United States Patent

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[72] Inventor Heinz W. Winter
Salt Lake City, Utah

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[73] Assignee Envirotech Corporation
Salt Lake City, Utah
a corporation of Delaware

[54] JAW CRUSHER AND METHOD OF OPERATION THEREOF

9 Claims, 9 Drawing Figs.

[52] U.S. Cl. 241/30, 241/81, 241/202
[51] Int. Cl. B02c 1/06
[50] Field of Search ..... 241/202, 217—219, 265, 30, 24, 81

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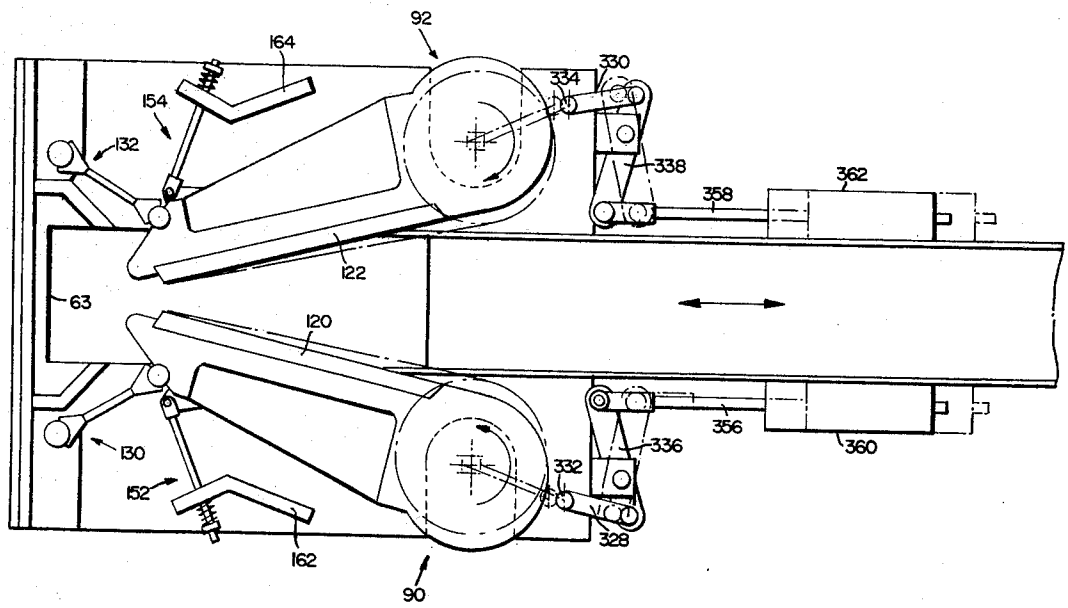
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Primary Examiner—Donald G. Kelly
Attorney—Stowell and Stowell

ABSTRACT: A generally horizontal flow vertical axis jaw-type crusher is provided wherein the jaws are mounted for eccentric motion toward and away from each other and linkage means driven by at least one of the jaws is provided for synchronous compaction feeding of material to be crushed into the jaws of the crusher.



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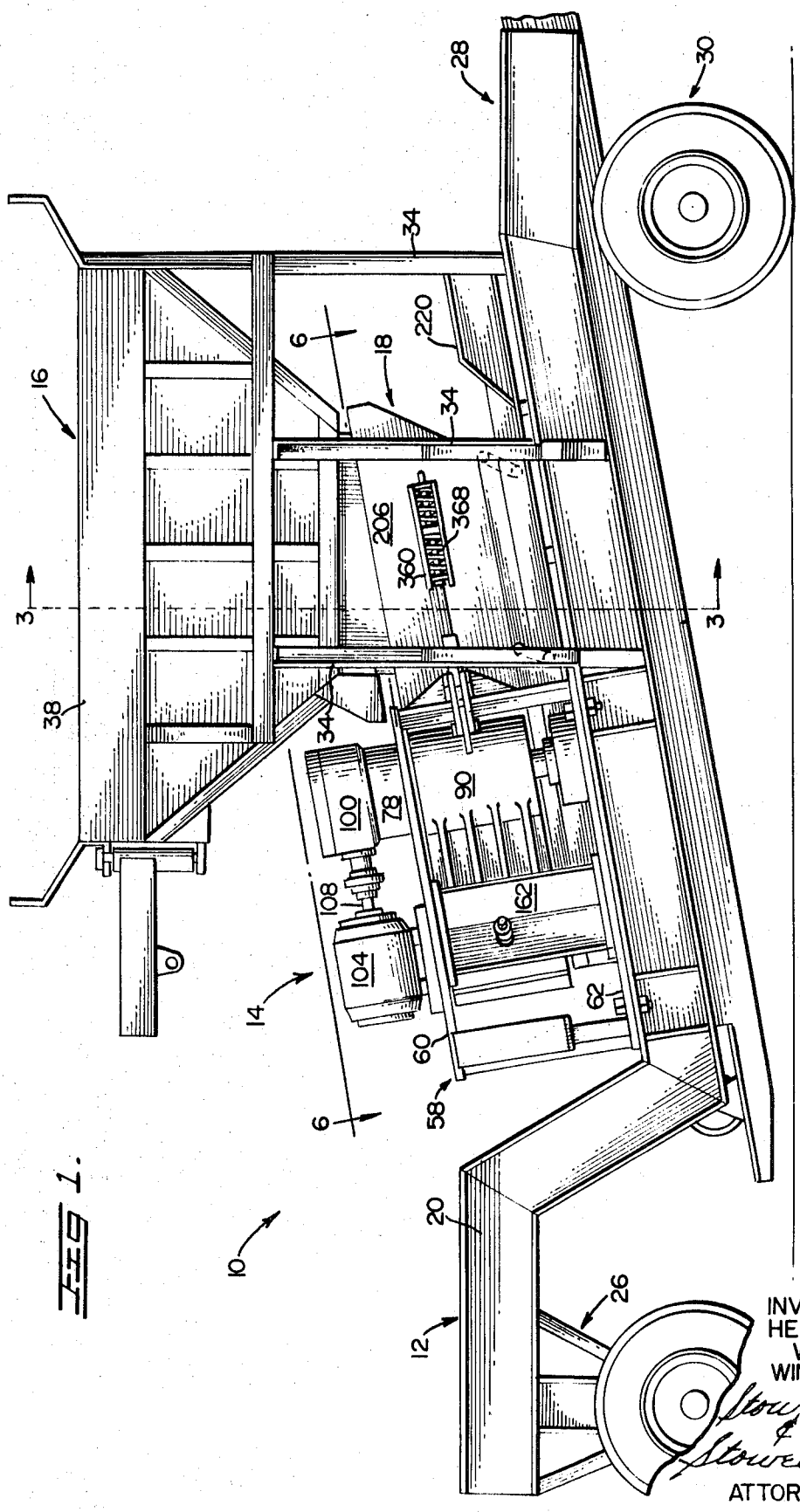


FIG 1.

INVENTOR
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W.
WINTER

Stowell & Stowell

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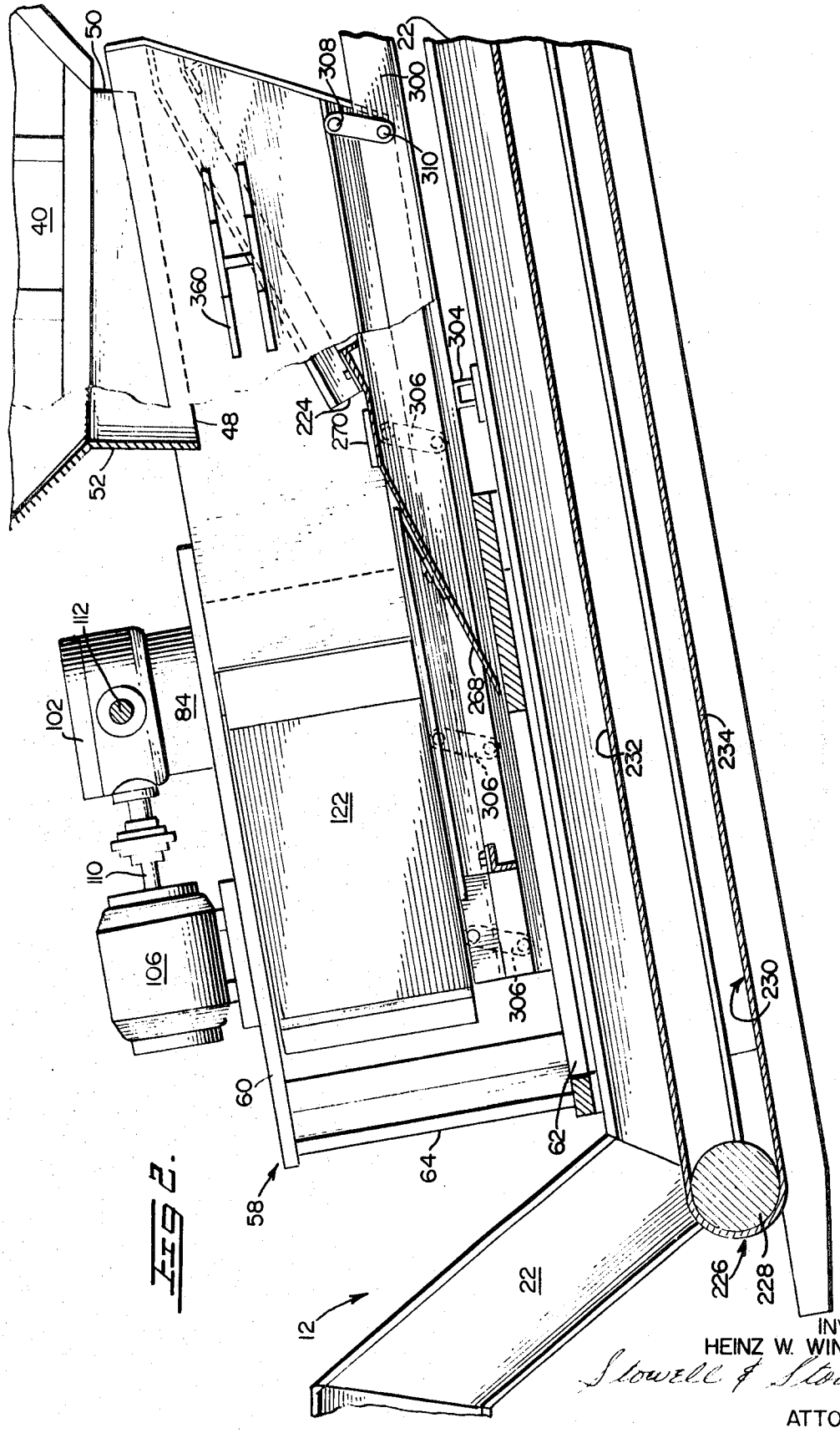
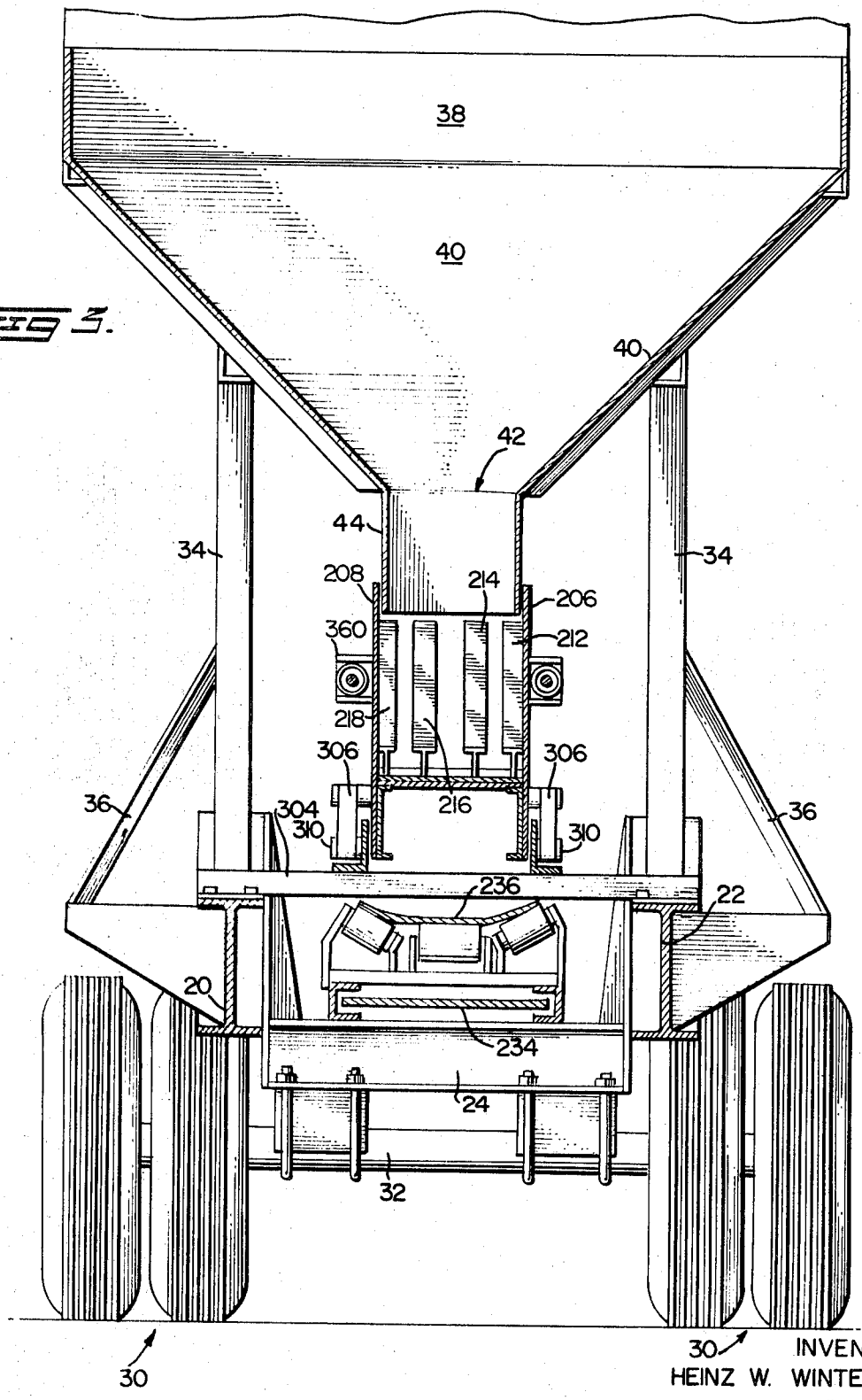


Fig 2.

INVENTOR
HEINZ W. WINTER
Stowell & Stowell
ATTORNEYS

Fig 3.



INVENTOR
HEINZ W. WINTER

Stowell & Stowell

ATTORNEYS

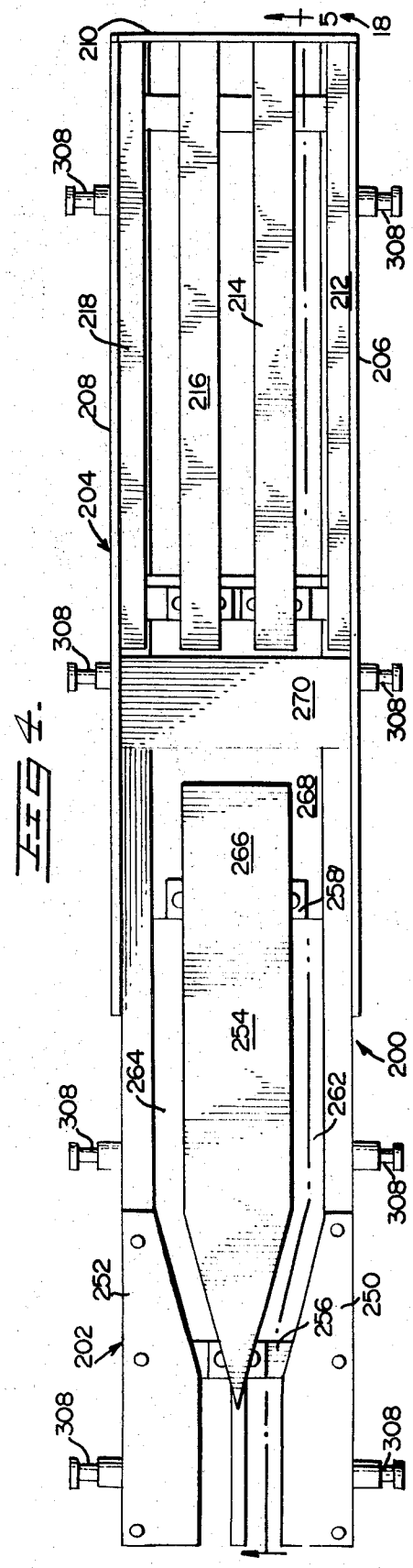


FIG 4.

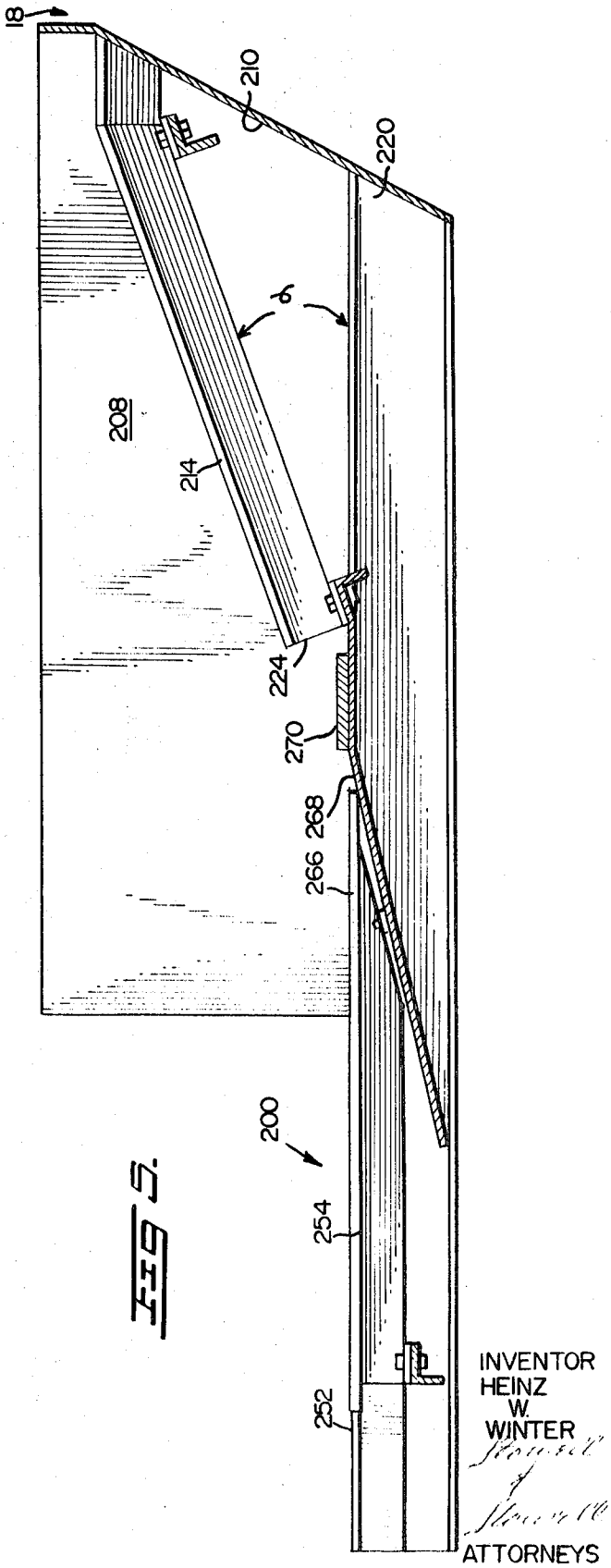
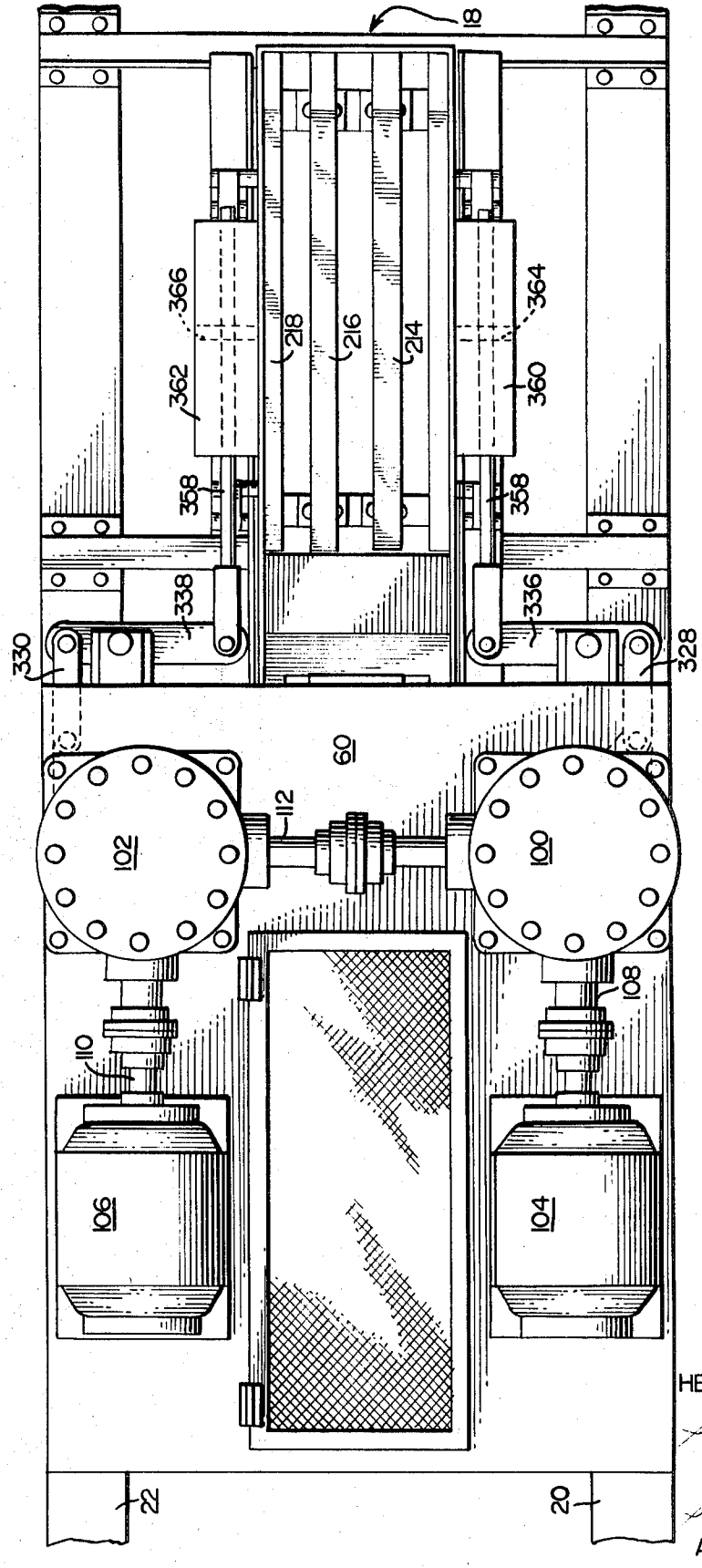


FIG 5.

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HEINZ
W.
WINTER

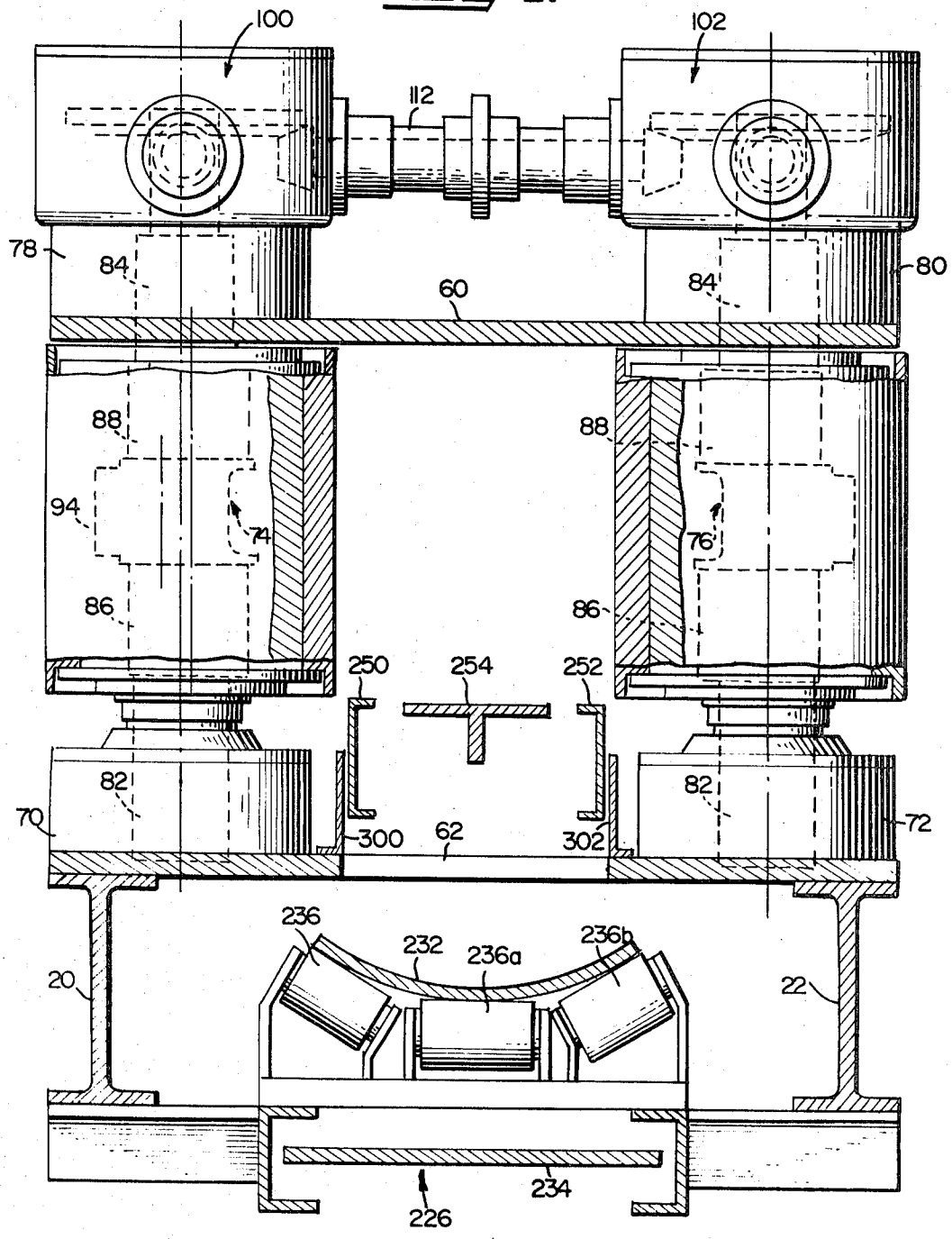
ATTORNEYS

FIG 6.



INVENTOR
HEINZ W. WINTER
Stowell & Stowell
ATTORNEYS

Fig 7.



INVENTOR
HEINZ W. WINTER

Stowell & Stowell

ATTORNEYS

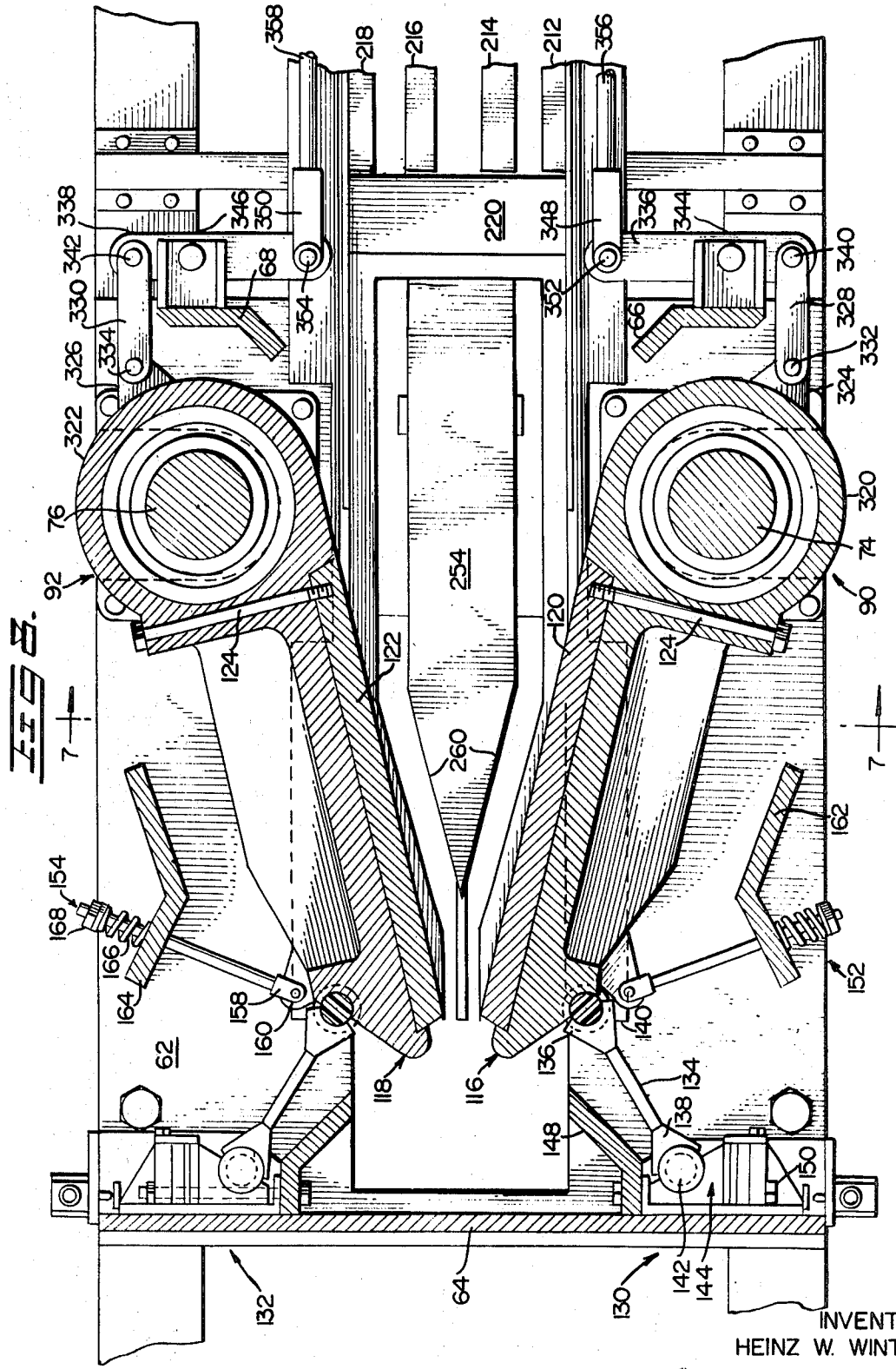


Fig. 8.

INVENTOR
HEINZ W. WINTER

Stowell & Stowell

ATTORNEYS

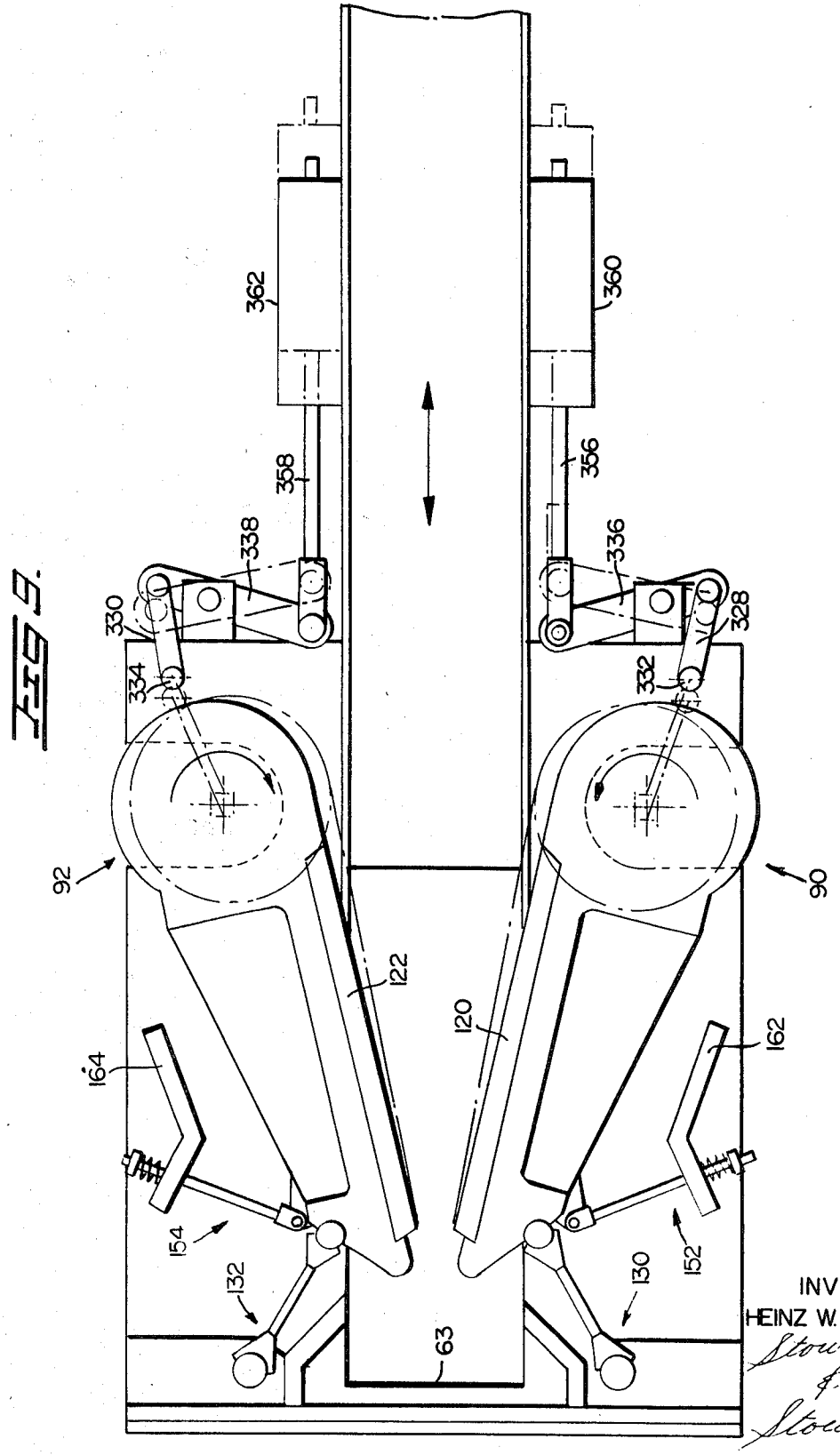


Fig. 9

INVENTOR
HEINZ W. WINTER
Stowell & Stowell
ATTORNEYS

JAW CRUSHER AND METHOD OF OPERATION THEREOF

BACKGROUND OF THE INVENTION

Most conventional jaw crushers are provided with at least one moveable jaw, usually supported on a horizontal shaft for eccentric motion. The jaw of the crusher oscillates or reciprocates about the horizontal axis in association with a further fixed or synchronously moveable jaw to provide a downwardly convergent crushing chamber. The material to be crushed is introduced into the wide, upper end of the crushing chamber and emerges from a relatively narrow, lower end, passing through the crushing chamber by force of gravity, while being crushed by the oscillating or reciprocating motion of the one-jaw relative to the other or the reciprocating or oscillating action of both jaws relative to each other.

More recently, vertical axis, generally horizontal flow jaw-type crushers have been invented as such horizontal flow crushers have materially reduced headroom. The low headroom requirements of horizontal material flow-type jaw crushers permit use of such crushers in underground mining operations where headroom is a critical factor.

In addition to the low headroom requirements of horizontal material flow jaw-type crushers, the low profile of such apparatus permits mobile operation of such machines as heavy foundations or supporting bases are substantially eliminated.

THE PRESENT INVENTION

The present invention is particularly directed to an improved horizontal material flow, vertical axis, oscillatory, jaw-type crusher having means to insure a more uniform flow of material through the jaws of the crusher and to means for synchronizing the jaws and the compaction feeding means which materially reduces the cost of manufacture by eliminating separate drive means for the feeder.

The present invention also provides means whereby the horizontal flow of material insures high throughput with a minimum of choking or clogging and to such feed means which assist in maintaining an effective flow profile of material through the crusher jaws.

These and other objects and advantages are provided in a horizontal flow vertical axis jaw-type crusher wherein at least one of the jaws thereof is mounted for eccentric motion toward and away from the other of said jaws, and means for synchronously feeding material into and between the jaws, wherein said feeding means comprises linkage means connected to the eccentrically mounted jaw for reciprocating the feeder in a direction opposite to the reciprocating component of the eccentrically mounted jaw; the invention is also provided in a method of operating a horizontal flow generally vertical axis jaw crusher and feed mechanism therefor which generally comprises the steps: moving at least one of the jaws in an eccentric path generally toward and away from the other of the jaws; converting the eccentric motion of the said one crusher jaw into opposed reciprocating motion and utilizing the converted opposed reciprocating motion to positively forwardly compact material to be crushed into the crusher jaws.

The invention will be more fully described in reference to the accompanying drawings wherein:

FIG. 1 is an elevational view of an improved jaw jaw-type crusher constructed in accordance with the teachings of the present invention;

FIG. 2 is an enlarged partial fragmentary view of the operating portion of the crusher illustrated in FIG. 1;

FIG. 3 is a vertical sectional view substantially on line 3–3 of FIG. 1;

FIG. 4 is a top plan view of the reciprocating compaction grizzly employed in the apparatus illustrated in FIG. 1;

FIG. 5 is a vertical sectional view substantially on line 5–5 of FIG. 4;

FIG. 6 is an enlarged fragmentary sectional view on line 6–6 of FIG. 1;

FIG. 7 is a fragmentary partial sectional view on line 7–7 of FIG. 8;

FIG. 8 is an enlarged substantially horizontal sectional view through the operating mechanism of the jaw crusher of FIG. 1; and

FIG. 9 is a diagrammatic horizontal view of the means for converting the eccentric or oscillatory motion of the jaws of the crusher into synchronous opposed reciprocating motion.

Referring to the drawing and, in particular, to FIGS. 1 and 3, 10 generally designates a mobile jaw-type crusher constructed in accordance with the present invention which generally includes a main frame 12, crusher assembly 14, material storage section 16 and material compaction feeding means 18.

The main frame assembly 12 includes a pair of spaced I-beams 20 and 22, which are maintained in their spaced relation by suitable crossbeams such as crossbeams 24 shown in FIG. 3. The forward end of the main frame 12 is supported on steerable wheel assembly means 26 having a yoke or fork, not shown, for attachment to a towing vehicle. The rearward end 28 of the main frame is supported on wheels 30 rotatably mounted on a fixed axle 32.

As more clearly shown in FIG. 1, the main I-beams 20 and 22 have a slight slope from the rearward end 28 toward the forward end, however, the bed of the vehicle may be horizontal or may have a greater or lesser slope than that illustrated in the drawing. The frame structure also includes a plurality of generally vertically extending rib members 34 suitably braced by further webbing 36 to support a large open hopper 38 for storage of the material to be crushed.

The hopper 38 has generally converging sidewalls 40 which feed to a reduced area opening 42, having a generally vertically extending outlet skirt 44, which directs material to be crushed into the compaction feeder means 18. As more clearly shown in FIG. 2, the outlet skirt 44 has its side edges 48 sloping downwardly from the rear walls 50 to the front wall 52 at substantially the same angle of slope as the main frame I-beams 20 and 22, for purposes which will be more readily apparent hereinafter.

THE CRUSHER MECHANISM

Referring particularly to FIGS. 1, 2, 6, 7 and 8, the crusher mechanism per se is housed in a boxlike frame 58, consisting of a top plate 60, a bottom plate 62, a forward end plate 64 and rear plates 66 and 68 suitably welded and bolted together to form a rigid support or housing for the crusher. The bottom plate 62 is mounted on the main frame members 20 and 22. Adjacent the rearward end of the bottom plate 62 and adjacent the lateral edges thereof are mounted a pair of bearing members 70 and 72 which journal the lower ends are eccentric drive shaft means 74 and 76 respectively. The upper ends of eccentric shafts 74 and 76 are journaled in corresponding bearing means 78 and 80 mounted on the upper surface of the top plate 60.

The shafts 74 and 76, as more clearly shown in FIG. 7, include concentric shaft portions 82 and 84, which are received in the bearing means 70 and 78 and 72 and 80 respectively, and eccentric portions 86 and 88 which are journaled in bores in the pair of jaw members 90 and 92. Between each of the pair of eccentric bearing portions 86 and 88 is an offset counter balance portion 94 which reduces vibration during rotation of the pair of shafts 74 and 76.

The upper end of each shaft projects into drive gear housing means 100 and 102 for shafts 74 and 76 respectively. A pair of motors 104 and 106, having output shafts 108 and 110, drive their respective shafts 74 and 76 through suitable gear means, not shown in the drawing, and the gear means include a cross-shaft 112 which synchronizes the rotation of shafts 74 and 76. While in the illustrated form of the invention dual motors 104 and 106 are shown as driving the pair of shafts 74 and 76, it will be recognized that only a single motor may be employed and that drive for the other of the shafts could be solely

through, for example, the cross-shaft **112** or the pair of shafts **74** and **76** could be interconnected by chain means to a single drive motor.

The pair of crusher jaws **90** and **92**, each has a forwardly extending cantilevered wing portion **116** and **118** respectively, the inner faces of which are fitted with removable crusher wear plates **120** and **122** secured to the wing portions **116** and **118** by welding, or, for example, bolts **124**, whereby the wear plates may be reversed after wear or inverted and replaced. The forward end of the cantilevered portions of the jaws **90** and **92** are suitably received in toggle linkage means **130** and **132**. The toggle linkage means **130** and **132** are identical in form, and are described in detail in my application entitled "-Toggle Link Means", filed on even at date herewith, Ser. No. 747,768, filed July 12,1968, now U.S. Pat. No. 3,479,904.

Since the toggle link means **130** are identical in form and are described in said copending application in detail only toggle link means **130** will be briefly described herein. Toggle link means **130** includes a link member **134** having hemicylindirical bearing means **136** and **138** at opposite ends thereof. Bearing means **136** engages a nylon bearing shaft **140** journaled in the extended end of jaw element **116**. The hemicylindrical bearing **130** engages a similar nylon bearing shaft **142** carried by an overload release support block **144** normally slidably mounted on the forward end wall **64** of the crusher housing **58**. The releasable slide block **144** is secured to a vertical web **148** by a long bolt **150** which is adapted to part under overload conditions to thereby permit the block **144** to slide laterally outwardly, thereby releasing the forward end of its cooperating jaw **90**.

Also at the forward end of each of the jaws **90** and **92** are spring-type tie means generally designated **152** and **154** respectively. The tie means **152** and **154** each includes a tie rod **156**, having a furcated end **158** pin connected to a wing element **160** of its respective crusher jaw. The extended outer end of each of the tie rods **156** passes through an enlarged bore in vertical plate means **162** for jaw **90** and **164** for jaw **92**. The extended ends are spring-biased by helical spring means **166** and locknuts **168** to thereby urge the extended and cantilevered ends **116** and **118** of the jaws of the crusher in an outwardly direction while still permitting relative inward motion upon actuation of the drive means **104** and **106**.

FEED MECHANISM

Referring particularly to FIGS. **2**, **3**, **4**, and **5**, the feeding and selective sizing of the material for the crusher jaws is performed by means generally designated **18** as hereinbefore generally described. The means **18** includes reciprocating frame member **200** having a relatively flat forward portion **202** and a hopper-type rearward portion **204**. The hopper-type rearward portion **204** includes sidewalls **206** and **208** and rear wall **210**. The bottom of the rear portion **204** includes a plurality of spaced beams **212**, **214**, **216** and **218** which slope downwardly from the rear wall **210**.

Referring specifically to FIG. **2**, it will be seen that material is initially deposited primarily upon the upper sloping faces of the bars **212** through **218**. In the illustrated form of the invention the bars **212** through **218** are at about a 20° angle to the lower frame member **220** of the reciprocating portion of the feeder. This angle, alpha, may be increased or decreased depending upon the amount of compaction-feeding that is desired and to some extent upon the type of material to be fed into the crusher jaws. It will be particularly noted from FIGS. **2** and **5** that the sloping bars **212** through **218** terminate just short of the forward edge **52** of the feed spout **44** of the storage hopper **38** and the edges **224** of these members **212** through **218** provide additional pushing force for material to be fed into the jaws as to be more fully described hereinafter.

In addition to the bars **212** through **218** providing the initial compacting and feeding action for material to be fed to the jaws of the crusher segregation of the material is provided by the spaces between the bars. These bars are so mounted that fine material and material having a predetermined size falls through the spaces between the bars on to a conveyor mechanism generally designated **226** positioned below the hopper and the crusher to remove crushed material to a rearward discharge position.

The endless belt conveyor **226** includes a forward idler pulley **228** and an endless belt **230** having an upper active flight **232** and a lower return flight **234**. The upper active flight is supported by a plurality of conventional idler rollers **236**, **236***a* and **236***b* to provide a troughlike catcher and supporter for crushed material, as more clearly shown in FIGS. **3** and **7** of the drawing.

The forward end **202** or grizzly portion of the reciprocating feeder **200** is generally formed of a pair side rail members **250** and **252** with a generally rectilinear center platform **254** mounted therebetween on cross bars **256** and **258**. The relationship between the crusher jaws and the center platform **254** is more clearly illustrated in FIG. **8** with the platform having tapered forward edges **260** which generally conform to the conveyance of the inner opposed faces of the jaws **90** and **92**. This platform **254** supports material maintained between the crusher faces **262** and **264**. The space between the lateral edges of the platform **254** and the side rails **250** and **252** permit material crushed, to a predetermined size, to fall from between the jaws of the crusher on to the active surface **232** of the conveyor belt assembly **226**.

It will be particularly noted that the bottom plate **62** of the crusher frame **58** is provided with a rectangular opening **63** over which reciprocates the forward end of the feeder mechanism.

Extending between the rearward end **266** of the platform **254** and the forward edges **224** of the sloping grizzly bars **212** through **218** is a further platform **268**, which is provided at its most rearward end with a horizontal plate **270** which directs material, smaller than the size of the spaces **262** and **264** and the spaces between the grizzly bars **212** through **218**, on to the active surface **232** of the conveyor **226**.

The entire feeder mechanism **200** is mounted for reciprocation, below the storage hopper **38** and below the crusher jaws, on a fixed frame consisting primarily of a pair of longitudinally extending beams **300** and **302** which are welded or otherwise secured to the upper surface of the bottom plate **62** of the housing **58** at their forward ends and upon suitable cross beams or sleepers **304** rearwardly thereof as shown, for example, in FIGS. **2** and **3** of the drawing. The spacing between the opposed faces of these beams **300** and **302** is such that beams **250** and **252** will freely slip therein as shown in FIGS. **3** and **7**. Beams **250** and **252** are mounted therein by a plurality of rocker links **306**. Each of the rocker links **306** has its upper end journaled in stub shafts **308** projecting laterally, at spaced intervals, from each of the side members **350** and **252** of the reciprocating feeder frames and from corresponding stub shafts **310** projecting laterally from the pair of spaced beams **300** and **302** as more clearly illustrated in FIGS. **2** and **3** of the drawing. By mounting the reciprocating feeder frame **200** vie the plurality of rocker links **306**, it will be seen that the feeder frame, including its hopper structure formed by walls **206**, **208** and **210**, is free to move longitudinally of the main frame **12** which rigidly carries the crusher assembly **58**.

DRIVE FOR FEEDER FRAME

As hereinbefore set forth, the feeder mechanism **200** is reciprocated in synchronism with the oscillation of the eccentrically mounted jaws **90** and **92** of the crusher. Referring particularly to FIGS. **1**, **6**, **8** and **9**, wherein the drive mechanism for the feeder frame **200** is more clearly illustrated, each of the barrel portions **320** and **322** of the crusher jaw members **90** and **92**, respectively, is provided with a rearwardly extending plate or ear member **324** and **326**, respectively. Each of the plates **324** and **326** is pivotally connected to link **328** and **330** respectively via pivot pins **332** and **334**. The rearward ends of each of the links **328** and **330** is then connected to a rocker

link 336 and 338, respectively, via pivot pins 340 and 342. The rocker links 336 and 338 are mounted for pivotal movement from the vertical rear wall members 66 and 68 of the boxlike support for the crusher jaws via pivot pins 344 and 346 respectively.

The most inner end of each of the rocker links 336 and 338 is pivotally connected to clevis portions 348 and 350 via pins, 352 and 354 respectively of rod members 356 and 358, which rod members are resiliently connected to sidewalls 206 and 208 respectively of the feeder mechanism. Each resilient connection includes a box portion 360 and 362 having a central partition member 364 and 366 respectively through which the rods 356 and 358 pass. Springs and suitable locknuts and washers generally designated 368, complete the assembly.

OPERATION

From the foregoing description and in reference particularly to FIGS. 8 and 9, it will be seen that is the motors 104 and 106 rotate shafts 74 and 76, the eccentrically mounted jaw members 90 and 92 follow an orbital path such that the jaws move inwardly and forwardly thence outwardly and rearwardly during each rotation of each of the shafts 74 and 76. This orbital or eccentric movement of each of the jaws 90 and 92 is converted to essentially straight line opposite-in-direction reciprocatory motion via the ears 324 and 326, secured to the rearward end of each of the barrel portions of the jaws 90 and 92, links 328 and 330, rocker links 336 and 338 and connecting rods 356 and 358. The primary conversion of the direction of motion is brought about by the rocker links such that as the jaws move outwardly and rearwardly, the rearward motion is converted to straight line forward reciprocating motion. This action is diagrammed in FIG. 9.

In an illustrated embodiment of the invention, with the jaws 90 and 92 having a height of 14 inches and a length of 33 inches, the shafts 74 and 76 are eccentrically mounted to the jaws to provide a maximum inward motion, for each of the rearward ends of each of the jaws of about one-half inches and a corresponding inward movement at each of the forward ends of the jaws. Due to the offcenter mounting of the rocker links 336 and 338, the slight eccentric motion of the crusher jaws is converted to straight line reciprocating motion of approximately about 1 inch. This reciprocating movement of the feeding mechanism 200 provides for positive compaction of the material to be crushed in the crusher jaws with the compaction primarily taking place as the jaws are moving rearwardly and outwardly. This synchronized control of the feeder, from the jaws of the crusher, insures a maximum throughput of the material to be crushed and in the example given above crushing rates from about 50 tons to 100 tons an hour, are readily obtainable with substantially no choking of the crusher jaws.

From the foregoing description of a preferred embodiment of the present invention, it will be seen that all of the objects hereinbefore set forth are fully accomplished.

It will be recognized by those skilled in the art, that various modifications may be made in the mechanism for carrying out the process of the invention without departing from the scope of the appended claims. Further, it will be recognized that the illustrated example is not by way of limitation but merely illustrates one form of apparatus embodying the principles of the present invention. For example, it will be recognized that the conversion of the eccentric motion of the crusher jaws into straight line reciprocating motion such that about one-half inch movement of the crusher jaws provides for about 1 inch movement of the feeder mechanism may be variously modified by merely changing the points of pivotal connection of the rocker links 336 and 338 to the main frame of the vehicle.

I claim:

1. A method of operating a horizontal material flow generally vertical axis jaw crusher and feed mechanism therefor comprising the steps of moving at least one of the jaws in an eccentric path generally toward and away from the other of the jaws of the crusher; converting the eccentric motion of the one jaw of the crusher jaws into opposed simple straight line reciprocating motion, and utilizing the converted opposed simple straight line motion to feed and compact materials into the crusher jaws.

2. In a generally horizontal flow vertical axis jaw-type crusher wherein at least one of the jaws thereof is mounted for eccentric motion toward and away from the other of said jaws, a classifier and feeder mounted for reciprocation below the jaws and means for synchronously reciprocating the classifier and feeder in response to eccentric motion of the said at least one jaw comprising linkage means connected to the eccentrically mounted jaw for reciprocating the feeder and classifier in a direction opposite to the reciprocating component of the eccentric motion of the jaw.

3. In a generally horizontal flow, vertical axis jaw-type crusher wherein at least one of the jaws thereof is mounted for eccentric motion toward and away from the other of said jaws, a classifier and feeder mounted for reciprocation below the jaws, and means for synchronously reciprocating the classifier and feeder in response to eccentric motion of the said at least one jaw comprising, a rocker arm, means connecting one end of the eccentrically mounted jaw to one end of the rocker arm, and means connecting the other end of the rocker arm to said feeder and classifier.

4. The invention defined in claim 2 wherein the classifier and feeder reciprocates at least in part below a storage hopper for material to be crushed.

5. The invention defined in claim 4 wherein the classifier and feeder includes a sloping end wall at the end remote from the jaws of the crusher to compact the material, in the normal direction of flow of material, into the crusher jaws.

6. The invention defined in claim 4 wherein the classifier and feeder includes a generally vertical offset zone in the bottom wall thereof upstream of the crusher jaws.

7. The invention defined in claim 2 wherein each of the crusher jaws is eccentrically mounted, the crusher jaws synchronously driven and each of the eccentrically mounted jaws assists in reciprocating the classifier and feeder.

8. The invention defined in claim 5 wherein the classifier and feeder includes a generally vertical offset zone in the bottom walls thereof upstream of the crusher jaws.

9. The invention defined in claim 3 wherein each of the crusher jaws is eccentrically mounted, the crusher jaws are synchronously driven and each of the eccentrically mounted jaws assist in reciprocating the classifier and feeder.