March 11, 1969 D. L. LOMBARD 3,431,765

HYDRAULIC EXTRUSION PRESS

Filed Oct. 14, 1964 Sheet 1 of 7

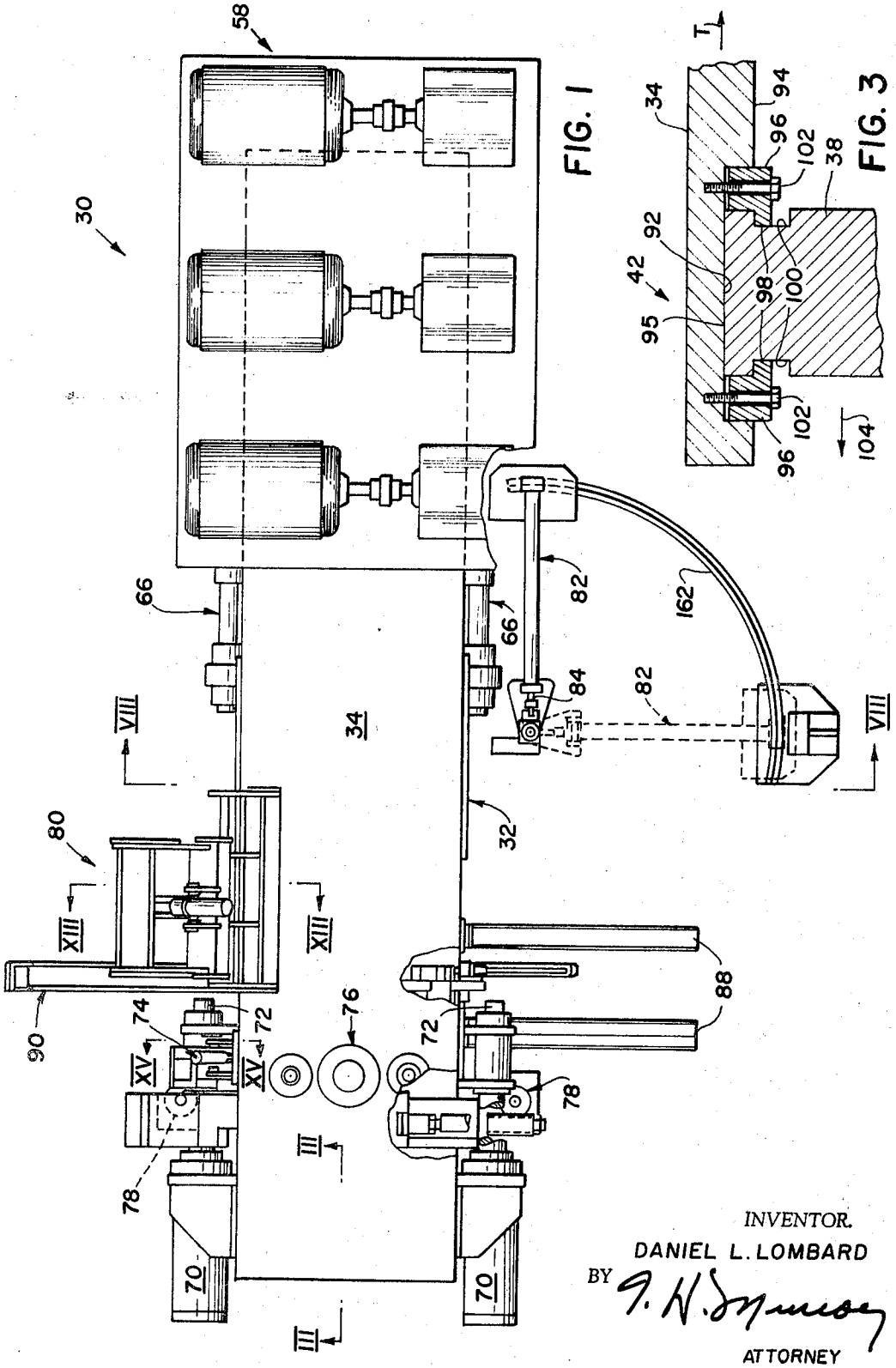


FIG. 1

FIG. 3

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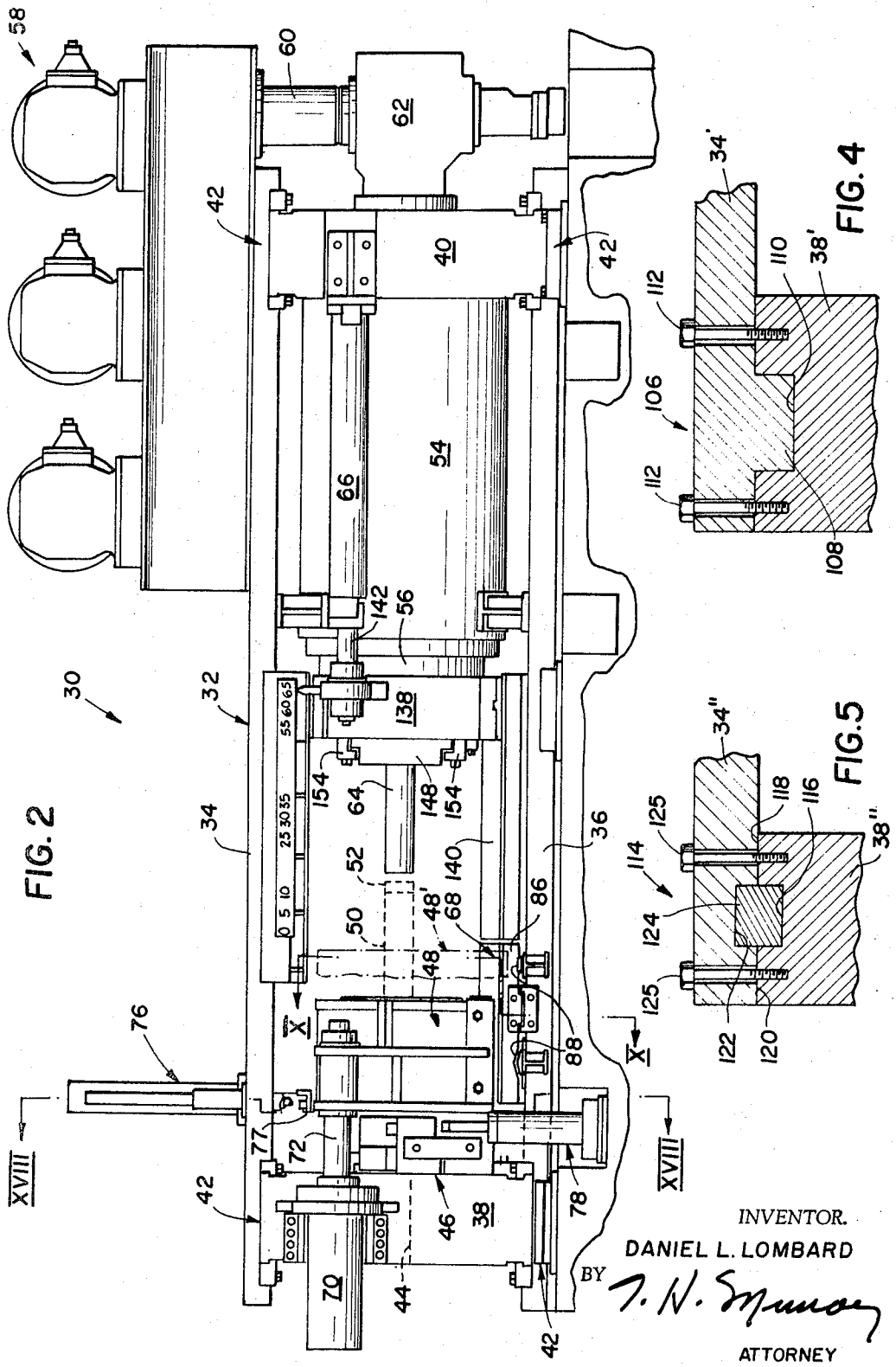


FIG. 2

FIG. 4

FIG. 5

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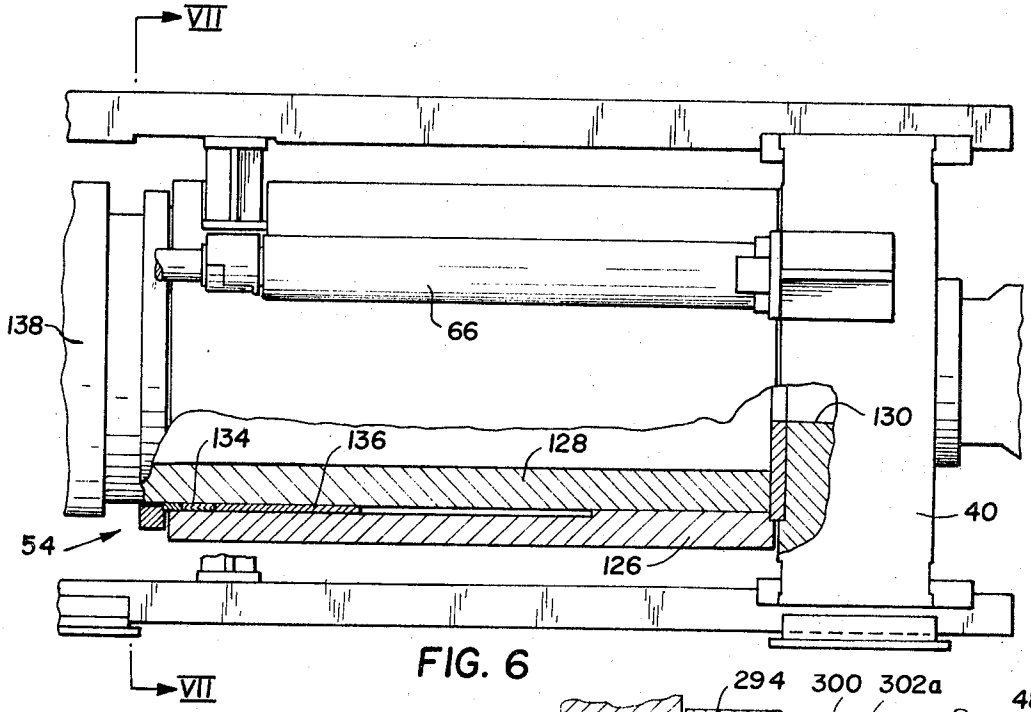


FIG. 6

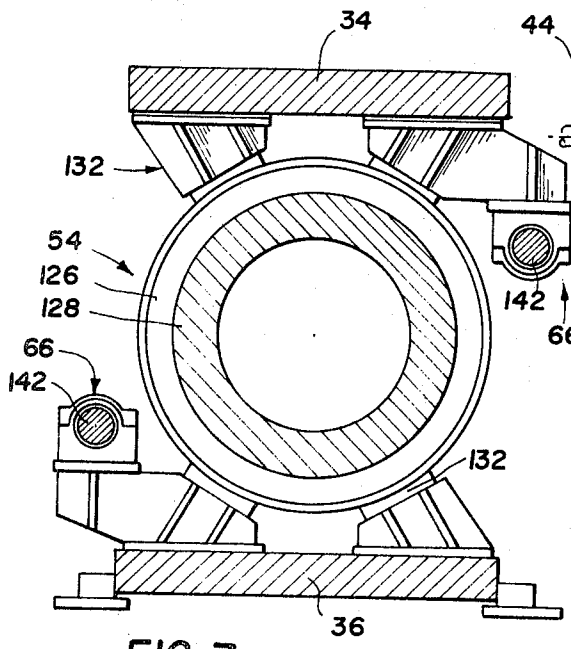


FIG. 7

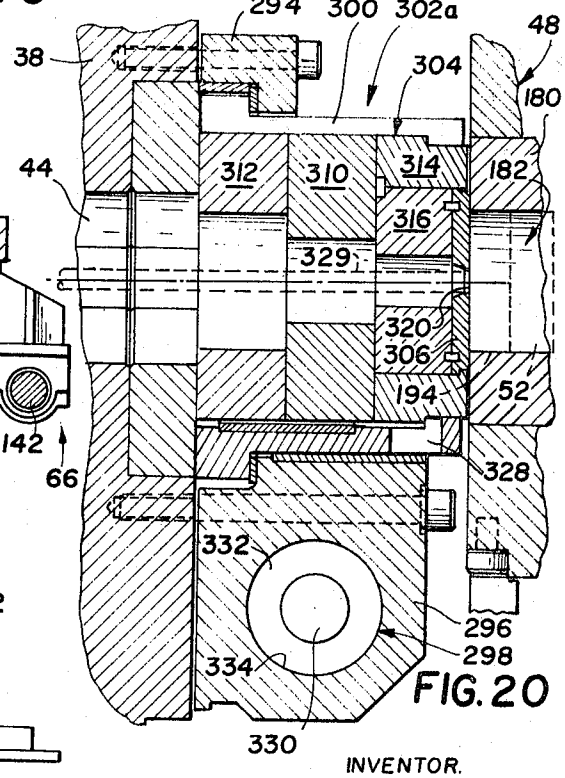


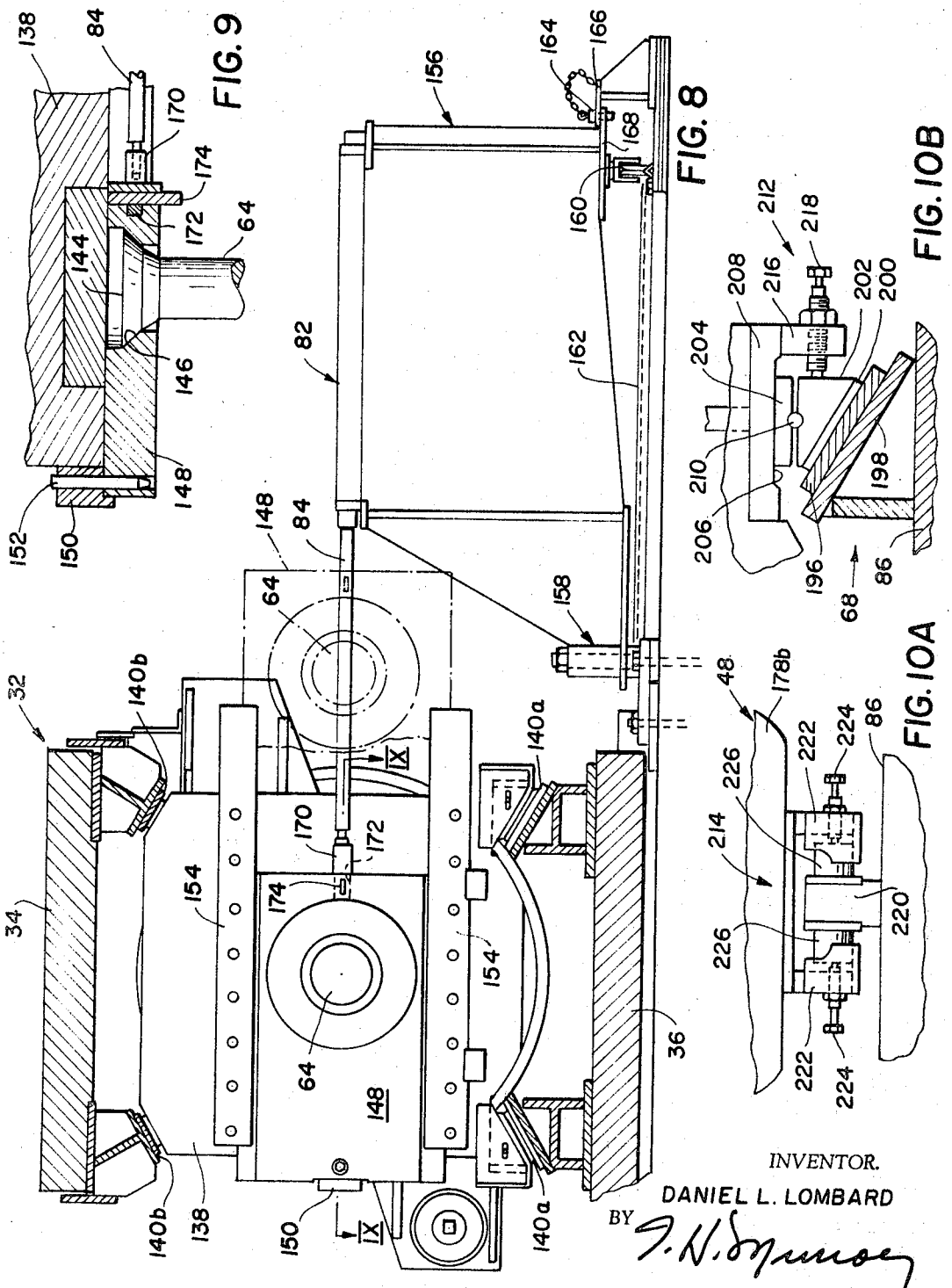
FIG. 20

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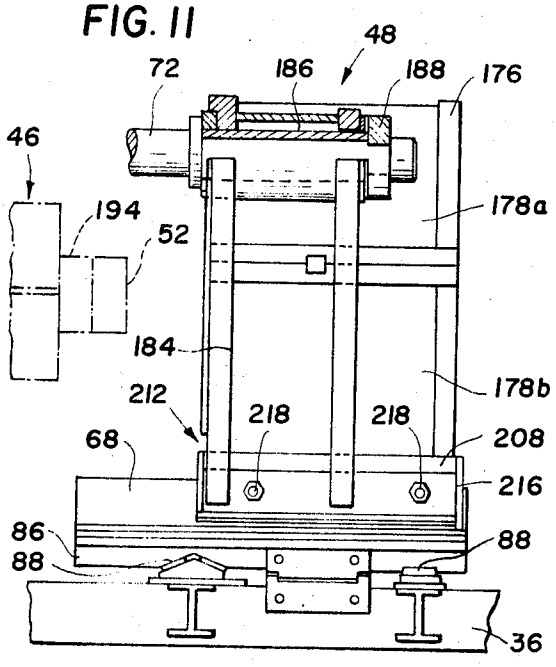


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FIG. 11



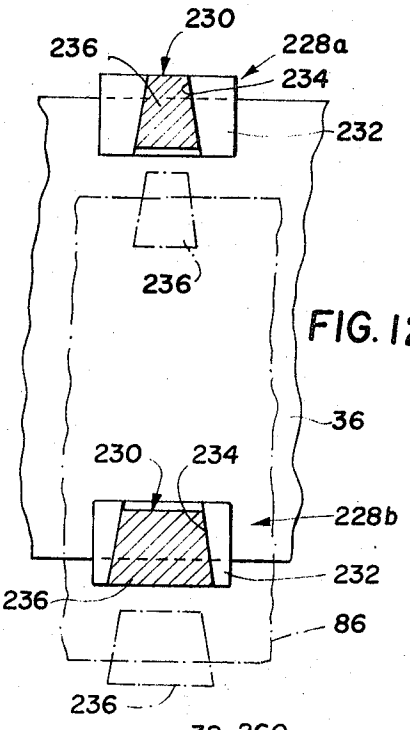


FIG. 12

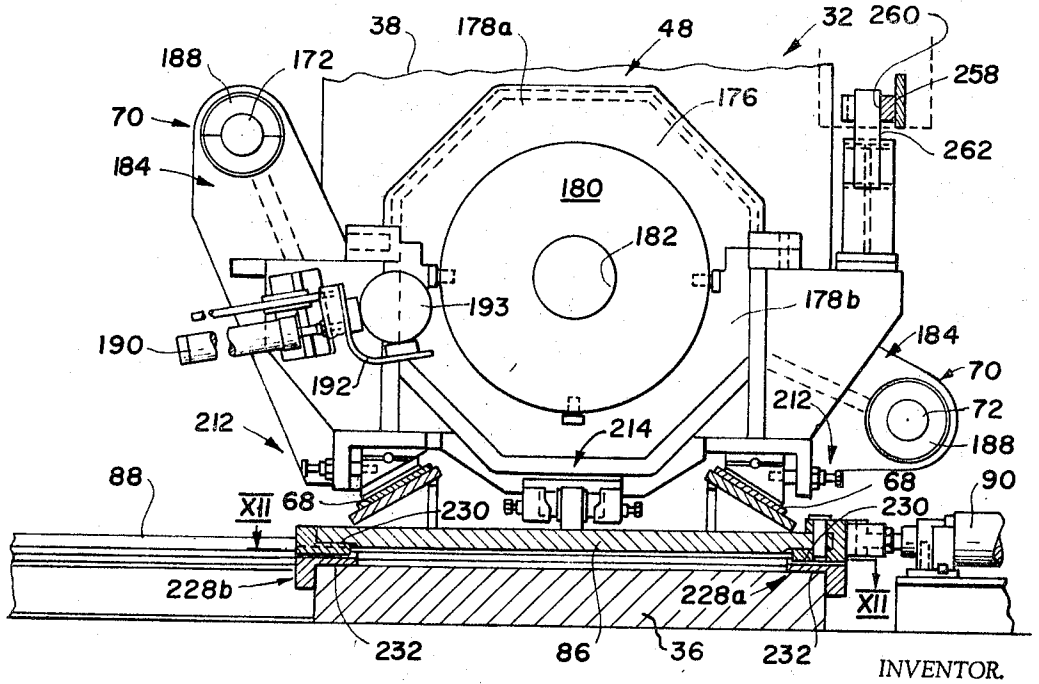


FIG. 10

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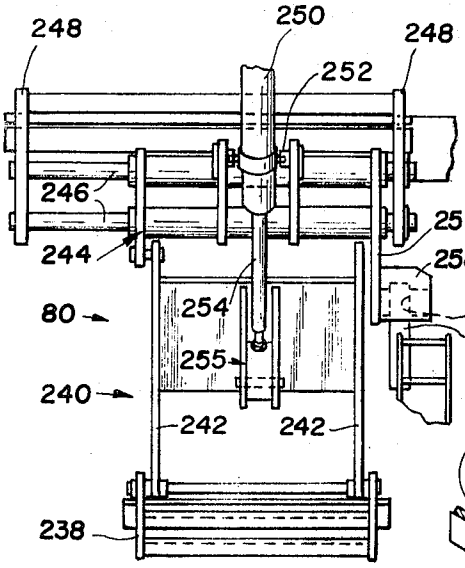


FIG. 14

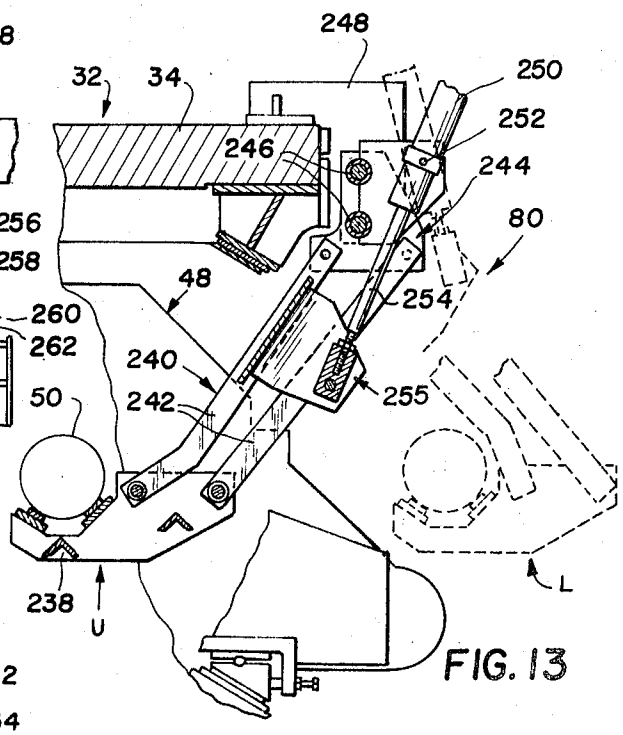


FIG. 13

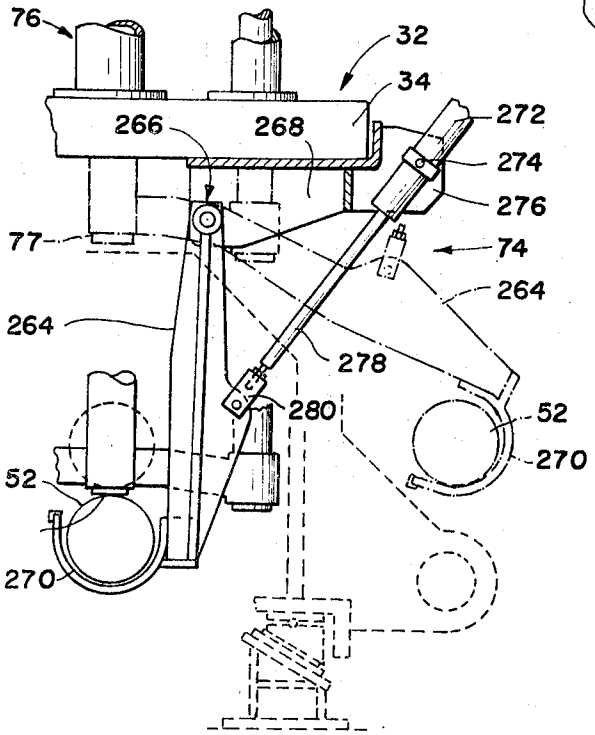


FIG. 15

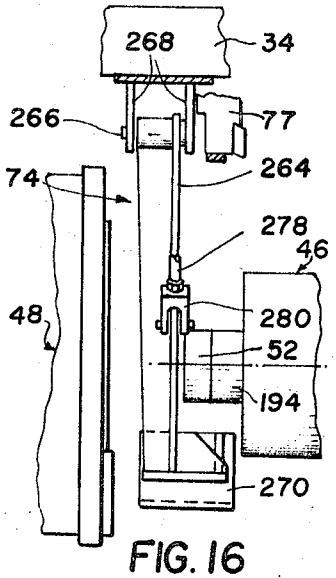


FIG. 16

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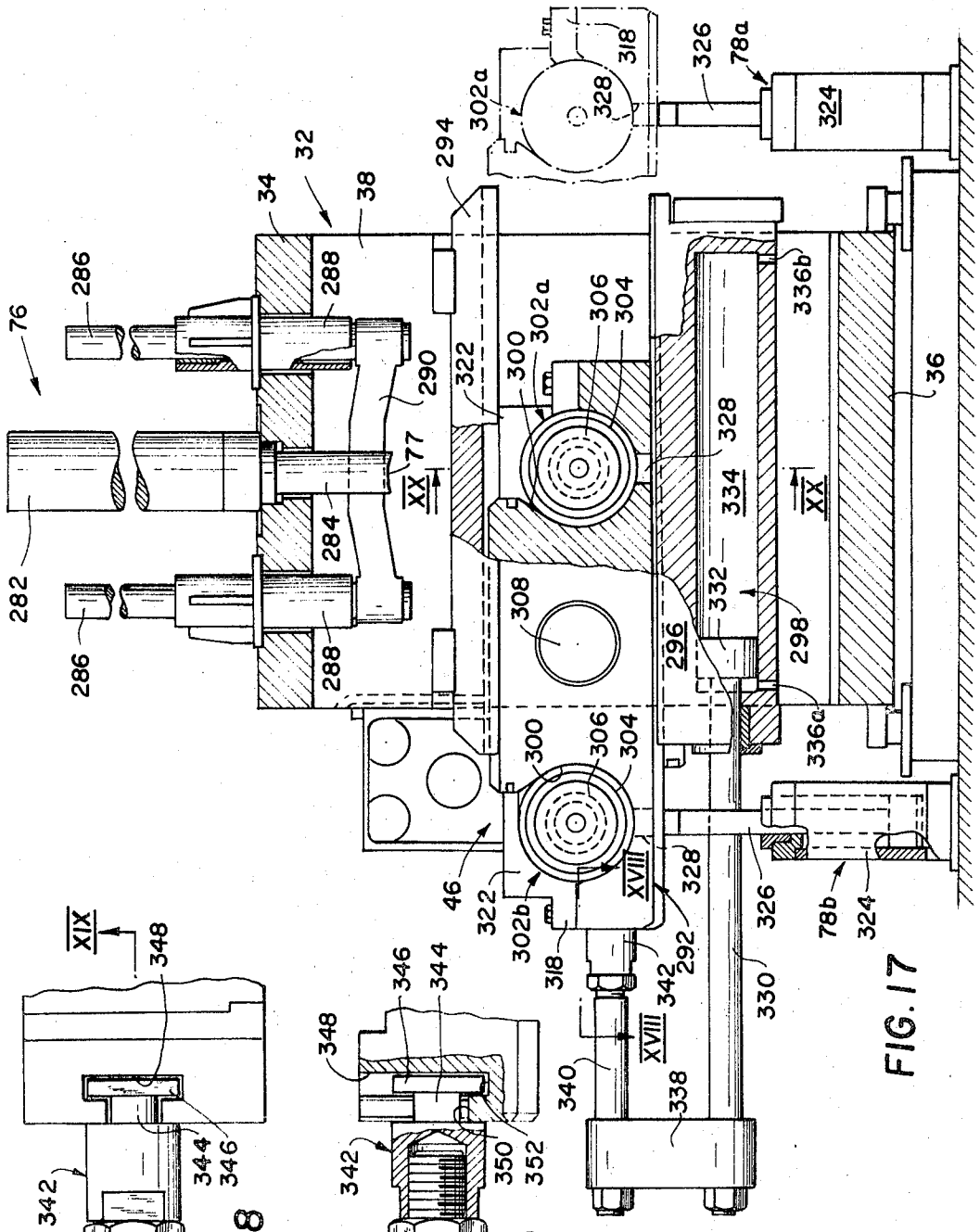


FIG. 17

FIG. 18

FIG. 19

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United States Patent Office 3,431,765
Patented Mar. 11, 1969

3,431,765

HYDRAULIC EXTRUSION PRESS

Daniel L. Lombard, Youngstown, Ohio, assignor to Lombard Corporation, Youngstown, Ohio, a corporation of Ohio

Filed Oct. 14, 1964, Ser. No. 403,836
U.S. Cl. 72—255 29 Claims
Int. Cl. B21c 23/21, 35/04

ABSTRACT OF THE DISCLOSURE

This patent discloses a hydraulic extrusion press having certain desirable features. In place of the forged steel columns that are usually used to restrain the forces separating the cylinder and the die, there are used horizontal slab members, which may be substantially unmachined to save expense, and which are keyed to vertical slab members associated with the die and the cylinder. The patent further discloses the press as having a hydraulic cylinder formed of two tubes, one nested within the other, so that it is possible to use appropriately finished heavy-walled tubing rather than a single-wall cylinder that would need to be specially manufactured. The patent further discloses means for moving the ram associated with the piston rod to a position outboard of the press, to facilitate its replacement; this means comprises a hydraulic cylinder mounted on a carriage pivoted at one end, the other end being movable along an arcuate track from an inoperative position to an operative position. The patent further discloses a billet container adjustable both horizontally and vertically about its operative position and a billet loader movable by means of a pair of coplanar arms operating in a pantograph-like fashion (so that the billet loader is held level during movement) to a position outboard of the press. To facilitate changing of the liner of the billet container, the billet container is also made movable to a position outboard of the press. Means for removing the butt and dummy block and means for changing dies are also disclosed. With the features described, there is provided a press that is versatile and convenient to use, and relatively inexpensive to manufacture.

This invention relates to a hydraulic extrusion press, and more particularly to certain improvements in the construction of horizontal extrusion press installations which have the ultimate effect of simplifying its construction thereby significantly reducing the cost of manufacture and installation.

As is known, a conventional extrusion press construction incorporates a cast steel platen which supports an extrusion die with an adjacent billet container; and a cast steel cylinder housing which supports a cast steel hydraulic cylinder into which is inserted a heavy chill cast iron piston having a ram projecting therefrom toward the billet container. During extrusion of a billet, hydraulic fluid under pressure is introduced into the hydraulic cylinder to force the ram into the billet container. A billet disposed within the container, is extruded through the extrusion die.

During the extrusion operation, tremendous expansive forces are produced which, in the absence of connecting elements, would separate the platen and the cylinder housing. In order to resist these expansive forces, the platen and cylinder housing are connected normally by means of a plurality of forged steel columns which are secured to and extend between the platen and the cylinder housing. The forged steel columns normally are equally spaced about the central axis of the extrusion die. Thus, the expansive forces are transmitted substantially equally to

the columns in the form of tensile forces, i.e., the columns are under considerable tension during the actual extrusion operation. For example, extrusion press machinery having capacities of 2000 to 2400 tons are common.

As is known, elements such as the platen and cylinder housing when formed from cast steel are relatively expensive. Furthermore, forged steel columns also are expensive to manufacture. The cost stems not only from the forging operation but also because they require a considerable amount of machining in order that they may be properly assembled to the platen and the cylinder housing. Accordingly, extrusion press facilities have had only limited application, and generally only in the large and well-established manufacturing concerns to whom the expense of extrusion press installation and servicing is a surmountable burden.

As an important overall object, the present invention seeks to provide an extrusion press installation of improved and novel construction whereby such installations are rendered suitable for and economically feasible to smaller manufacturers and fabricators.

More particularly, the present invention seeks to provide a novel extrusion press installation comprising a horizontal extrusion press having improved and substantially simplified press frame and hydraulic cylinder constructions which significantly reduce the cost of fabrication and installation of the extrusion press.

Other important objects of the present invention, include:

To provide an extrusion press having a frame of simplified construction, which is equally as rigid and of equal capacity as those frames manufactured in accordance with conventional designs;

To provide an extrusion press with a frame of improved design which results in a reduction in the overall size of the press frame as compared to an extrusion press of the same capacity incorporating normal design features;

To provide an extrusion press having a hydraulic cylinder formed from two telescoping substantially unmachined tubular members, the construction resulting in a considerably more simplified design and a significant reduction in the cost of manufacture and installation of the same;

To provide a novel extrusion press having a ram supporting structure which is movable laterally of the frame and to a position outboard thereof wherein replacement of the ram is easily accomplished;

To provide a novel extrusion press wherein the billet container is movable transversely of the frame to a position outboard thereof wherein replacement of the billet container is easily accomplished;

To provide a novel extrusion press wherein loading of each billet is accomplished from a position outboard of the frame, which position is easily accessible to the operators;

To provide a novel extrusion press wherein the butt of the extruded billet and the dummy block associated therewith are caught after shearing from the extrusion die and displaced to a position outboard of the frame wherein discharge thereof is easily accomplished; and

To provide a novel extrusion press having a plurality of extrusion dies which are alternately positionable in alignment with the billet container for extrusion of a billet.

In accordance with the invention, a horizontal extrusion press is provided having a frame formed from upper and lower horizontal slab members which extend over and under the extrusion press and substantially parallel with the central axis of the extrusion die. First and second vertical slab members comprising a solid-steel platen and a solid-steel crown, each extend vertically between a pair of adjacent ends of the horizontal slab members.

Novel connecting means are employed for connecting the horizontal slab members to the upper and lower ends of the first and second vertical slab members, the arrangement being such that substantially all of the expansive force produced by the extrusion press is transferred to the connecting means in the form of shear forces. The present connecting means provides a simplified, low-cost method of connecting the horizontal slab members to the first and second vertical slab members. The resulting press frame has the required rigidity and load-carrying capacity.

The upper and lower horizontal slab members, as used in the present invention, require a minimum of machining or preparation. For example, rolled steel slabs in the form in which they leave the roll mill, may be used with a minimum of further preparation. The only machining required is performed on the slab ends, in the region of connection to the first and second vertical slab members. By using steel slabs in this form instead of the previously employed forged steel columns, the cost of fabrication and installation of the press frame and the overall size of the extrusion press are significantly reduced.

Further, in accordance with the invention, there is provided a hydraulic cylinder means of simplified construction and employing a pair of telescoping outer and inner tubular members. In the present hydraulic cylinder means, the second vertical slab member is employed for sealing one end of the outer tubular member while a crosshead, which also supports the ram, is employed to seal the free end of the inner tubular member. A sealing member is interposed between the outer and inner tubular members at the projecting end of the outer tubular member. In the present hydraulic cylinder means, the outer and inner tubular members require a minimum of machining or preparation and, hence, further reduce the cost of fabricating the present extrusion press.

Further, in accordance with the invention, the ram is supported for movement transversely of the frame to a position outboard of the frame whereby replacement of a worn ram is easily accomplished. A novel means is provided for moving the ram between the outboard position and the operative position wherein it is in alignment with the central axis of the extrusion die. The billet container of the present extrusion press, is movable axially along the frame and laterally thereof to a position outboard of the frame. In the outboard position, replacement of a worn billet container may be easily accomplished. In the present extrusion press, unextruded billets are loaded onto a loading mechanism which is disposed outboard of the frame. The loading mechanism then is displaced within the frame proper to position the unextruded billet in alignment with the billet container. Means is provided for catching the butt of the extruded billet and the dummy block associated therewith upon shearing thereof from the extrusion die. The catch means thereafter moves the butt and dummy block to a position outboard of the frame wherein removal is easily accomplished.

The above and other objects and advantages of the present invention will become apparent from the following detailed description by reference to the accompanying drawings, in which:

FIG. 1 is an overall plan view of the present extrusion press;

FIG. 2 is an overall side view of the present extrusion press;

FIG. 3 is a fragmentary cross-sectional view, taken substantially along the line III—III of FIG. 1, illustrating a means for connecting a horizontal slab member and a vertical slab member;

FIGS. 4 and 5 are fragmentary cross-sectional views, similar to FIG. 3, illustrating alternative connecting means for securing a horizontal slab member to a vertical slab member;

FIG. 6 is a fragmentary side view, with portions cut away to show details, illustrating the main cylinder means for displacing the ram of the present extrusion press;

FIG. 7 is a cross-sectional view, taken along the line VII—VII of FIG. 6, further illustrating the main cylinder means of the present extrusion press;

FIG. 8 is a cross-sectional view, taken along the line VIII—VIII of FIG. 1, illustrating a ram supporting structure and means for displacing the same;

FIG. 9 is a cross-sectional view, taken along the line IX—IX of FIG. 8, further illustrating the ram supporting structure of FIG. 8;

FIG. 10 is a cross-sectional view, taken along the line X—X of FIG. 2, illustrating a billet container supporting assembly;

FIG. 10A is a fragmentary elevation view, on an enlarged scale, illustrating means for displacing the billet container in a horizontal direction;

FIG. 10B is a fragmentary elevation view, on an enlarged scale, illustrating means for elevating and lowering the billet container;

FIG. 11 is a fragmentary side view illustrating the billet contained support platform prior to movement of movement thereof transversely of the press frame;

FIG. 12 is a cross-sectional view, taken along the line XII—XII of FIG. 10, illustrating a means for keying the billet container support platform prior to movement to the billet container toward the extrusion die;

FIG. 13 is a fragmentary cross-sectional view, taken along the line XIII—XIII of FIG. 1, illustrating a billet loading mechanism;

FIG. 14 is a side view further illustrating the billet loading mechanism of FIG. 13:

FIG. 15 is a cross-sectional view, taken along the line XV—XV of FIG. 1, illustrating a butt and dummy block catching mechanism;

FIG. 16 is a side view of the butt and dummy block catching mechanism of FIG. 15;

FIG. 17 is a cross-sectional view, taken along the line XVII—XVII of FIG. 2, illustrating a multiple extrusion die supporting assembly;

FIG. 18 is a plan view as seen from the line XVIII—XVIII of FIG. 17, illustrating a clevis connecting arrangement between the die slide plate and a power means;

FIG. 19 is a cross-sectional view, taken along the line XIX—XIX of FIG. 18, further illustrating the clevis connecting means; and

FIG. 20 is a cross-sectional view, taken along the line XX—XX of FIG. 17, illustrating one of the extrusion die assemblies employed in the present extrusion press.

EXTRUSION PRESS—GENERAL DESCRIPTION

Reference is now directed to FIGS. 1 and 2, wherein there is illustrated a horizontal extrusion press generally designated by the numeral **30**. The extrusion press **30** is adapted to rest on a horizontal surface and comprises a frame **32** formed from upper and lower horizontal slab members **34**, **36** and first and second vertical slab members **38**, **40**. The press frame **32** is closed at both ends and at its top and bottom. Entrance to the interior of the press frame **32** is provided only through its opposite sides. Connecting means **42** are provided for securing the first and second vertical slab members **38**, **40** to the upper and lower horizontal slab members **34**, **36**.

The first vertical slab member **38** is provided with an opening **44** (shown in phantom outline) through which will extend the extruded product. Mounted on the inner face of the first vertical slab member **38**, is an extrusion die structure **46** which, as will be described, includes two spaced-apart extrusion die assemblies which are alternately positionable in alignment with the opening **44** of the first vertical slab member **38**. Adjacent to the extrusion die structure **46** is a billet container **48** which receives a billet **50** and associated dummy block **52** (both shown in dotted outline) and supports the same in align-

ment with the die opening of the extrusion die structure **46**.

Projecting axially toward the extrusion die structure **46** is a main hydraulic cylinder means **54** which is supported on the second vertical slab member **40**. A main hydraulic cylinder means **54** includes a piston **56** which is forcibly moved toward the extrusion die structure **46** by means of hydraulic fluid under pressure. Hydraulic fluid pumping apparatus **58** is supported on the upper horizontal slab member **34** adjacent to the hydraulic cylinder means **54**. A conduit **60** depends vertically from the pumping apparatus **58** along with additional piping, and serves to communicate the hydraulic fluid through a valve **62** into the hydraulic cylinder means **54** during the extrusion operation. A pumping apparatus and valve suitable for use in the present extrusion press are disclosed and illustrated in U.S. Patent No. 2,751,076.

At the free end of the piston **56** there is supported a ram **64** which, during the extrusion operation, enters the billet container **48** and forces the billet **50** to be extruded through the die opening provided in the extrusion die structure **46**. At the completion of the extrusion operation, the piston **56** will project out of the hydraulic cylinder means **54**. The piston **56** is retracted within the hydraulic cylinder means **54** by means of a pair of piston motor means **66** disposed on opposite sides of the cylinder means **54**.

At the completion of the extrusion of one billet, the billet container **48** must be moved away from the extrusion die structure **46** so that the remaining portion of the billet **50**, hereinafter to be termed "butt," and the dummy block **52** may be removed from the extrusion die structure **46**. The billet container **48** is supported for movement toward and away from the extrusion die structure **46** by means of first track means **68**. The billet container **48** is moved by means of a pair of container motor means **70**, each of which preferably comprises a hydraulically operated cylinder having a piston rod **72**, the end of which is releasably secured to the billet container **48**. Activation of the pair of container motor means **70** will cause the billet container **48** to be moved away from the extrusion die structure **46** into the position indicated at dotted outline at **48'** (FIG. 2). At this time a butt and dummy block catch mechanism **74** (FIG. 1) will be activated to introduce a catching member between the billet container **48** and the extrusion die structure **46**. Thereafter, a butt shear mechanism **76** will lower a butt shear **77** carried thereon, between the billet container **48** and the extrusion die structure **46** to shear the butt and dummy block from the extrusion die structure **46**. The catching member of the butt and dummy block catch mechanism **74** receives the butt and dummy block and transports them to a position outboard of the frame **32** wherein they may be unloaded.

The extrusion die structure **46** includes motor means (to be described in conjunction with FIG. 17) whereby the die structure **46** may be shifted to the right or to the left to align a new extrusion die assembly with the opening **44** and the billet container **48**. The previously employed extrusion die assembly, which now resides at a position outboard of the frame **32**, will be disengaged from the die structure **46**. Die knockout means **78***a*, **78***b*, one each disposed on each side of the frame **32**, are employed to push the extrusion die assembly out of the die structure **46**, as will be described.

Reactivation of the container motor means **70** will move the billet container **48** toward the extrusion die structure **46** in the position illustrated in FIG. 2. At this time a new billet **50** may be loaded into the billet container **48**. A billet loading mechanism **80** (FIG. 1) having a cradle which normally is disposed in a position outboard of the frame **32**, is provided to transfer a new billet **50** and dummy block **52** into axial alignment with the central axis of the extrusion die and adjacent to the front face of the billet container **48** as shown in FIG. 2. At this point, the hydraulic cylinder means **54** will be activated whereby the ram **64** will displace the new billet **50** and dummy block **52** into the billet container **48** preparatory to extruding the same.

After a series of billets have been extruded, the ram **64** normally must be replaced. In the present extrusion press **30**, the ram **64** is supported for sliding movement transversely of the frame **32** from an operative position wherein the ram **64** is in axial alignment with the central axis of the extrusion die to a second position wherein the ram **64** is disposed outboard of the frame **32**. In the outboard position, exchange of the ram **64** may be relatively easily accomplished. Movement of the ram **64** to the outboard position is accomplished by means of a ram motor means **82**. The ram motor means **82** is mounted for gate-like movement from an inoperative position shown in full lines in FIG. 1 to an operative position shown in dotted lines. In the operative position, the ram motor means **82** extends perpendicularly to the frame **32** and is aligned with the ram supporting structure. The ram motor means **82** preferably comprises a hydraulically operated cylinder and piston having a piston rod **84** which, when the ram motor means **82** is in the operative position, may be extended into coupled engagement with the ram supporting structure and retracted for transporting the ram **64** to the aforementioned outboard position. When the exchange of the ram has been accomplished, the ram motor means **82** is activated to push the ram supporting structure into the frame **32** whereby the new ram is axially aligned with the central axis of the die. The piston rod **84** is disconnected from the ram supporting structure and is retracted. Thereafter, the ram motor means **82** is swung to the inoperative position shown in full lines in FIG. 1.

After a series of billets have been extruded, it is normal to replace a liner housed within the billet container **48**. The liner receives and supports the billet **50** during extrusion thereof. To exchange the liner, the billet container **48** first is moved away from the extrusion die structure **46** by means of the pair of container motor means **70**. At this point, the piston rods **72** of the container motor means **70** are detached from the billet container **48** and retracted. As can best be seen in FIG. 2, the first track means **68** is supported on a platform **86** which, in turn, is supported for sliding movement transversely of the press frame **32** by means of second track means **88**. The second track means **88** extend outboard of the frame **32** (see FIG. 1). Secured to and disposed on the opposite side of the platform **86** is a platform motor means **90** which serves to move the platform **86** together with the billet container **48** to a position outboard of the frame **32**. In this outboard position, the liner may be replaced. Thereafter, the platform motor means **90** is reactivated to move the platform **86** and the billet container **48** into the frame **32** and position it in axial alignment with the central axis of the extrusion die. The piston rods **72** of the container motor means **70** are extended and again secured to the billet container **48**. Activation of the container motor means **70** now will move the billet container **48** along the first track means **68** to a position adjacent to the extrusion die structure **46** as illustrated in FIG. 2.

PRESS FRAME 32

The press frame **32** is of simplified construction wherein the cost of manufacturing the same is significantly reduced. Although the press frame is of simplified construction, its rigidity and load-carrying capacity are equal to those of press frames manufactured in accordance with conventional design practices. The upper and lower horizontal slab members **34**, **36** comprise solid-steel slabs which are substantially unmachined. Similarly, the first and second vertical slab members **38**, **40** comprise solid-steel slabs which are substantially unmachined. In essence, then, the slabs **34–40** may be used substantially in the form in which they leave the roll mill, i.e., with a minimum of further preparation. The only machining required in these slabs is performed on the ends, in the region of con-

nection between the horizontal slab members **34**, **36** and the vertical slab members **38**, **40**.

The preferred construction of the connecting means **42** is illustrated in FIG. 3 on an enlarged scale. The connecting means **42** are identical in construction, hence, only one of the connecting means **42** will be described. As can be seen in FIG. 3, a groove **92** is formed in the lower face **94** of the slab member **34** adjacent to the end thereof. The groove **92** extends transversely of the slab **34** and is adapted to receive an upper end portion **95** of the vertical slab member **38**. The groove **92** is wider than the vertical slab member **38**. A pair of claming members **96**, one each on each side of the vertical slam member **38** serve to clamp the slab member **38** to the horizontal slab **34**, thereby preventing vertical separation thereof during the extrusion of a billet. Each of the clamping members **96** is interposed between one side of the vertical slab member **38** and a vertically disposed wall of the groove **92**. Each of the clamping members **96** includes a lug **98** engaged in a slot **100** formed in each side wall of the vertical slab **38**. A plurality of bolts **102** (only one visible) extends through the clamping member **96** and is threaded into the horizontal slab **34**.

During the extrusion of a billet, a portion of the expansive force produced by the extrusion press **30** will tend to move the vertical slab member **38** in the direction of the arrow **104**. This force will be resisted by a tensile force acting on the horizontal slab **34** and indicated by the arrow labeled T. From the principles of statics, the forces acting on the end portion **95**, which in reality is a key, are substantially entirely shear forces. Hence, in the press frame **32**, the connecting means **42** are positioned to resist substantially all of the expansive forces produced in the extrusion press **30**. The expansive forces are applied to the connecting means **42** as shearing forces.

An alternative configuration of a connecting means is illustrated in FIG. 4 and indicated by the numeral **106**. Corresponding primed numerals will be employed to identify corresponding parts already described. In this configuration, the horizontal slab **34'** includes a depending lug or rib **108** which resides within a groove **110** formed in the upper end of the vertical slab member **38'**. A plurality of bolts **112** secures the horizontal slab **34'** to the vertical slab **38'** and prevents their vertical separation during an extrusion operation. An analysis of this configuration with respect to the forces acting on the lug **108** will reveal that the lug **108** is being acted on by shearing forces. The lug **108** and the groove **110** extend transversely of the horizontal slab **34'** and the vertical slab **38'**, respectively, and along substantially the entire length thereof. Hence, the connecting means **106** is positioned to resist substantially all of the expansive forces produced by the extrusion press **30** as shear forces.

A further alternative configuration of a connecting means is illustrated in FIG. 5 and is indicated generally by the numeral **114**. Corresponding double primed numerals will be employed to identify parts already described. As can be seen in FIG. 5, the vertical slab member **38''** includes a keyway **116** formed in its upper face **118**. The horizontal slab member **34''** includes a lower face **120** which is engaged with the upper face **118** of the vertical slab member **38''** and which has a keyway **122** formed therein. The keyway **122** corresponds with the keyway **116**. Residing within the corresponding keyways **116**, **122** is an extrinsic shear key **124**. A plurality of bolts **125** prevents vertical separation of the horizontal slab member **34''** and the vertical slab member **38''** during operation of the extrusion press **30**. The corresponding keyways **116**, **122** and the shear key **124** extend transversely of the horizontal slab member **34''** and along substantially the entire width of the horizontal slab member **34''** and the vertical slab member **38''**. Hence, during the extrusion of a billet, the shear key **124** will sustain the expansive forces produced in the extrusion press **30** as shearing forces.

MAIN HYDRAULIC CYLINDER 54

For a complete description of the main hydraulic cylinder means **54**, reference is directed to FIGS. 2, 6 and 7. The hydraulic cylinder means **54** and piston **56** preferably comprise a pair of telescoping outer and inner tubular members **126**, **128**. The outer tubular member **126** has an inside diameter which is larger than the outside diameter of the inner tubular member **128**. The outer tubular member **126** projects horizontally from and has one end secured to the second vertical slab member **40**. The second vertical slab member **40** is provided with a passageway **130** which serves to communicate the hydraulic fluid under pressure into the interiors of the first and second tubular members **126**, **128** during the extrusion operation. The first tubular member **126** is supported at its other end by means of a plurality of brace members **132** which support the first tubular member **126** at spaced points around its periphery. The brace members **132** are secured to the upper and lower horizontal slab members **34**, **36**.

The inner tubular member **128** is slideably supported within the outer tubular member **126** by means of suitable sealing means **134** and bushing **136**. The sealing means **134** and bushing **136** are disposed in the annular space between the outer and inner tubular members **126**, **128**. The inner tubular member **128** is slideable through the sealing assembly **104** and the bushing **136** toward and away from the billet container **48**. Thus, the outer surface of the inner tubular member **128** must be finished to prevent injury to the components of the sealing means **134** and to reduce the sliding friction between the sealing means **134** and the bushing **136**. It should be noted that only a portion of the inner surface of the outer tubular member **126** and the outer surface of the inner tubular member **128** require a finishing operation. Hence, the outer and inner tubular members **126**, **128** may comprise substantially unmachined large diameter pipe sections having mechanical properties such as tensile strength and allowable stress values in excess of the forces under which they will be subjected.

Secured across the outer end of the inner tubular member **128** is a crosshead **138** which serves to seal the outer end of the inner tubular member **128** and also to support the ram **64**. As can be seen in FIG. 2, the crosshead **138** is supported on track members **140** (one visible) for sliding movement toward and away from the billet container **48**. The piston motor means **66**, employed in retracting the inner tubular member **126**, each comprise a hydraulically operated cylinder having a piston rod **142** secured to the crosshead **138**. It should be evident, then, that a significant reduction in the cost of fabricating the hydraulic cylinder means **54** is achieved through the use of substantially unmachined telescoping tubular members.

SUPPORTING STRUCTURE AND REPLACEMENT OF RAM 64

As stated above, the ram **64** is supported on the crosshead **138** for movement transversely of the press frame **32** from an operative position, illustrated in FIG. 2, wherein the ram **64** is aligned with the central axis of the die, to a replacement position wherein the ram **64** is disposed outboard of the press frame **32**. A complete description of the supporting structure and means for moving the ram between the operative and inoperative positions will now be described with reference to FIGS. 1, 2, 8 and 9.

As can best be seen in FIG. 9, the ram **64** has an enlarged end portion **144** which is received within a correspondingly shaped opening **146** provided in a slide plate **148**. A stop member **150** provided at one side of the crosshead **138** is engaged by the slide plate **148** to position the ram **64** in axial alignment with the central axis of the die. A locking pin **152** extends through the stop member **150** and the slide plate **148** to lock the slide plate **148** in the operative position.

As can be seen in FIGS. 2 and 8, the slide plate **148** is

clamped to the crosshead **138** and supported for sliding movement by a pair of clamping members **154**. Extraction of the locking pin **152** and loosening of the clamping members **154** permits the slide plate **148** to be moved transversely of the press frame **32** to an inoperative position illustrated in dash-dot outline in FIG. 8. In the inoperative position, the ram **64** is disposed outboard of the press frame **32** wherein replacement thereof is easily accomplished.

As described above in conjunction with FIG. 1, the ram motor means **82** may be moved in gate-like fashion from the inoperative position shown in full lines to the operative position shown in dotted outline in FIG. 1. In FIG. 8 the ram motor means is shown disposed in its operative position. The ram motor means **82** is supported on a carriage **156**. A vertically oriented pivot means **158** is connected to and supports one end of the carriage **156** whereby the carriage **156** may be swung in gate-like fashion. The opposite end of the carriage **156** is provided with a roller **160** which rolls over a length of arcuate track member **162**, best seen in FIG. 1, between the inoperative and operative positions described above. A pin member **164** extends through a bracket **166** and into a plate **168** of the carriage **156** to lock the ram motor means **82** in its operative position during transfer of the slide plate **148** and ram **64**.

When replacement of the ram **64** is required, the ram motor means **82** is swung into its operative position illustrated in FIG. 8 and locked therein. The piston rod **84** is then extended toward the slide plate **148**. As can be seen in FIGS. 8 and 9, the remote end of the piston rod **84** is provided with a coupling member **170** which fits into an opening **172** provided in the slide of the slide plate **148**. A locking pin **174** extends through slide plate **148** and the coupling member **170** to complete the securement of the remote end of the piston rod **84** to the slide plate **148**. Thereafter, the ram motor means **82** may be reactivated to pull the slide plate **148** to the outboard position illustrated in dash-dot outline in FIG. 8. After a new ram has been installed in the slide plate **148**, the ram motor means **82** is activated to move the slide plate **148** into the operative position, illustrated in full lines in FIG. 8. The slide plate **148** then is locked in position by means of the locking pin **152**. Extraction of the locking pin **174** permits retraction of the piston rod **84**. Thereafter, the locking pin **164** may be extracted and the carriage **156** moved so that the ram motor means **82** is in its inoperative position shown in full lines in FIG. 1.

BILLET CONTAINER 48

Referring to FIGS. 10 and 11, the billet container **48** comprises a housing **176** formed from upper and lower housing portions **178***a*, **178***b*. Within the housing **176** there is secured a liner **180** having a billet receiving opening **182** provided centrally therein. The upper housing portion **178***a* is detachable from the lower housing portion **178***b* whereby the liner **180** may be replaced when worn.

The container motor means **70** are disposed on opposite sides of the billet container **48** in diametrically opposed relation. The arm structures are each provided with a rod receiving conduit **186** (FIG. 11) which receives the piston rod **72** of each of the container motor means **70**. The piston rod **72** is releasably secured to the arm structures **184**, for example, by means of a split-body collar **188**. The collars **188** permit extraction of the piston rod **72** from the rod receiving conduits **186** whereby the billet container **48** may be moved laterally of the press frame **32** for exchange of the liner **180**, as will be described.

In FIG. 10 there is shown a hydraulic cylinder **190** having a cradle **192** supported for movement into axial alignment with the billet receiving opening **182**. The cradle **192** is adapted to support an ejector block **193** which is inserted within the billet receiving opening **182** for the purpose of cleaning it out. The ejector block **193** is forced through the billet receiving opening **182** by means of the ram **64**.

As stated above, the billet container **48** is movable axially of the press frame **32**, that is, parallel with the central axis of the die opening; and also is movable transversely of the press frame **32** to position the billet container outboard of the press frame **32** for the purpose of exchanging the liner **180**. In FIG. 11, the billet container **48** is shown spaced from the extrusion die structure **46** (shown in dash-dot outline). The billet container is displaced into this position so that the liner **180** may be cleaned by forcing the ejector block **193** through the billet receiving opening **182** thereof; and to permit shearing of a butt **194**, shown in dash-dot outline, from the extrusion die structure **46** by means of the butt shear mechanism **76** shown in FIG. 2. The butt **194** comprises that portion of the billet **50** which remains at the completion of the extrusion operation. Notice also that the dummy block **52** remains engaged with the butt **194**.

The billet container **48** is movable along the first track means **68** from a position adjacent to the extrusion die structure **46**, as shown in FIG. 2, to a position spaced from the extrusion die structure **46**, as illustrated in FIG. 11. As can be seen in FIGS. 10 and 10B, each of the first track means **68** comprises a wear plate **196** supported on and secured to an inclined plate **198**. A liner **200** is secured to a shoe **202** and is engaged over the wear plate **196**. A second shoe **204** is disposed above the shoe **202** and is engageable in a groove **206** formed in a bearing plate **208**. The second shoe **204** is slideable to the right and to the left of FIG. 10B within the groove **206**. The first and second shoes **202**, **204** are maintained spaced apart and coupled by means of a rod **210** residing in corresponding grooves formed in the opposed faces of the first and second shoes **202**, **204**. The rod **210** permits the second shoe **204** to undergo tilting movement about the rod **210** while the liner **200** is maintained in surface engagement with the wear plate **196**. As is known, the billet container **48** will be heated by means (not shown) as well as by introduction of a hot billet. The upper portion of the billet container **48** will tend to expand at a greater rate than the lower portion. Consequently, the uneven expansion occurring in the billet container **48** will cause the bearing plates **208** to undergo tilting in opposite directions. Since the rod **210** permits the second shoe **204** to undergo slight tilting movement, the tilting of the bearing plates **208** will not affect the position of the first shoe **202** whereby the liner **200** is maintained in overall surface engagement with the wear plate **196**. Hence, the first and second shoes **202**, **204** and the rod **210** comprise means for maintaining the liner **200** in overall surface contact with the bearing plate **196** and for compensating for the skewing of the bearing plates **208** caused by the uneven expansion of the billet container **48**.

It is necessary that the central axis of the billet receiving opening **182** be coaxial with the central axis of the die opening. Hence, as can be seen in FIG. 10, the billet container **48** is provided with a vertical adjustment means **212**, one each associated with each of the first track members **68**, and a horizontal adjustment means **214** disposed centrally between the track means **68**.

The vertical adjustment means **212** is best illustrated in FIG. 10B. As can be seen therein, a flange **216** depends from the outboard end of the bearing plate **208** and receives a plurality of adjusting bolts **218**, the inner ends of which engage the first shoe **202**. Inward movement of the adjusting bolts **218** will cause the first and second shoes **202**, **204** to undergo simultaneous inward and upward movement. That is to say, the first shoe **202** will slide up the inclined plate **196** while the second shoe **204** will slide horizontally across the groove **206**. Movement in the inward direction will cause the billet container **48** to be raised so as to elevate the central axis of the billet receiving opening **182**. Conversely, outward

movement of the adjusting bolts **218** will cause the billet container **48** to be lowered.

The horizontal adjustment means **214** is best illustrated in FIG. 10A. The horizontal adjustment means **214** comprises a vertical bearing member **220** which projects above the platform **86** and extends parallel to the central axis of the extrusion die. Disposed on each side of the vertical bearing member **220** are cup-like members **222** which are secured to the lower face of the lower housing portion **178***b*. The cup-like members **222** each threadedly receive a plurality of adjusting bolts **224**. On the lower legs of the cup-like members **222** there is supported a wear plate **226** each disposed in surface engagement with the lateral surfaces of the vertical bearing member **220**. In FIG. 10A, the billet container **48** is movable into and out of the plane of the drawing. During this movement, the billet container **48** will be guided by the wear plates **226** and the vertical bearing member **220**. The billet container **48** may be disposed in a horizontal direction, for example, to the right of FIG. 10A, by loosening those adjusting bolts **224** on the right side of the bearing member **220** and by tightening those adjusting bolts **224** on the left side of the bearing member **220**. Conversely, loosening of the adjusting bolts on the left-hand side of the bearing member **220** and tightening of the adjusting bolts **224** on the right-hand side of the bearing member **220** will cause the billet container **48** to be displaced to the left of FIG. 10A.

Referring now to FIGS. 10 and 11, the billet container **48** may be moved to a position outboard of the press frame **32** wherein replacement of the liner **180** may be accomplished. During lateral movement of the billet container **48**, the platform **86** slides over the second track means **88** which extends over the lower horizontal slab member **36** and laterally thereof. The platform motor means **90** when activated, will displace the billet container **48** and the platform **86** over the second track means **88**. After the liner **180** has been replaced, and the upper housing portion **178***a* has been secured to the lower housing portion **178***b*, the platform motor means **90** is activated to move the billet container **48** and the platform **86** to the right of FIG. 10. Unitary stop and locking means **228***a*, **228***b* are provided at each end of the platform **86** to terminate the movement of the platform **86** when the central axis of the billet receiving opening **182** is aligned with the central axis of the die opening and to lock the platform **86** in that position.

Each of the unitary stop and locking means **228***a*, **228***b* comprises upper and lower cooperating block members **230**, **232**. As schematically illustrated in FIG. 12, each of the lower block members **232** is provided with a V-shaped groove **234** which is adapted to receive a depending plate portion **236** provided on each of the upper block members **230**. The depending plate portion **236** has a peripheral shape which corresponds to the V-shape of the groove **234**. In FIG. 12, the platform **86** is illustrated in dotted-outline as being displaced laterally of the lower horizontal slab member **36**. The depending plate portions **236** also are shown displaced. It should be evident from FIG. 12 that when the platform **86** is moved over the lower slab member **36**, that is, into the position shown in FIG. 10, the depending plate portions **236** of the upper block members **230** will enter the V-shaped grooves **234** of the lower block members **232** until the vertical walls thereof engage the vertical walls of the V-shaped groove **234**. At this time, no further inward movement of the platform **86** is possible. Simultaneously, the platform **86** will be locked or fixed to the lower slab member **36** whereby the billet container **48** now may be moved toward the extrusion die structure **46** (FIG. 11).

BILLET LOADING MECHANISM 80

Referring now to FIGS. 1, 13 and 14, the billet loading mechanism **80** comprises a cradle **238** adapted to support a billet **50** in a horizontal position. The cradle **238** is supported by means of a swing frame **240** formed from pairs of coplanar arms **242**. The arms of each pair of coplanar arms **242** are pivotally secured at their lower ends to the cradle **238** and are pivotally secured at their upper ends to a carriage **244**. Hence, each pair of arms **242**, the cradle ends and the carriage ends cooperate to define a pantograph-like structure wherein the cradle **238** is always horizontal.

The carriage **244** is slideably supported on rods **246** for reciprocal movement parallel to the central axis of the extrusion die. The rods **246** are secured to the upper horizontal slab member **34** by means of plate members **248**. A hydraulic cylinder means **250** is pivotally supported at **252** on the carriage **244**. The hydraulic cylinder means **250** includes a piston rod **254**, the free end of which is pivotally secured as at **255** to the swing frame **240**. The overall arrangement of the billet loading mechanism **80** is such that the cradle **238** may be moved through an arcuate path from an unloading position indicated by the arrow designated U to a loading position shown in dotted outline in FIG. 13 by the arrow designated L. The construction of the swing frame **240** is such that the cradle **238** will be maintained in a horizontal position at all times during its movement between the loading position and the unloading position. The hydraulic cylinder means **250** serves to move the swing frame and hence the cradle **238** between the loading and unloading positions.

The cradle **238**, the swing frame **240** and the hydraulic cylinder means **250** are suspended from the carriage **244** and are movable therewith along the rods **246**. On one side of the carriage **244** there is provided a depending plate member **256** comprising one side of the carriage **244**. Secured to the lower end of the depending plate member **256** is a block member **258** having a groove **260** formed therein which opens toward the billet container **48**. The groove **260** receives a tongue-like member **262** which, as can best be seen in FIG. 10, is secured to and projects above the lower housing portion **178***b* of the billet housing **176**. The connection provided by the groove **260** and tongue **262** permits the billet loading mechanism **80** to be moved with the billet container **48** toward and away from the extrusion die structure **46** thereby maintaining the billet loading mechanism **80** properly aligned with the billet receiving face of the billet container **48**. That is to say, at all times during the movement of the billet container toward or away from the extrusion die structure **46**, the billet loading mechanism **80** will be positioned for loading of a billet into the billet receiving opening **182** of the liner **180**. The connection provided by the groove **260** and the tongue **262** also permits the billet container **48** to be moved laterally of the press frame **32** to the aforementioned outboard position without the need for manually disconnecting the billet loading mechanism **80** and the billet container **48**. Conversely, upon movemnt of the billet container **48** toward the billet loading mechanism **80**, the billet container **48** will be automatically connected to the billet loading mechanism **80** and is movable therewith.

BUTT AND DUMMY BLOCK CATCH MECHANISM 74

As stated above in conjunction with FIG. 11, at the completion of the extrusion of a billet, the billet container **48** is moved away from the extrusion die structure **46** to expose the butt **194** and the dummy block **52**. The butt shear mechanism **76** (FIG. 2 is activated to lower the butt shear **77** to shear the butt **194** from the extrusion die structure **46**. The butt and dummy block catch mechanism **74** is provided for catching the butt **194** and dummy block **52** after shearing thereof and for transferring the same to a position outboard of the press frame **32** wherein removal thereof may be easily accomplished.

Referring now to FIGS. 15 and 16, the butt and dummy block catch mechanism **74** comprises a swing arm **264** having its upper end pivotally connected as at **266** between a pair of depending flange member **268** which are secured to the upper horizontal slab member **34**. A generally U-

shaped catch member **270** is secured to the lower end of the swing arm **264**. A hydraulic cylinder **272** is pivotally supported as at **274** between a pair of flange members **276** (only one visible) which extends outwardly from the depending flange members **268**. The hydraulic cylinder means **272** includes a piston rod **278** having a clevi smember **280** for pivotally connecting the piston rod **278** to the swing arm **264**.

The hydraulic cylinder **272** will effect movement of the swing arm **264** between a loading position shown in full lines in FIG. 15 and an unloading position shown in dash-dot outline in FIG. 15. The swing arm **264** will be moved into the region between the extrusion die structure **46** and the billet container **48** is shown in FIG. 16. The generally U-shaped catch member **270** will be disposed directly beneath the butt **194** and dummy block **52** preparatory to catching the same. The butt shear mechanism **76** upon activation will lower the shear **77** from its normally elevated position illustrated in full lines in FIG. 16 to the limit of its downward stroke as illustrated in full lines in FIG. 15. During the downward movement, the shear **77** will engage the butt **194** and shear it from the extrusion die structure **46**. Upon shearing, the butt **194** and dummy block **52** will fall into the catch member **270**, whereupon the hydraulic cylinder means **272** will be activated to transfer the butt **194** and dummy block **52** to a position outboard of the press frame **32** as shown in FIG. 15. In the outboard position of the butt and dummy block catch mechanism **74**, the butt **194** and dummy block **52** may be unloaded from the catch member **270**.

BUTT SHEAR MECHANISM 76

Referring now to FIG. 17, the butt shear mechanism **76** comprises a hydraulic cylinder **282** extending above and secured to the upper horizontal slab member **34**. The hydraulic cylinder **282** includes a piston rod **284** to which is attached the shear **77**. On opposite sides of the hydraulic cylinder **282** and the piston rod **284** there are provided guide rods **286** which extend through guide conduits **288** secured to the upper horizontal slab member **34**. Connecting arm **290** extends between and is connected to the lower ends of the guide rods **286**. The lower end of the piston rod **284** also is secured to the connecting arm **290**. The overall arrangement is such that when the hydraulic cylinder **282** is activated, the piston rod **284** will be lowered from its normally elevated position illustrated in FIG. 17 to a point below the die opening of the extrusion die structure **46** as illustrated in FIG. 15. Thereafter, the hydraulic cylinder **282** will be reactivated to raise the piston rod **284** into its normally illustrated position. The guide rods **286** and connecting arm **290** serve to guide the piston rod **284** during its downward and upward movement.

EXTRUSION DIE STRUCTURE 46

Referring again to FIG. 17, the extrusion die structure **46** as well as the knockout means **78** now will be described in detail.

The extrusion die structure **46** comprises, in general, a slide plate **292** which is supported on the first vertical slab member **38** for sliding movement transversely thereof by means of upper and lower guide tracks **294, 296**. Slide plate motor means **298** disposed below the slide plate **292** serves to move the slide plate transversely of the press frame **32**. The slide plate **292** is provided with a pair of generally U-shaped wells **300**, one each adjacent each end thereof. Extrusion die assemblies **302*a*, 302*b*** are provided, one each being received in the wells **300**. As will be described, each of the extrusion die assemblies **302*a*, 302*b***, includes a tool stack **304** provided with a die plate **306**. The slide plate **292** is provided with a centrally located cold billet removal opening **308**. Prior to removing the cold billet from the billet receiving opening **182** of the liner **180**, the slide plate **292** is moved so as to align the cold billet removal opening **308** with the billet receiving opening **182** and opening **44** through which the cold billet is removed by the advancing ram **64**.

Referring now to FIGS. 17 and 20, each of the extrusion die assemblies **302*a*, 302*b***, each comprise a sandwich-like structure including the tool stack **304** and a pair of bolster plates **310, 312**. The tool stack **304** is comprised of a housing **314** within which resides the die plate **306** and a supporting plate **316** to which the die plate is keyed. The tool stack **304** is maintained within the well **300** and releasably secured to the slide plate **292** by means of a tool stack clamp member **318** (FIG. 17). The die plate **306** is provided with a die opening **320** through which the billets will be extruded. The support plate **316** and the two bolster plates **310, 312** are provided with openings of increased diameter through which the extruded shape will pass. The opening **44** provided in the first vertical slab member **38** is coaxially aligned with these openings and receives the extruded shape. As can best be seen in FIG. 17, the bolster plates **310, 312** are secured within the well **300** by means of a bolster plate clamp member **322** which is secured to the slide plate **292**.

At the completion of an extrusion operation, the slide plate motor means **298** is activated to transfer the slide plate from the position shown in full lines in FIG. 17 to the right of FIG. 17 whereby the previously employed extrusion die assembly **302*a*** is now disposed outboard of the press frame **32** and directly above the knockout means **78**. To discharge the extrusion die assembly **302*a***, the clamp member **318** is released whereupon the knockout means **78*a*** is activated. Each of the knockout means **78*a*, 78*b*** preferably comprises a hydraulically operated cylinder means **324** having a piston rod **326** extending vertically toward the extrusion die assembly **302**. The slide plate **292** is provided with an opening **328** which is disposed directly beneath the tool stack **304**. The opening **328**, for example, of the die assembly **302*a*** shown in dotted outline in FIG. 17, is aligned with and receives the piston rod **326** upon activation of the knockout means **78*a***. The piston rod **326** will engage and displace the tool stack **304** from within the well **300**. Thereafter, a new tool stack may be inserted within the well **300** and the clamping member **318** clamped to the slide plate **292**.

In FIG. 20 the butt **194**, the dummy block **52** as well as an extrusion **329** are illustrated in dotted outline. The dummy block **52**, the butt **194** and the extrusion **329** are illustrated in the position they would assume at the completion of an extrusion operation.

At this time, the billet container **48** will be moved away from the extrusion die structure **46** to expose the dummy block **52** and butt **194** for shearing by the butt shear mechanism **76**, as described above. It should be noted that the extrusion die structure **46** and the first vertical slab member **38** are arranged such that two subsequent shearing operations are performed which aid in the clean-out of the opening **44** through which the extrusion **329** is discharged, as well as the clean-out of the bolster plates **310, 312** and the tool stack **304**. These shearing operations now will be described.

The first shearing operation occurs when the extrusion die structure **46** is shifted to align the cold billet removal opening **308** (FIG. 17) with the opening **44** (FIG. 20). During this shifting, the extrusion **329** is sheared as the bolster plate **312** passes the opening **44**. Hence, the extrusion **329** is freed and may be transported away from the extrusion press **30** for storage or further processing.

The second shearing operation occurs when the tool stack **304** is displaced upwardly out of the well **300**. During discharge of the tool stack **304**, any portion of the extrusion **329** remaining within the support plate **316** and the bolster plate **310** will be sheared. The bolster plate clamp member **322** (FIG. 17) is of substantial size and strength and maintains the bolster plates **310, 312** rigidly fixed within the well **300** during the shearing action. Hence, the bolster plates **310, 312** may be easily

cleaned out prior to introducing a new tool stack **304** into the vacant well **300**.

As can best be seen in FIG. 17, the slide plate motor means **298** comprises a piston rod **330** and a piston **332** which is housed within a bore **334** formed in the lower track member **296**. Openings **336***a*, **336***b* serve to communicate a working fluid to the opposite sides of the piston **332**. At the free end of the piston rod **330** there is secured a connecting block **338** which extends upwardly therefrom. At the upper end of the connection block **338** there is provided a connecting rod **340** which extends inwardly toward the slide plate **292**. A connecting block **342** serves to secure the connecting rod **340** to the slide plate **292** in a particular manner which will be described in conjunction with FIGS. 18 and 19. In operation, fluid under pressure is admitted through the opening **336***a* to force the piston **332** to the right of FIG. 17. The slide plate **292**, connected to the piston rod **330**, also is moved to the right of FIG. 17. Limit switches (not shown) are provided for stopping the slide plate **292** so that either one of the extrusion die assemblies **302***a*, **302***b* or the clean-out opening **308** may be aligned with the opening **44**.

As is conventional, the slide plate **292** rides over bronze wear strips or other similar means, from one side of the extrusion press to the other. Cam means (not shown) are provided for adjusting the slide plate **292** to compensate for wear occurring in the aforementioned wear strips. Cam means suitable for use with the present slide plate **292** is illustrated and described in U.S. Patent No. 2,960,202, issued to Daniel A. Katko and assigned to the assignee of the present invention. Hence, the slide plate **292** will be elevated, from time-to-time, through incremental distances to compensate for the wear occurring in the aforesaid wear plates.

The manner in which the second connecting block **342** is connected to the slide plate **292** permits the slide plate **292** to be elevated through incremental distances without affecting the interconnection. Referring now to FIGS. 18 and 19, the end of the second connecting block **342** is provided with a shaft **344** having a disc **346** extending transversely thereof. The shaft **344** and the disc **346** are received within a T-shaped slot **348** formed in the outboard end of the slide plate **292**. The shaft **344** and the disc **346** are initially positioned above the lower walls **350**, **352** of the T-shaped slot **348**. Hence, a space is provided through which the slide plate **292** may be moved vertically during adjustments performed by the aforementioned cam means. The shaft **344** and disc **346** and the T-shaped slot **348** provide a clevis-like arrangement.

Although the invention has been illustrated in connection with one specific embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the present invention

I claim as my invention:

1. An extrusion press comprising in combination: a frame comprising upper and lower horizontal slab members maintained vertically spaced apart by first and second vertical slab members interposed between and each disposed at one end of said frame, and connecting means for connecting the ends of each of said horizontal slab members to the ends of each of said vertical slab members in shear sustaining relation, said frame being closed at its top and bottom and at each of its ends but open at its opposite sides; an extrusion die connected to said first vertical slab member in such manner that the first vertical slab member will resist horizontal displacement of said die; a billet container positioned adjacent to said extrusion die; a piston and cylinder means projecting horizontally from said second vertical slab member and including a ram supported on the free end of the piston and adapted to enter the billet cntainer during extrusion of a billet; and means for communicating hydraulic fluid under pressure into said piston and cylinder means for forcibly displacing said ram into said billet container; an expansive force being created during extrusion of a billet which tends to separate said first and second vertical slab members; said connecting means resisting substantially all of said expansive force.

2. The combination of claim **1** wherein said upper and lower horizontal slab members each comprise a substantially unmachined, steel slab.

3. The combination of claim **1** wherein each of said connecting means comprises a shear key and at least one keyway formed in one of said slab members, said key and keyway extending transversely of said horizontal slabs.

4. The combination of claim **1** wherein each of said connecting means comprises an extrinsic shear key and complementary keyways formed in the engaged ends of said horizontal and vertical slab members; said complementary keyways extends transversely of said upper and lower horizontal slab members.

5. The combination of claim **1** wherein each of said connecting means comprises a rib member serving as a shear key and forming an integral part of one of said members and a keyway formed in the other of said members; said rib member residing within said keyway and extending transversely of said upper and lower slab members.

6. The combination of claim **1** wherein each of said connecting means comprises an end portion of said vertical slab member residing within a slot formed in said horizontal slab member.

7. The combination of claim **1** wherein the width of each of said first and second vertical slab members is substantially equal to the width of said upper and lower horizontal slab members.

8. The combination of claim **1** including carrier means supporting said ram; means slideably connecting said carrier means to the free end of said piston means for movement between a first position wherein said ram is axially aligned with the central axis of said extrusion die to a second position wherein said ram is disposed outward of said frame; and ram motor means for moving said carrier means from said first position to said second position and vice versa.

9. The combination of claim **8** wherein said ram motor means comprises a hydraulically operated piston and cylinder means, said piston being movable into coupled engagement with said carrier means.

10. The combination of claim **8** including carriage means for supporting said ram motor means in a horizontal position; vertically oriented pivot means at one end of said carriage means, said carriage being movable in a gate-like fashion from an operative position wherein said ram motor means is positioned normal to said ram, to an inoperative position which is angularly spaced from said operative position; and track means associated with the other end of said carriage means for guiding said carriage means during its gate-like movement.

11. The combination of claim **1** wherein said piston and cylinder means comprises a first tubular member extending from said second vertical slab member and having only its inner surface machined; a second tubular member slideable within said first tubular member and having only the outer surface thereof machined; and means for sealing the projecting end of said second tubular member; said hydraulic fluid under pressure being communicated to the interiors of said first and second tubular members for moving the ram toward said billet container.

12. The combination of claim **11** wherein said second tubular member has an outside diameter which is less than the inside diameter of said first tubular member; and means disposed in the annular space between said first and second tubular members for supporting said second tubular member during movement thereof.

13. The combination of claim 1 including first track means upon which said billet container is slideable toward and away from said extrusion die; platform means supporting said first track means; second track means supporting said platform means for movement transversely of said first track means; container motor means releasably connected to said billet container for moving the same from an operative position adjacent to said extrusion die to an inoperative position spaced therefrom and vice versa; and platform motor means connected to said platform means for moving said platform and said billet container from said inoperative position to a position outboard of said frame and vice versa.

14. The combination of claim 13 wherein said first motor means comprises a hydraulically operated piston and cylinder having a limited stroke whereby movement of said billet container away from said extrusion die is limited to a position wherein said billet container is generally centered over said second track means.

15. The combination of claim 13 including means for guiding said billet container during its movement over said platform, said means comprising a pair of wear plate members and a vertical bearing member interposed between and engaged by said wear plate members; one of said members being secured to said platform and the other of said members being secured to said billet container.

16. The combination of claim 15 including adjustment means supporting each of said wear plates for movement transversely of said platform, said billet container being displaceable transversely of said press frame by said adjustment means to compensate for horizontal misalignments between the central axis of a billet receiving opening in said billet container and the central axis of said extrusion die.

17. The combination of claim 13 wherein said first track means comprises spaced-apart wear plates secured to and extending over said platform; each of said wear plates being inclined with its inboard edge spaced upwardly from said platform; and including a pair of cooperating shoe members interposed between each wear plate and the underside of said billet container; means disposed between said shoe members permitting independent angular displacement of the upper shoe member whereby the lower shoe member is disposed at all times in overall surface contact with said wear plate.

18. The combination of claim 17 wherein the lower shoe member is slideable over the wear plate and the upper shoe member is slideable over the underside of said billet container; and including means for displacing each pair of cooperating shoe members transversely of said press frame for compensating for vertical misalignments between the central axis of a billet receiving opening in said billet container and the central axis of said extrusion die.

19. The combination of claim 13 including stop means for terminating the movement of said platform when said billet container is disposed in said inoperative position; said stop means comprising at least two block members, one each secured to said platform means and to said lower horizontal slab; one of said block members having a generally V-shaped groove formed therein which opens toward the outboard position of said billet container; and a generally V-shaped plate portion projecting from the other of said block members; said generally V-shaped plate portion being received in said groove to terminate the movement of said platform means.

20. The combination of claim 13 including a billet loading mechanism comprising a carriage supported on one side of said upper horizontal slab for movement parallel with the movement of said billet container; a swing frame suspended from said carriage, said swing frame being movable in a direction transversely of said press frame; a cradle supported at the lower end of said swing frame for swinging movement from an unloading position wherein the billet carried thereby is axially aligned with the central axis of said die and positioned for loading into said billet container to a loading position which is outboard of said press frame; said swing frame maintaining said cradle means generally horizontal at all times; motor means for moving said cradle means between said unloading and loading positions; and means connecting said carriage to said billet container for movement therewith in a direction parallel to the central axis of said extrusion die.

21. The combination of claim 20 wherein said means for connecting said carriage to said billet container comprises a tongue and groove connection wherein said tongue is separable from said groove upon movement of said billet container from said inoperative position to the position outboard of said frame and wherein said tongue is engageable with said groove upon movement of said billet container from its position outboard of said frame to said inoperative position.

22. The combination of clam 1 including means supporting said billet container for movement toward and away fro msaid extrusion die; means for moving said billet container to an inoperative position which is spaced from said extrusion die upon completion of the extrusion of a billet; shear means carried on said upper horizontal slab member which is lowered through the space between said extrusion die and said billet container for shearing the butt and dummy of a billet just extruded; catch means normally disposed outboard of said frame for catching the butt and dummy block when sheared; swing arm means supporting said catch means and providing for swinging movement of said catch means from its normally outboard position to a position beneath the butt and dummy block; and motor means for swinging said catch means.

23. The combination of claim 1 including an extrusion die supporting assembly comprising a slide plate; first and second extrusion die assemblies, one each at each end of said slide plate; means supporting said slide plate for sliding movement transversely of said billet container; and motor means for moving said slide plate alternately from one position wherein said first extrusion die assembly is aligned with said billet container and said second extrusion die assembly is disposed outboard of said frame, to a second position wherein said second extrusion die assembly is aligned with said billet container and said first extrusion die assembly is disposed outboard of said frame.

24. The combination of claim 23 wherein said slide plate includes a well at each end thereof within which said extrusion die assemblies reside; each of said extrusion die assemblies comprising a tool stack including a housing, a die plate disposed within said housing and adjacent to said billet container, and a backup plate disposed within said housing and adjacent to said die plate, said backup plate having an opening which is larger in diameter than the die opening of said die plate; and means for releasably securing said tool stack to said slide plate whereby said tool stack may be detached from said slide plate when each of said assemblies is disposed outboard of said frame.

25. The combination of claim 24 including die knockout means, one each on opposite sides of said frame for displacing the tool stack associated with said first and second extrusion die assemblies when each of said assemblies is disposed outboard of said frame, each of said die knockout means comprising a piston rod displaceable upwardly by means of hydraulic fluid, through an opening provided in said slide plate for engagement with said tool stack.

26. The combination of claim 25 wherein each of said extrusion die assemblies includes at least one bolster plate residing within said well and engaged with the face of said backup plate opposite said die plate, said bolster plate having an opening which is larger in diameter than the opening in said backup plate; and means for rigidly securing said bolster plate within said well whereby during

forced discharge of said tool stack from said well, any portion of the extrusion remaining within said bolster plate and said backup plate will be sheared by the passage of the rim of the opening in said backup plate past the rim of the opening in said bolster plate.

27. In an extrusion press, the combination of a vertical slab member comprising a frame member; said vertical slab member having an opening therein through which an extrusion is discharged; an extrusion die assembly supported adjacent to said vertical slab member and comprising a slide plate; at least one extrusion die assembly supported on said slide plate; means supporting said slide plate for reciprocal movement transversely of said vertical slab member; motor means for moving said slide plate alternately from a first position wherein said extrusion die assembly is aligned with said opening and positioning for extrusion of a billet to a second position wherein said extrusion die assembly is positioned outboard of said vertical slab member; said extrusion die assembly comprising a die plate having a die opening for extrusion of a billet and a bolster plate having an opening which is larger in diameter than said die opening; said bolster plate being positioned relative to said vertical slab member with one face thereof engaged with and slideable over the inboard face of said vertical slab member whereby during movement of said slide plate from said first position to said second position, any portion of said extrusion remaining within the opening of said bolster plate will be sheared.

28. In an extrusion press having a press frame, an extrusion die supported at one end of said press frame, and a billet container positioned adjacent to said extrusion die and adapted to receive and support a billet axially aligned with the central axis of said extrusion die, the combination comprising: cradle means for supporting said billet in a horizontal position; a swing frame suspended from said press frame and supporting said cradle means for swinging movement from an unloading position wherein the billet carried thereby is axially aligned with the central axis of said die and positioned for loading into said billet container to a loading position which is outboard of said frame, said swing frame maintaining said cradle means horizontal at all times; and motor means for moving said cradle means between said unloading and the loading positions.

29. The combination of claim **28** wherein said swing frame comprises pairs of spaced-apart, coplanar arms, one pair of arms at each end of said cradle means; each of said arms being pivotally connected at one end to said cradle means and pivotally connected at the other end to said frame; each said pair of arms comprising a pantograph structure which maintains said cradle means generally horizontal at all times.

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