can subsequently be converted into the highly compacted small lumps, mostly consisting of iron, as described earlier in this application.

When applied to the arrangement shown in FIGS. 8 and 9, the inventive concept of the present application actually provides a useful method which comprises the steps of heating the scrap materials to a predetermined temperature lower than the melting point of iron but higher than that of non-ferrous metals and impurities therein (in a single step or in several steps, at successively higher temperatures), — compressing, immediately after the heating step, the scrap materials into a compact columnar block while still at the predetermined temperature, — and cutting, immediately after the compressing step, the block into small lumps while still at the predetermined temperature.

During the compressing treatment, the car is still in a highly heated condition of about 600° to 800° C, and thus it can be easily compressed into an extremely compact columnar block. The obtained block is immediately sheared into small lumps in the cutting box. This shearing operation can be readily accomplished since the columnar block is still in a highly heated condition of at least 500° to 700° C.

In FIG. 8, the numerals 530, 536 as well as 538 to 540 are used to signify parts corresponding to the counterparts in FIGS. 1 to 3, e.g., 30, 36, etc.

It should be understood, of course, that the foregoing disclosure relates only to preferred embodiments of the inventive apparatus, and that it is intended to cover all changes and modifications of the described examples, falling within the scope and spirit of the invention.

What I claim is:

1. An apparatus for forming small lumps from scrap materials, such as motor vehicles and the like, comprising means for compressing scrap materials into a compact columnar block, said compressing means being substantially oblong and having an open inlet top and an outlet end, means for cutting the block into small lumps, said cutting means being substantially vertically disposed at said outlet end of the compressing means, at least two spaced and juxtaposed lower dies and at least one upper die for shearing the block, said upper die being reciprocable into the space between said lower dies, at least two reciprocable presser blocks disposed on both sides of said upper die and adapted to hold the block in cooperation with said lower dies during the shearing operation, and elastic supports for said presser blocks from said upper die so as to elastically hold the block in cooperation with said lower dies.

2. An apparatus for forming small lumps from scrap materials, such as motor vehicles and the like, comprising means for compressing scrap materials into a compact columnar block, said compressing means being substantially oblong and having an open inlet top and an outlet end, means for cutting the block into small lumps, said cutting means being substantially vertically disposed at said outlet end of the compressing means, at least two spaced and juxtaposed lower dies and at least one upper die for shearing the block, said upper die being reciprocable into the space between said lower dies, and a pusher block for pushing out the lumps received in the space between said lower dies, said pusher block having a top bevelled surface and being slidably arranged in said space.

3. An apparatus for forming small lumps from scrap materials, such as motor vehicles and the like, compris-

ing means for compressing scrap materials into a compact columnar block, said compressing means being substantially oblong and having an open inlet top and an outlet end, means for cutting the block into small lumps, said cutting means being substantially vertically disposed at said outlet end of the compressing means, at least two spaced and juxtaposed lower dies and at least one upper die for shearing the block, said upper die being reciprocable into the space between said lower dies, wherein said compressing means includes at least one compression box and at least one force plate reciprocable in said box for compressing the scrap materials into the block, and wherein said compression box is provided with a delivery port at said outlet end, open to said cutting means, a push plate arranged reciprocably on the side of said compression box opposite to said delivery port, and slidable door means between said delivery port and said push plate, said door means acting in its closed condition as a crushing wall for the scrap materials, said plate being adapted to push the block into said cutting means through said delivery port when said door means is in its open condition.

4. The apparatus as defined in claim 3, wherein said

compression box includes a primary box and a secondary box disposed in rectilinearly aligned relationship with said primary box, said door means being disposed between said boxes, and wherein said force plate includes a primary force plate reciprocable in said primary box for compressing the scrap materials in a first direction and a secondary force plate reciprocable in said secondary box for compressing the same in a second direction substantially perpendicular to the first direction.

5. The apparatus as defined in claim 4, wherein said primary box is provided with a delivery port open to said secondary box and a push plate arranged reciprocably on the side of said primary compression box opposite to said delivery port, said secondary box being also provided with a delivery port open to said cutting means and disposed on the side of said secondary compression box opposite to said first-named delivery port of the primary box, and said push plate is adapted to push out the block from said primary compression box through its delivery port into said secondary compression box and further through said delivery port of the latter into said cutting means.

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